Barriers to Research Utilisation amongst Diagnostic Radiographers in the UK

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I give the utmost thanks to God Almighty for making this possible.

Dedication

This work is dedicated to Anastasia, Olivia-Adelaide and Joel.

Declaration

I confirm that this thesis which has been submitted for the award of a Doctor of Professional Studies is my own work and has not been submitted elsewhere, in whole or in part, for any other degree. I am also aware of and understand the University's policy on plagiarism and has therefore acknowledged all the sources used in this work.

Abstract

Introduction: Lack of research uptake and utilisation compared to other Allied Health Professions prompted the publications of four consecutive research strategies by the Society and College of Radiographers in attempts to bridge the gap.

Aims: The aim of this study was to find out perceived barriers to research utilisation amongst diagnostic radiographers in the UK.

Methods: A descriptive cross-sectional survey was conducted in 2016. A random sample was used to select 1,080 radiographers who were sent a link to the web-based questionnaire.

Results: The response rate was 72.8%. Most radiographers were Band 6 (n=296, 47.0%) holders. The commonly identified perceived barriers to research utilisation included lack of time for research-related activities, how to develop research questions, find relevant literature and lack of authority to change practice.

It was found that 142(50.7%) of BSc and 26(44.0%) of MSc had difficulty in finding relevant literature. Interestingly, 20(40%) of the Band 8 radiographers perceived themselves to lack the authority to change practice. In the area of practice category, sonographers (n=35, 57.4%) were more likely to perceive themselves to lack authority in changing their practice. While there was a positive attitude to research utilisation, 198(31.4%) held the view that research was not in their scope of practice. A further 127(20.2%) felt radiologists and physicists should review research that were relevant to their practice. It emerged that highest educational qualification was associated with a higher probability of knowledge of research skills and attitude to research utilisation.

Conclusions: The study concludes that dissemination mechanisms to facilitate research utilisation are lacking. Radiology service managers and the Society and College of Radiographers have key roles to play in research utilisation in terms of time allocation and training in research skills.

Word Count: 287

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Abbreviations

BI	Breast Imaging
CI	Confidence Interval
CSI	Cross-sectional Imaging
CT	Computerised Tomography
DCR	Diploma of the College of Radiographers
DoH	Department of Health
DR	Diagnostic Radiography
EBP	Evidence-Based Practice
EBPQ	Evidence-Based Practice Questionnaire
EROS	Emotion Regulation of Others and Self
Fluoro	Fluoroscopy
FTF	Face-to-Face
GAL	Global Address Lists
GR	General Radiography
HCPC	Health and Care Professions Council
HMQ	Hospital Model Questionnaire
KAP	Knowledge Attitude and Practices
KWT	Kruskal Wallis Test
MWUT	Mann-Whitney U Test
NI	Nuclear Imaging
NICE	National Institute for Health and Care Excellence
NIHR	National Institute for Health Research
NIHRQ	National Institute for Health Research Questionnaire
PgC/D	Postgraduate Certificate or Postgraduate Diploma
PhD	Doctor of Philosophy (Also, Professional Doctorate or Doctor of Professional Studies)
QWCQ	Quality Work Competence Questionnaire

RCN	Royal College of Nursing
Rep	Reporting
Res	Research
RR	Research Radiographer
RSS	Rich Site Summary
RU	Research Utilisation
SCoR	Society and College of Radiographs
SDQ	Self-Designed Questionnaire
SHURA	Sheffield Hallam University Research Archive
SHUREC	Sheffield Hallam University Research Ethics Committee
SPSS	Statistical Package for Social Sciences
TR	Therapeutic Radiography
TRR	Therapy Research Radiographer
US	Sonography
WBQ	Web-Based Questionnaire

CHAPTER ONE
Introduction

1.0 Overview

This chapter first examines the background information that prompted this study. Sections 1.2 and 1.3 introduce the aim and objectives of the study respectively. The significance of the study is presented in Section 1.4 followed by the research questions in Section 1.5.

1.1 Background to the study

In 1994[1], the College of Radiographers (as cited in Society and College of Radiographers [SCoR], 2005) published its first research strategy. Three consecutive research strategies have since been published (SCoR 2005; 2010; 2015). These research strategies were against the backdrop of lack of uptake and use of research. The research strategies predominantly sought to enable radiographers to develop their research skills and to undertake evidence-based practice (EBP), to promote the need for research awareness and usage and to encourage the development of workplace cultures where research is valued. Research capacity and capability have been identified in the previous research strategies as major barriers to research utilisation[2] within radiography. These included staff shortages, time constraints, lack of research skills and funding.

[1] Several attempts were made to get a copy of the 1994 research strategy but to no avail. The College of Radiographers was contacted for a hard copy, but it turned out it had been discarded due to a 'house cleaning' exercise. The researcher took to social media for help, but this too proved unsuccessful. So, the only evidence of the 1994 research strategy being published by the College of Radiographers was from secondary sources.

[2] The use of research evidence to inform practice by way of synthesising and disseminating it within a group.

Introduced in the early 1990s by Sacket, Rosenberg, Gray, Haynes and Richardson (1996), EBP has become an increasingly prominent approach to practice in healthcare (Muller, McCauley, Harrington, Jablonski, & Strauss, 2011).

Evidence-based practice (EBP) evolved from the evidence-based medicine of which the most widely-quoted definition is that by Sackett et al. (1996, p71):

> *"…the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients."*

They further explained that EBP involves the integration of expertise of the clinician (which accounts for the individual patient's needs) with the best available external clinical evidence. EBP, however, is a multifaceted approach towards delivering the best healthcare.

Five steps thus emerge from the EBP process as given by Sackett et al. (1996):

(a) asking the right questions arising from practice, (b) searching the medical literature for evidence, (c) critically appraising the evidence obtained, (d) utilising the outcome into practice and, (e) evaluating the performance of the used evidence. EBP, therefore, needs certain skills or knowledge of the research process in order to effectively achieve it (Belsey, 2009).

Research utilisation is, therefore, a subset of EBP – in fact, it is the fourth step as outlined in the EBP process. Research utilisation is the implementation of new research ideas, knowledge or evidence into practice.

Government initiatives have backed the adoption of evidence-based healthcare systems in which decisions made by managers, practitioners and patients are based on high-quality evidence (Gerrish et al., 2007). There are institutions in the UK such

as the National Institute for Health Research [NIHR], (n.d.) and the National Institute for Health and Care Excellence [NICE], (n.d.) providing initiatives with a mandate of research and development, and evidence-based services to anyone delivering care. Health policy on EBP has ensured that professional bodies now demand the involvement of members in research to facilitate the EBP agenda as valuable to the care process (Health and Care Professions Council [HCPC], 2009). It has been over twenty years since the Peckham report was issued by the government with the central focus of making clinical practice evidence-based (Department of Health [DoH], 1993). Gerrish et al. (2007) have argued that setting up guidelines is only the beginning. They contended that practitioners ought to possess skills to appraise research for its appropriation into practice through translation, implementation and evaluation.

It has long been argued that diagnostic radiography, traditionally, has not been perceived by its practitioners to require investigation, thereby relinquishing those responsibilities to radiologists and medical physicists and rather performing the role of the 'research consumer' (Challen, Kaminski, & Harris, 1996; Reeves, Wright, Shelley & Williams, 2004). However, Challen et al. (1996) adduced that radiographers had begun to be more confident to challenge acceptable practices through a variety of measures which have followed on from the introduction of all-graduate entry into the profession. Meanwhile, continuous technological development, advanced diagnostic procedures and increasingly quality-conscious users (which Gambling, Brown and Hogg (2003) referred to as 'expert patients'), necessitate an effective high-quality service. There have been growing concerns about the lack of research utilisation amongst allied health professions in the UK by policymakers and the Research Forum for Allied Health Professions (Reeves et al., 2004). Radiography was lagging behind physiotherapy and occupational therapy as measured by research indicators (Reeves

et al., 2004) hence, the publication of four consecutive research strategies to encourage uptake and utilisation of research.

Dawes et al. (2005) observed that the enormity of information articulated in the healthcare literature should increase our knowledge and render practice more effective. However, this does not appear to be apparent as Gerrish et al. (2007) pointed out the struggle amongst healthcare professionals in grasping several research concepts. Arguably, as far as radiography is concerned, the concept of EBP is new. The objectives of the SCoR research strategies were to enable radiographers to develop research skills to undertake EBP, to promote the need for research awareness and usage and to encourage the development of workplace culture in the research cycle. SCoR (2010) identified four barriers to undertaking and utilisation of research in radiography. They included staff shortages, lack of training in research skills such as critically appraising the evidence and lack of confidence to use the evidence. Similar barriers have been identified amongst healthcare professionals to affect research utilisation in clinical practice (Fairbrother, Cashin, Rafferty, Symes, & Graham, 2016; Joyce & O'Leary, 2014; Lyons, Brown, Tseng, Casey, & McDonald, 2011). However, the top four barriers to EBP identified in the healthcare literature included lack of time; lack of support from colleagues, management and doctors; lack of facilities and resources; and lack of authority to implement new ideas (Brown, Wickline, Ecoff, & Glaser, 2009; Brown, Tseng, Casey, McDonald, & Lyons, 2010; Scurlock-Evans, Upton, & Upton, 2014; Williams, Brown, & Costello, 2015). Although not identified as amongst the top barriers to EBP, limited skills in appraising the scientific literature can also be a substantial barrier towards research utilisation in practice.

It can be argued that one's ability to undertake EBP is hinged on the capacity to find and critically appraise the evidence. Joyce and O'Leary (2014) for example, conducted a study to determine why diagnostic radiographers (DR) did not increase the distance between the X-ray source and image receptor to reduce radiation exposure to patients. It emerged that only 6% had knowledge about the technique. They attributed this to a lack of awareness of research and dissemination, a problem the SCoR (2010) has recognised as a barrier to EBP. This raises the question of the research capacity of diagnostic radiographers in radiology departments - a phenomenon which will be explored in this study. While Elliott, Wilson, Svensson and Brennan (2009) have argued for a healthy research-active radiography environment, it appears the determinants are absent in most hospitals. For instance, a UK nationwide study by Price et al. (2009) revealed that only five out of 108 hospitals had a substantive radiographer in a research capacity. Out of these five sites, only one was led by a diagnostic research radiographer. This contrasts hugely with therapeutic radiography (TR) where 20 out of 33 centres had a substantive radiographer in a research capacity with 42% of the research in these centres being led by TR (Price et al., 2009). It then suggests that TR is making inroads in research. To buttress this point, a recent study by Probst et al. (2015) indicated that, six years on, TR has made additional gains in expanding their research capacity base. In their audit, it emerged that about 80% of 45 radiotherapy centres routinely had some research-related activities. To sum it up, Snaith (2016) has described the state of evidence-based practice in diagnostic radiography as practice drift or creep[3].

[3] Practice drift is a phenomenon where a practitioner takes a short-cut to circumvent from how they were trained or thought, to achieve immediate goals. Practice creep is the gradual move towards the adoption of innovative ideas which often occur as a result of bright individuals sharing the idea for example.

According to Snaith (2016), while it is apparent that optimisation of technique to visualise the anatomy, pathology or reduce radiation dose is the responsibility of the individual radiographer, it is otherwise the chief domain of advanced and consultant radiographers who are expected to develop and implement evidence-based practice at the workplace in the forms of protocols or guidelines.

1.2 Aim of the study

This study, therefore, seeks to find out perceived barriers to research utilisation amongst diagnostic radiographers in the UK. These perceived barriers will encompass those within the departmental settings, perceived knowledge of research skills and attitude to research utilisation.

1.3 Objectives of the study

The set objectives of this study were to:

1. investigate the commonly perceived barriers to research utilisation
2. determine differences in knowledge of research skills
3. evaluate attitudes towards research utilisation
4. find out any correlation between the level of highest educational qualification and perceived knowledge of research
5. find out any correlation between the level of highest educational qualification and attitude to research utilisation
6. determine any correlations between the area of practice and attitude to research utilisation

1.4 Significance of the study

The only study that has been done to assess factors that hinder research utilisation since all radiography training entered higher education[4] was by Elliott et al. (2009). However, this study only looked at sonographers who are a subset of the diagnostic radiography workforce. This current study will include respondents from all the specialities within diagnostic radiography. It seeks to learn about the perceived barriers, knowledge and attitude towards research. The outcome might contribute to policy-making in terms of enhancing and developing a research-oriented profession.

[4] University level education in which prospective candidates are awarded a bachelor's degree where research is an integral component towards the award of the degree.

CHAPTER TWO
Literature Review

2.0 Overview

This chapter examines the relevant literature on evidence-based practice (EBP) and research utilisation (RU) in healthcare settings. It will also situate the current state of RU in diagnostic radiography in the context of radiography as a profession. Sections 2.1 and 2.2 provide a brief background to EBP and conceptual framework for research utilisation respectively. Sections 2.3 and 2.4 present how the literature was retrieved and critical analysis of the psychometric scale used for this research. Sections 2.5, 2.6 and 2.7 discuss reported barriers to RU. The next section focusses on research utilisation in diagnostic radiography. Finally, the psychometric scale which was adopted by this project will be examined in section 2.8.

2.1 Conceptual framework

Research utilisation draws on Rogers' diffusion of innovation theory which propounds that adoption of innovation relies on communication, time, and social system (Rogers, 2003). Greenhalgh (2014) has emphasised the complexity of implementation of best evidence due to multiple influences operating at different levels and it is also dependent on human factors such as the person's motivational needs, specific skills (which may include their knowledge of the research process), and/or values, meaning that individuals ascribe to a new approach, adoption based on someone else, or being told to do so from a hierarchy.

Social science theory of diffusion of innovations by Rogers (2003) underpins this research. His theory was developed in 1962 to explain how innovation is diffused through an organisation. From Rogers' (2003) theory, in a social system, the relationship that exists between members, coupled with their perception of innovations and the environment, influences how they adopt a new practice. Diffusion is the process by which new ideas are spread through an organisation over a certain period of time. Hence the four elements characterising Rogers' (2003) theory are innovation, communication, time and the social system. These four elements are influencing factors by which diffusion of innovation takes place. *Innovation* is here described as a new practice perceived as new by individuals (the adopter). *Communication* is the exchange of information between individuals within the social system. According to Rogers (2003), for successful communication of innovation, there has to be an individual (practitioner) or unit (society or advocate group) with knowledge of this new practice, an individual or unit oblivious about this new practice, and a communication channel linking the two.

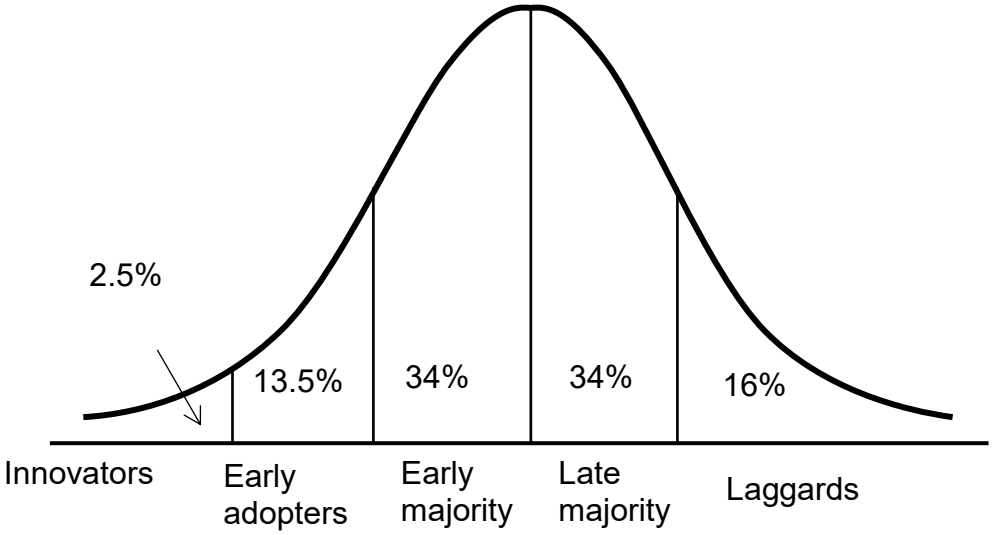
Rogers' (2003) theory also explores two important aspects of human communication. Transfer of ideas occurs more frequently and effectively between individuals who are similar in education and, status and therefore are drawn by the same interests which often render greater gain in knowledge and attitude formation. On the other hand, communication of innovation, as argued by Rogers, usually emanates from change agents who are more technically competent. Rogers (2003) affirms that the *time* dimension in the diffusion of the innovation process is an essential component in that it starts and ends with the whole process from when an individual becomes first aware (relative earliness or lateness of adoption – see Figure 2.0) of the new practice to its adoption or rejection. *Time,* as presented by Rogers' theory, is defined by the Oxford

English Dictionary ("Time," n.d.) is that which relates to "*the continued progress of existence as affecting people and things"* rather than "a *moment or definite portion of time allotted, used, or suitable for a purpose.*" To measure *time* as a construct (that is, how long it takes an idea to be diffused in a unit) would require a longitudinal study. Therefore, the element of time that is being investigated in this study is the latter definition. Lastly, the *social system* consists of individual practitioners, informal groups (journal clubs) and or subsystems (advanced practitioner groups) with a common goal to accomplish. Rogers (2003) contests that, because diffusion takes place in a social system, it affects the process in several ways such as the social structure, effects of norms, the role of opinion leaders/change agents and the consequences of innovation.

Rogers (2003) also suggests that the individual passes through a sequential process of knowledge, persuasion, decision, implementation, and confirmation before an idea is adopted. First, the individual must be exposed to the existence of, and understand, the innovation. Persuasion is where the individual forms an attitude (favourable or otherwise) towards the innovation. At the decision stage, the individual engages in activities that lead to a choice in adopting or rejecting the innovation. The next step is when the idea is put to use (implementation). Lastly, the individual seeks reinforcement about the decision already made at the confirmation stage.

According to Rogers (2003), the innovativeness of individuals (*as depicted in Figure 2.0*) is relative, hence the adopter has been categorised accordingly. Thus, we have *innovators*, the first in a social system to adopt innovations and these people are keen to develop or try new ideas. The *early adopters* represent opinion leaders who usually have awareness and are comfortable to embrace change. *Early majority* members, on the other hand, adopt new ideas before the average person.

Figure 2.0: Adopter categories



Source: Rogers (2003) Diffusion of Innovations.

Those in the *late majority* category do not feel the need to adopt new ideas until pressure from peers. Finally, the *laggards* are described as traditionalists who always dwell on the past. Rogers (2003) retorts that since the laggards are the last to adopt an innovation, by the time they do, it may have been superseded with a new practice.

Since change or innovation is not adopted spontaneously by individuals in a social system, it is therefore important for change agents[5] (or opinion leaders as Rogers calls them) to identify the level at which certain individuals belong so that facilitation of adoption can commence. In other words, the obstacles preventing individuals from adopting new ideas have to be identified to help device facilitation tools. These change agents are then responsible to a larger extent for the communication or diffusion of

[5]Typically, change agents would be consultant radiographers, advanced practitioners, research radiographers. However, this can also be a bottom-up approach, as there are instances where Junior radiographers may become aware of a new approach due to their association with certain groups like journal club or may have read it in a journal.

current practice. Communication, for example, can take place through departmental meetings or journal clubs.

One major criticism that has been levelled against this theory is that taking up innovation does not consider the resources that have been put in place to support the individuals towards facilitating the adoption of innovation (LaMorte, 2016). These resources could be the preparedness of the individual (in the case of EBP adoption), the knowledge of research skills of individuals acquired through education or professional development, or the time allotted for individuals in order to pursue new ideas. Time is a fundamental component in the adoption of innovation in the sense that it does not exist independently of events; rather it is an aspect of every activity (Rogers, 2003).

According to Rogers (2003), there are obstacles to getting new ideas adopted in an organisation and that there is a wide gap between what is known and what is actually utilised in practice.

Healthcare professionals play a significant role in patient management which heavily relies on scientific research on treatment, diagnosis and investigation, for example. According to Chau, Lopez and Thompson (2008), successful communication and translation of research evidence depend upon an understanding of the key factors involved; that is organisational settings, the workplace culture and the practitioners.

2.2 The BARRIERS Scale

Credit has been given to Funk, Champagne, Wiese and Tornquist (1991a; 1991b) for pioneering research into perceived barriers in research utilisation amongst nurses in the United States (USA) leading to the development of the psychometric scale widely known as the 'BARRIERS' scale. The BARRIERS Scale has been adopted and used in other healthcare professions. It is used to measure health practitioners' perceived knowledge of research, attitude to research utilisation and perceived barriers in the organisation settings. The healthcare literature is replete with research on barriers, predictors and facilitators of RU in diverse professions.

Funk et al. (1991b) undertook a study to evaluate barriers that nurses encountered in research utilisation in the United States using a scale which later became known as the BARRIERS Scale. They evaluated 1,989 (representing 40% of 5,000 stratified sample) nurses of varying demographic characteristics including educational background, specialities, and job scale. The scale measured four concepts or factors comprising the characteristics of adopter, organisation, innovation and communication (as derived from Rogers' theory of innovation (2003) for the 29 items). Psychometric analyses were performed for the 29 items. The split-half[6] method was used to determine internal reliability/consistency by reaching two halves of the 1989 sample from random selection. Sample one (n=974) had a variance of 43.4% and 44.9% for sample two. All the items in sample one had a loading factor greater than 0.4 except for the item "the amount of research was overwhelming". In sample two the item "the literature is not compiled in one place" had a loading factor[7] of 0.36 and thus was

[6] Split-half method is used to measure the internal consistency of a psychometric test. It measures whether the variables measured contribute equally to the observed effect (Frey, 2018).
[7] In a factor analysis, loading factor is a correlational coefficient assigned to a variable amongst a group of variables that intend to measure a concept (factor). For instance, all questions in a questionnaire that

removed. Apart from the communication factor with a Cronbach's alpha[8] of 0.65, the other factors (adopter, organisation, and innovation) were higher (0.8, 0.8, and 0.72 respectively) showing the items correlated well. It must be borne in mind that an alpha coefficient for measuring internal reliability ranges from 0 to 1 with values greater than 0.8 often regarded as acceptable although Bryman (2012) points out that some authors have defended values as low as 0.6 as equally acceptable. A factor analysis of the full sample matched with the two halves analyses suggesting a stable structure for the BARRIERS Scale. In addition, the descriptive analysis of the mean item for the four-factors in the BARRIERS Scale ranged from 2.34 to 2.87 from a possible 1 to 4.

Several studies have tested the validity and reliability in many countries (Temel, Uysal, Ardahan and Ozkahraman, 2010; Kajermo et al., 2010; & Williams et al., 2015) as explored by Kajermo et al. (2010). The study by Temel, Uysal, Ardahan, and Ozkahraman (2010) conducted in Turkey confirmed the structural stability of the BARRIERS Scale with a Cronbach's alpha of 0.92 for the general scale which was even greater than that of Funk and colleagues. Furthermore, their mean item score ranged from 1.83 to 3.35. Not all studies have complemented the psychometric properties of the BARRIERS Scale as shown in the systematic review by Kajermo et al. (2010). The authors reviewed 63 citations of varying nursing specialities and found mixed results. Fourteen of the 63 studies that reported Cronbach's alpha values for the general scale had scores ranging from 0.84 to 0.96, indicating internal consistency. However, 24 studies reported alpha values for the subscale in the range of 0.47 to 0.94 of which 17 of them reported alpha values of less than 0.70 (lacking internal

measure attitude or behaviour etc. Loading factor ranges from -1 to 1 with values approaching 1 indicating strong measure and vice versa (Salkind, 2010).

[8] Cronbach's alpha is a measure of how the items in a concept or construct measure what it purports to measure (Tavakol & Dennick, 2011). In other words, it measures the internal consistency of a test or scale. It is a number expressed between 0 and 1.

consistency), mostly belonging to the communication subscale. Only 13 out of the 63 studies performed factor analysis. Unlike Funk et al. (1991b) who had a four-factor solution, 10 of these studies had a 3 to 8-factor solution. Studies like Hutchinson and Johnston (2004) and Mehrdad, Salsali and Kazemnejad (2008) had almost identical factors to that of Funk et al. (1991b).

It is worth noting that the quality of the studies reviewed by Kajermo et al. (2010) demonstrated weak-to-moderate strengths (23 weak, 38 moderate and 3 strong). The quality of the studies was not fundamental to their analysis, therefore, weaker studies would impact greatly on the reliability of the BARRIERS Scale. Nevertheless, Kajermo et al. (2010) asserted that the BARRIERS Scale was reliable for identifying barriers to research use. Nonetheless, Bostrom, Kajermo, Nordstrom and Wallin (2008) and Kajermo et al. (2010) have raised the issue of construct validity because the scale does not distinguish between research users and non-users.

Williams et al. (2015) also undertook a study to investigate the dimensional structure and stability of the BARRIERS Scale across three cross-cultural cohorts of occupational therapists. Using Generalised Procrustes Analysis[9] (Mardia & Dryden, 2016), nine of the approved 28 items by Funk et al. (1991b) had values below the reference point of 0.8 making them less than ideal for the model. They concluded that 19 of the 28 items as provided by Funk et al. (1991b) were robust and also maintained the four-factor solution too.

In summary, internal consistency has been confirmed by several studies to be fit for purpose. One of the strengths of the scale is its flexibility, as the 29 items can be

[9] A form of analysis used to compare the results of surveys by generating a weighting factor to compensate for the differences in individual usage of the scale.

grouped into three to eight-factor analysis as found in the literature other than the four-factor derived by Funk et al. (1991b). Depending on the sample, there is a potential for studies to remove some of the items after factor analysis. It, therefore, suggests that the number of items to use on the BARRIERS Scale is not stringent and can be subject to modification as exhibited in some studies.

2.3 Searching the literature

Strategies used in searching the literature to retrieve desirable articles for the literature review have been outlined in the following subsections.

2.3.1 The search strategy

An initial search was conducted in July 2015 during the proposal phase. A final search was performed in January 2017 and rich site summary (RSS) feeds to the databases used for the search were subscribed for regular updates on new articles that met the search criteria.

Two types of search were performed to retrieve citations that have examined perceived barriers to research utilisation amongst health care professionals. A title-only and keywords search were performed separately. The keywords search excluded nearly all the articles that were retrieved using the title-only search. Also, fewer articles (twelve) were retrieved in comparison to the thirty articles from title-only search. Some researchers have experienced poor yield using formal search techniques such as keywords or index terms too (Greenhalgh et al., 2014). As such, the title-only search became the preferred choice since it yielded better output.

Boolean phrases used for the search in article title-only were as follows:

- Research utilisation
- Evidence base

These phrases were combined with search terms shown in Figure 2.1. Combining the Boolean phrases with the search terms resulted in the search pattern as shown in Figure 2.2. The search was limited to articles written in the English language and published between 2008 and 2017.

Figure 2.1 Acceptable and unacceptable words in the article title

Acceptable	***Unacceptable***
Barriers	Curriculum
Predictors	Education
Knowledge	Undergraduate
Attitude	Learning
Facilitators	Teaching

Figure 2.2: Search syntax used to retrieve research articles

TITLE (“research utilisation*” **AND** (barriers **OR** predictors **OR** knowledge **OR** attitude **OR** facilitators)) **OR**

TITLE(“evidence base” **AND** (barriers **OR** predictors **OR** knowledge **OR** attitude **OR** facilitators))

AND NOT **TITLE** (“research utilisation*” **AND** (curriculum **OR** education **OR** undergraduate **OR** learning **OR** teaching))

AND NOT **TITLE**(“evidence base” **AND** (curriculum **OR** education **OR** undergraduate **OR** learning **OR** teaching))

The subject area only included Nursing and Allied Health Professions. Medicine was excluded because it was deemed that the nature of barriers which doctors faced might

be different because they are more autonomous. Furthermore, evidence-based practice emanated from medicine (Sacket et al., 1996) and it is also an integral part of their training/education. They also have protected study time which is not readily available to nursing and other allied health professionals.

2.3.2 Summarised results

From CINAHL, SCOPUS, ScienceDirect and Google Scholar, a total of 105 citations were screened (Figure 2.3). Using citation index search also added three more articles. The results were exported to a folder in ProQuest RefWorks® where 62 out of the 108 articles were removed using the 'exact duplicate' function. After the abstract screening, 11 articles from the remaining 46 were found to have been submitted to different journals (with the same authors but the titles were differently worded) and so were excluded. A further five articles were excluded due to methodological inadequacies after critically appraising them (Hendricks & Cope, 2017; O'Connor & Pettigrew, 2009; Oh, 2008; Schoonover, 2009; Stavor, Zedreck-Gonzalez, & Hoffmann, 2017) leaving 30 citations as presented in the flowchart diagram (Figure 2.3). These inadequacies were, very small sample sizes, non-calculation of response rates, lacking rigorous statistical tests, and no pre-test of measuring instruments. The number of barriers identified in the 30 articles reviewed is presented in Table 2.0. The 30 articles have also been charted and presented in Table 2.1.

The country with the most studies was Turkey (5). Australia and the USA both had three studies. Twenty-three of the studies had the characteristics of a cross-sectional survey. There were one qualitative article and three review papers. Nineteen of the 30 studies were from nursing publications and four studies explored diverse professions.

The BARRIERS Scale (Funk et al., 1991a; 1991b) was used by the majority of the studies (18).

Despite the benefits derived from EBP, there is growing evidence in the literature that healthcare professionals still report barriers to RU. Although professional bodies highlight the need for their members to engage and use current evidence in their practice for the benefit of their patients, there is a gap between what is known and what is done. The literature will be reviewed under these headings: organisational barriers, knowledge of research skills and attitude to research utilisation with the most cited barriers sub-headed.

Figure 2.3 Search strategy flow chart

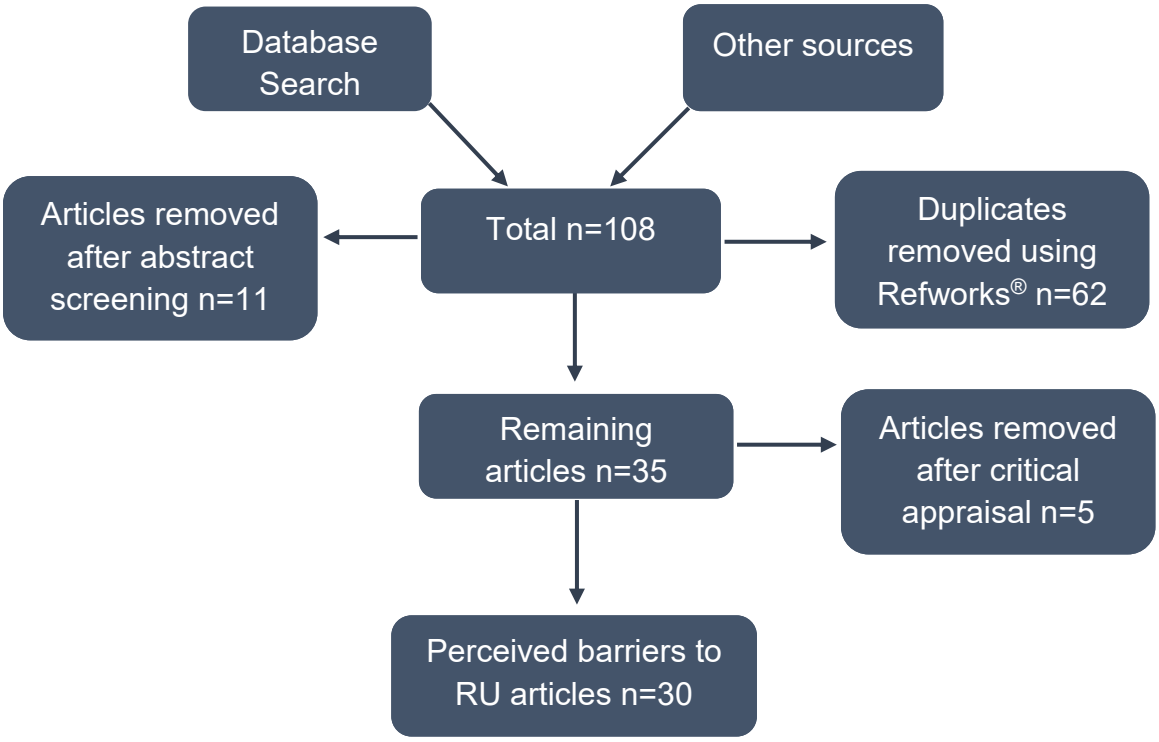


Table 2.0: Perceived barriers cited in the 30 reviewed articles

	Perceived barriers	Number of times cited	Number of times cited as the greatest perceived barrier
1	Time constraints	19	14
2	Inadequate facilities	14	4
3	Unaware of research	7	2
4	Lack of authority	14	3
5	Lack of support	7	2
6	Generalisability	2	0
7	Implications not made clear	3	0
8	Lack of statistical knowledge	5	0
9	Lack of research skills	4	1
10	Literature is overwhelming	6	0
11	Quality of research	3	1
12	Research not valuable	2	1
13	Publication language	2	1
14	Workplace culture	3	0
15	No knowledgeable colleague	1	0
16	Communication	1	0

Table 2.1: EBP and RU articles selected for the review

	Author/year	Country	Profession	Study type*	Sample	Scale^	Barriers
1.	Brown et al. (2010)	Australia, UK & Taiwan	Occupational therapy	Survey	696	BARRIERS	1, 2, 15, 7
2.	Brown et al. (2010)	US	Nursing	Survey	974	BARRIERS, EBPQ	1, 4, 3
3.	Brown et al. (2009)	US	Nursing	Survey	458	BARRIERS, EBPQ	1, 4, 5
4.	Chau et al. (2008)	Hong Kong	Nursing	Survey	1,487	BARRIERS	2, 4, 1, 10
5.	Chen et al. (2013)	Taiwan	Nursing	Survey	510	BARRIERS	11, 3, 8
6.	Chien (2010)	Hong Kong	Nursing	Survey	710	BARRIERS	1, 12, 2
7.	Chien et al. (2013)	China	Nursing	Survey	743	Hutchinson & Johnston, BARRIERS	4, 1, 11
8.	Cline et al. (2017)	US	Nursing	Survey	369	BARRIERS	1, 4, 10, 3
9.	Donnellan et al. (2013)	Ireland	Multidisciplinary	Focus group	3 & 7	Interview	2
10.	Elliott et al. (2009)	UK	Radiography	Mixed methods	218	FTF, SDQ	9, 1, 5, 4
11.	Fairbrother et al. (2014)	Australia	Nursing	Survey	169	SDQ	4, 7, 10, 14
12.	Hussein et al. (2016)	Jordan	Nursing	Mixed methods	300/23	FTF,	5, 4
13.	Jansson et al. (2013)	Finland	Nursing	Survey	101	SDQ	3, 2
14.	Joyce and O'Leary (2014)	Ireland	Multidisciplinary	Triangulation		FG, FTF, SDQ	2, 3
15.	Kajermo et al. (2008)	Sweden	Nursing	Survey	833	BARRIERS, HMQ, QWCQ	5, 7

*All surveys were cross-sectional. ^ BARRIERS = BARRIERS Scale
Abbreviations: N - sample size; EBPQ - evidence-based practice questionnaire; EROS - emotion regulation of others and self; KAP - knowledge, attitude and practices; NHRIQ - national health research institute questionnaire; HMQ - hospital model questionnaire; QWCQ - quality work competence questionnaire; FTF - face-to-face interview; SDQ - self-designed questions

Table 2.1: EBP and research utilisation articles selected for review (continued)

	Author/year	Country	Profession	Study type*	Sample	Scale^	Barriers
16.	Kajermo et al. (2010)	Worldwide	Nursing	Systematic review	63	-	1, 8, 4, 2, 10
17.	Kang (2015)	Korea	Nursing	Survey	147	BARRIERS	14, 6, 3
18.	Kocaman et al. (2009)	Turkey	Nursing	Survey	329	BARRIERS	1, 14, 2
19.	Lyons et al. (2011)	Australia	Occupational therapy	Survey	138	KAP, EROS, BARRIERS	1, 8, 11
20.	Mehrdad et al. (2008)	Iran	Nursing	Survey	410	BARRIERS	1, 2, 4
21.	Moreno-casbas et al. (2011)	Spain	Nursing	Survey	848	BARRIERS	11, 5, 16, 3, 9
22.	Sari et al. (2012)	Turkey	Nursing	Survey	718	BARRIERS	2, 10, 3
23.	Scurlock-Evans et al. (2014)	Worldwide	Physiotherapy	Systematic review	32	-	1, 9
24.	Tan and Hatah (2017)	Malaysia	Pharmacy	Survey	466	KAP	3, 8, 4, 1
25.	Tan et al. (2012)	Turkey	Nursing	Survey	1,094	BARRIERS	1, 5
26.	Uysal et al. (2010)	Turkey	Nursing	Survey	216	BARRIERS	2, 10, 14
27.	Walker et al. (2014)	Australia	Chiropractic	Survey	584	Jette et al.	1, 6
28.	Weng et al. (2013)	Taiwan	Multidisciplinary	Survey	6,160	NHRIQ	19
29.	Williams et al. (2015)	Worldwide	Multidisciplinary	Scoping review	49	-	1, 5, 2, 4, 14
30.	Yava et al. (2009)	Turkey	Nursing	Survey	631	BARRIERS	4, 1, 2

*All surveys were cross-sectional. ^ BARRIERS = BARRIERS Scale
Abbreviations: N - sample size; EBPQ - evidence-based practice questionnaire; EROS - emotion regulation of others and self; KAP - knowledge, attitude and practices; NHRIQ - national health research institute questionnaire; HMQ - hospital model questionnaire; QWCQ - quality work competence questionnaire; FTF - face-to-face interview; SDQ - self-designed questions

2.4 Organisational barriers to RU

Williams, Perillo and Brown (2015) have highlighted the significant role the organisation plays in RU and argued that organisational barriers are often beyond the control of the individual. These barriers are discussed as follows:

2.4.1 Lack of time

Nineteen out of the 30 studies reported lack of time as a major perceived barrier with fourteen citing it as the topmost barrier. It appears in three forms as:

- Insufficient time on the job due to workload to implement new ideas (Brown et al., 2010; Kajermo et al., 2010; Kocaman et al., 2010; Tan et al., 2012),
- Insufficient time to read research (Brown, Kim, Wickline, Rose, Klimpel, & Glaser 2010; Brown et al., 2010; Lyons, Brown, Tseng, Casey, & McDonald, 2011).
- Time constraints (Fairbrother et al., 2016; Scurlock-Evans, Upton, & Upton, 2014; Walker, Stomski, Hebert, & French, 2014)

Scurlock-Evans et al. (2014) have argued that, if this barrier was modifiable, then there would be a huge potential for increased research utilisation but also argued that this was unlikely to happen due to the ever-growing demand on health services. For instance, the numbers of diagnostic imaging examinations performed in England continue to rise (NHS England, 2015, 2016, 2017). Out of the 30 articles reviewed, 14 of them reported time constraints as the greatest barrier to research utilisation and this was reflected in several other studies. For instance, Tan et al. (2012) examined 1,094 Turkish nurses in a cross-sectional survey and reported the greatest barrier to RU as ‘insufficient time on the job to implement new ideas’ (45.4%). A comparative cross-

sectional survey by Brown et al. (2010) amongst paediatric occupational therapists in Australia, UK and Taiwan also found 79.7% (n=696) reporting the same barrier. Furthermore, Tan et al. (2012) also reported a lack of time to read research (n=1,094; 77.3%). There was a significant difference in terms of geographical location and the extent to which this barrier was reported to be greater thus, 74.6% from Australia, 77.2% from the UK and 80.9% from Taiwan (Brown et al., 2010). Williams et al. (2015) conducted a scoping review involving 49 articles of diverse healthcare professions. Out of these, 38 of them cited workload as the greatest barrier. The authors acknowledged the limitations inherent in scoping reviews as they did not seek to select studies based on the quality and depth of literature (as opposed to systematic review). In another multi-institutional study involving 974 nurses, the top barrier was from the organisation subscale - insufficient time to read research (Brown et al., 2010). A multiple regression analysis involving the BARRIERS subscales and evidence-based practice questionnaire (EBPQ[10]) (in which they investigated research utilisation amongst nurses) showed a negative relationship between the organisation subscale and practice of EBP and explains only 2.7% of the variation with no statistical significance.

Despite the studies cutting across geographical locations, cultural settings, disciplines and specialities, all the three reviews (Kajermo et al., 2010; Scurlock-Evans et al., 2014; Williams et al., 2015) reported practitioners citing lack of time as the greatest perceived barrier to RU. In the systematic review by Kajermo et al. (2010) 'insufficient time on the job to implement new ideas' and 'the nurse does not have time to read research' were ranked by 49 and 48 articles respectively as the top two barriers.

[10] EBPQ stands for evidenced-based practice questionnaire used by Brown et al. (2009) and Brown et al. (2010) shown in Table 2.1

Williams et al. (2015) grouped the various forms of time factor barrier into the theme workload. In their review, 38 out of the 49 articles emanating from different healthcare disciplines ranked workload as the most perceived barrier.

2.4.2 Lack of authority to change practice

Three studies reported lack of the authority to change practice as the greatest barrier to RU (Chien, 2010; Fairbrother et al., 2016; Tan & Hatah, 2017; Yava et al., 2009). In Rogers' (2003) diffusion of innovation, the social system is found to have a tremendous influence on the process by which an innovation is adopted. When an individual is not valued, the urge to create (or be involved in creating) appears suppressed unless that individual is self-motivating. Chien (2010) investigated 710 nurses in Hong Kong (also using the BARRIERS Scale) reporting lack of the authority to change practice as the greatest barrier. However, Chien (2010) asserted that fewer barriers (7) were found amongst these nurses as compared to the 10 found elsewhere (Fink, Thompson, & Bonnes, 2005; Glacken & Chaney, 2004; Hutchinson & Johnston, 2004). It is hard to substantiate this claim because (unlike the other studies which reported all the 29 items in the BARRIERS Scale) Chien (2010) did not provide the whole range of items and this raises questions about the strength of the argument.

Chien (2010) was also of the view that improvement in professional status through nursing education was enough to overcome the barrier of lacking authority. This too may be misplaced because countries which have well-established advanced clinical practice roles such as the USA, Australia, and the UK also reported lack of the authority to change practice as a significant barrier to RU (Brown et al., 2009; Brown et al., 2010; Fink et al., 2005; Hutchinson & Johnston, 2004). There was a trend in the 30 articles reviewed which suggested that more autonomous professions, such as

occupational therapy, chiropractic and physiotherapy, did not perceive lack of the authority to change practice as compared to those who work in close collaboration with physicians such as nurses.

A study to canvas 947 nurses' perceived barriers and facilitators of RU in Turkey by Yava and colleagues (2009) had a majority (63.6%) essentially disagreeing with the statement 'the nurse does feel she or he has enough authority to change practice'.

2.4.3 Lack of support

To create a workplace culture where research utilisation thrives, to some extent depends on how much support is given to individuals from either managers or colleagues. This is most often not the case as practitioners are faced with opposition from immediate superiors, colleagues or physicians. Kajermo et al. (2008) conducted a study amongst 833 nurses in Sweden and concluded that perceiving superiors to offer no support for research-related activities significantly reduced the likelihood of engaging in RU. In a logistic regression analysis to predict perceived barriers to research utilisation, at $p=0.008$ and odds ratio of 1.8, nurses' perception of barriers was increased by 80% when they perceived dissatisfaction with support from superiors for research-related activities.

Hussein, Dalen, Duff and Schmied (2016) studied the practices of episiotomy amongst midwives using mixed methods design in which 300 birth records were analysed and 23 semi-structured face-to-face interviews were carried out. In their study, it emerged that without support and authority to implement what is known, practitioners continued to use outmoded practices in their care.

In a 49-article scoping review of physiotherapy publications, 37 of them mentioned the lack of co-operation from either staff or management as the main barrier to RU (Williams et al., 2015). In their review, this barrier was identified as frequently as insufficient time to implement new ideas due to workload.

2.5.4 Inadequate facilities

There is a rapid advancement in health technology to keep pace with research development in diagnostic tests and treatment. Acquisition of these technologies is dependent on factors such as the financial strength of the organisation or the organisation's appetite or commitment to the practice of using current evidence that point to a need for new facilities. Their unavailability is a significant barrier to knowledge translation. Inadequate facilities have been referenced many times in the healthcare literature as amongst the top barriers towards RU (Chien, 2010; Kocaman et al., 2010; Mehrdad et al., 2008; Sari, Turgay, Genc, & Bozkurt, 2012; Uysal, Temel, Ardahan, & Ozkahraman, 2010; Yava et al., 2009). Irrespective of the form these facilities may take, these studies cover rich, middle-income and poor countries. It shows that, depending on the type of management existing in an organisation, even healthcare facilities in the richest of countries may still lack the appropriate tools that practitioners need to carry out their duties effectively. Donnellan, Sweetman and Shelley (2013) conducted focus group interviews with a total number of 38 participants from three teaching hospitals. The participants made up of allied health professionals, physicians and managers in which all the groups expressed their frustration at not being able to offer the needed care because of inadequate resources. Importantly, one participant was of the view that it is one thing to have guidelines and another to have the facilities or resources to do what the guideline says.

Other studies also noted inadequate facilities as being a great or moderate barrier to RU (Chau et al., 2008; Jansson, Ala-Kokko, Ylipalosaari, Syrjälä, & Kyngäs, 2013). Chau et al. (2008) investigated 1,478 nurses in Hong Kong and found 74.8% rating inadequate facilities as the greatest barrier, although no statistically significant difference existed between subgroups. Similarly, a survey of critical care nurses' adherence to evidence-based guidelines to prevent ventilator-associated pneumonia in Finland (n=101) also ranked inadequate facilities as the greatest barrier (Jansson et al., 2013).

2.5 Research skills as a barrier to RU

The second and third steps in undertaking EBP concern knowledge of research skills. Nearly all healthcare professional qualifications in the advanced world had been integrated into higher education at the turn of the 21st century. Nursing, for instance, had entered higher education in the UK and the USA by the mid-20th century (Institute of Medicine, 2011; Royal College of Nursing [RCN], 2012) and radiography had become graduate entry by 1993 (Pratt & Adams, 2003) where research is integrated into the curriculum. Graduates are therefore expected to have at least the basic skills or knowledge of research. Barriers in research skills that were reported as great or moderate are discussed in the sections that follow.

2.5.1 Generalisability, implications and quality of research

Walker et al. (2014) investigated 584 chiropractors' knowledge of research in relation to research utilisation in Australia. Although there were fewer indicators that these chiropractors had learnt the foundations of research utilisation (56.6%), critical

appraisal during undergraduate training (57.9%), formal training in literature searching strategies (56.6%), lack of generalisability of research findings were perceived as amongst the greatest barriers to research utilisation. The perception that chiropractors felt results were not generalisable to their own setting was also ranked as amongst the greatest barriers (60.5%, mean=2.88, SD=.87).

Another perceived barrier that healthcare professionals have mentioned in the literature was 'research implications are not made clear'. In a study by Lyons et al. (2011) with a possible score range of 1 (no extent) to 4 (great extent), paediatric occupational therapists from Australia ranked the item 'implications for practice not made clear' amongst the top three barriers to RU (n=134, mean=2.87, standard deviation=0.83). The only study that reported the practitioner could not tell 'the quality of the research' as a major perceived barrier was that of Moreno-Casbas et al. (2011). They investigated 917 nurses' perceived barriers to research utilisation. However, one major weakness of this study was that the educational background of the sample was unknown even though the authors compared nurse investigators (researchers n=69) with clinical nurses (n=848).

2.5.2 Lack of research skills

The term *research skills* include several variables which sum up the skills needed to understand research. It includes searching the literature, ability to critically appraise the literature and (in the case of quantitative research) interpret statistics. However,

studies using the BARRIERS Scale tend to group these variables together with 'research skills.'

Moreno-Casbas et al. (2011) explored 917 nurses' attitudes and perceived barriers to RU in Spain in which they compared nurses with, and without, a role as a researcher. Lack of research skills was amongst the top three barriers (75%). In a systematic review, Scurlock-Evans et al. (2014) concluded that one of the major barriers that physiotherapists faced in the research utilisation process was a lack of research skills. They explained that some studies found that lack of confidence to use information technology was often referred to as a significant barrier. Weng et al. (2013) undertook a large study in Taiwan to investigate the barriers towards implementation of EBP involving 11 randomly chosen regional hospitals. A sample of 6,160 comprising multidisciplinary healthcare team members showed a statistically significant difference at $p<0.001$ for both variables. Physicians perceived fewer barriers in critical appraisal skills (37.6%; n=227) compared to nurses (50.4%; n=1,692) and pharmacists (58.6%; n=235). Similarly, physicians also perceived fewer barriers to searching the literature (29%; n=178) in comparison to nurses (45.3%; n=1519) and pharmacists (48.1%; n=193).

Fewer studies reported a lack of statistical knowledge as barriers to RU (Chen, Shao, Hsiao, & Lee, 2013; Lyons et al., 2011; Tan & Hatah, 2017). Practitioners had also cited difficulty in searching the literature due to the enormous amount of information, or literature is not available or compiled at one place (Cline, Burger, Amankwah, Goldenberg, & Ghazarian, 2017; Sari et al., 2012; Uysal et al., 2010). For instance, the study by Sari et al. (2012) showed 718(80%) of Turkish nurses had difficulty with the amount of literature to search from. Interestingly, 62.3% and 7.2% had obtained a Bachelor and MSc degrees respectively. An even higher percentage was found

amongst 396 nurses in the USA (Cline et al., 2017) in which 91.5% ranked the same item on the BARRIERS Scale as their greatest barrier where 47% and 18% had a bachelor's and MSc degree respectively.

2.6 Barriers relating to attitude to RU

2.6.1 Awareness and value of research

Seven studies have reported lack of awareness or research evidence as an adopter characteristic to RU (Brown et al., 2010; Chen et al., 2013; Chien, 2010; Jansson et al., 2013; Joyce & O'Leary, 2014; Kang, 2015; Sari et al., 2012; Tan & Hatah, 2017). Sari et al. (2012) found in their study consisting of 718 registered nurses in Turkey, that 79% of them were unaware of related research in their practice. When they were asked the frequency of reading research articles, only 19% did so monthly and 23 % had never done so. It was different from a Taiwanese study (N=510) where 35% read professional literature monthly and 10% had never read any (Chen et al., 2013). Meanwhile, in Korea (Kang, 2015), 96% of 147 of nurses had no subscription to professional journals. Unlike the UK, where NHS health professionals have ready access to a variety of electronic journals, not every country has this privilege due to several reasons such as subscription fees. Free access to these profession-specific journals is inextricably linked to membership subscriptions to their respective professional bodies. In some professions like physiotherapy, just over half of registered professionals have professional membership as highlighted by Scurlock-Evans et al. (2014). That said, it is not known how many of these subscribers read the journals to which they had free access.

Only two out of the 30 review articles reported practitioners as stating that research had no value to clinical practice (Chen et al., 2013; Chien, Bai, Wong, Wang, & Lu, 2013).

2.7 Radiography and research

The amount of research that has been done within the profession is numerous. They cover a wide range of interests, from humanities to the social sciences and technological innovations, for example. However, the subsections that follow review research articles that have examined barriers that hinder research utilisation within diagnostic radiography.

2.7.1 The journey so far…

The early 1990s saw the UK Government issued its white paper "*Supporting Research and Development in the NHS"* in which emphasis was made to healthcare practitioners to give research utilisation a special place in the care process (DoH, 1991). A few years later the College of Radiographers took the first step in policy guidance by publishing "A Strategy for Research" (College of Radiographers, 1994 as cited in SCoR, 2005). Subsequently, three further updated research strategies have been published (SCoR, 2005; 2010; 2015). These research strategies advocate for high quality research to be undertaken by the workforce to lift the image for the profession amongst the scientific community. Not only that, the Society and College of Radiographers undoubtedly are in support of the radiographic workforce using current evidence in improving patient care and service delivery (SCoR, 2013a). It is also stated explicitly in the professional code of conduct that practitioners must provide care based on recent evidence (SCoR, 2013b). The research strategy audaciously aimed to:

- Motivate all radiographers to use research evidence as stipulated in the HCPC's *Standards of proficiency* (2013), (SCoR, 2010)
- Support radiographers to appraise evidence towards RU (SCoR, 2010)
- Expect all clinical diagnostic and therapeutic departments to have their own research strategy by 2021 (SCoR, 2015)
- Develop a workforce that values research by making research a standing item on staff meeting agendas (SCoR, 2015)
- Promote awareness and usage of research by radiographers (SCoR, 2005).
- Encourage radiography service managers to make research a standing item on staff meetings and agendas (SCoR 2015).
- In the second and third editions, the emphasis on these strategies appeared to be centred on producing and using research. Although the fourth edition (SCoR, 2015) also hints at these factors, it was more about strengthening the status of the radiography journal, advocating for advanced practice and beyond to work towards the attainment of Master's and Doctorate level qualification, as though the basic problems of lack of research skills among radiographers have been overcome.

In general, these research strategies promote both the utilisation and uptake of research. But it is not clear what mechanisms have been put in place to arrive at these objectives.

Gambling et al. (2003) have called for the profession to be proactive in research both in doing and using research, to impact on clinical practice in order to advance the profession. They have argued that while the NHS Trusts and primary care groups have

the responsibility of ensuring the quality of care delivery, the individual radiographers are responsible for their own practice.

2.7.2 During the Diploma era

Soon after the first research strategy was published, Challen et al. (1996) undertook a survey of 102 sampled radiographers looking at the 'research-mindedness in the radiography profession'. All the respondents had qualified with the Diploma of the College of Radiographers (DCR) but had been engaged in some form of research activities which typically involved collecting data for other people's research. Challen and colleagues found that 80.4% of them expected radiographers to be involved in some aspect of research activity. The respondents indicated a lack of time (83.3%) and knowledge of research skills (53.3%) as major obstacles to RU.

2.7.3 Post Diploma era

Radiography became a degree by 1993 with the first higher education programmes commencing in 1989 (Pratt & Adams, 2003). In higher education, facilitation and acquisition of research skills are embedded in the curriculum and therefore, radiographers in the post-Diploma era are expected to have the knowledge required for EBP. This is vital because the traditional roles of radiographers have changed from just taking images to also performing tasks that used to be the sole domain of the radiologists. The advent of advanced clinical practice means radiographers now perform roles such as prescribing, conducting and/or managing complex invasive procedures, requesting radiological procedures and reporting radiological images (Nightingale & Hogg, 2003; SCoR, 2017; Snaith, 2007). Furthermore, technological

advancement and complex diagnostic procedures in medical imaging demand diagnostic radiographers to be abreast with the current evidence in the field.

However, research indicators suggested radiography was still lagging behind physiotherapy and occupational therapy (Reeves et al., 2004) which may be in part attributed to a few substantive research roles for diagnostic radiographers. A study consisting of 108 service providers showed as few as 5% of diagnostic radiographers were in substantive roles as researchers (Price et al., 2009). Later, surveys with a more varied sampling frame in comparison to that of Price et al. (2009) have shown steady percentage increment of 19% (SCoR, 2012) and 29% (SCoR, 2017). The latter was a nationwide survey of diagnostic radiography workforce in which 71 service providers participated. Fifty-two of the providers who supplied specific services had 17(29%) diagnostic radiographers in a substantive role as a researcher. Therapy radiography also seems to have made significant improvements as highlighted in the study by Probst et al. (2015). Their audit showed that 51 therapy research radiographers (TRR) were in post averaging 1 researcher per centre. Interestingly, only fifteen per cent of these TRRs in the post were leading their own research with the rest coordinating clinical trials which contrasts hugely with DRRs whose sole mandate was research (SCoR, 2017). Probst et al. (2015) also reported a really encouraging research culture of which 80% of radiotherapy centres (45) had a research agenda on departmental meetings.

The issue of research capability is far from being resolved even if allowing for the above developments in research capacity which encapsulates those radiographers in substantive roles as researchers. It has been suggested that some research radiographers (RRs) progressed into this role without the needed support or additional training (Russell et al., 2007). Russell et al. (2007) conducted a study to identify the

role description and training needs of TRRs. It emerged that out of the 38 centres that took part in the study, 40% of the researchers in these centres indicated they lacked research methodological understanding and statistics.

While there seems to be a lot of research in diagnostic radiography in attempts to improve practice and service delivery, knowledge translation appears to be the major hindrance to EBP (Snaith, 2016). Although the individual practitioner is responsible for their practice, the blueprint chiefly resides with advanced and consultant practitioners who are responsible for developing protocols and guidelines (Snaith, 2016). According to Snaith (2016), diagnostic radiography is experiencing practice creep and practice drift. Snaith (2016) opined that practice creep is tied to the dissemination of current evidence which is not done in the speed and manner that it should, in spite of their availability in the healthcare literature. Practitioners also drift away from best practices due to workflow pressures by adopting simpler techniques contrary to the evidence (Snaith, 2016). According to Snaith (2016), practice drift occurs as a result of the removal of experienced radiographers from the frontline which has been created by the introduction of advanced clinical practice.

2.7 Barriers to RU in diagnostic radiography: the UK versus other countries.

The advanced radiographer practitioner and the consultant radiographer have a responsibility towards research and evidenced-based practice. However, evidence from recent literature suggests research is not considered to be a principal role amongst both employers and the post holders (Ford, 2010; Forsyth & Maehle, 2010; Rees, 2014; Harris & Paterson, 2016; Booth, Henwood & Miller, 2016). Some of these consultants have little experience and skills in research. Furthermore, most of them lacked the confidence to do research and that their roles are largely clinically based.

These studies have also reported a lack of clarity and how their roles in research are undervalued by their departments. Amongst the role development in radiography is also the research radiographer with the mandate of undertaking and disseminating research (one of the core domains of advanced clinical practice). Their roles diversify into areas such as promoting research activities, engaging radiographers in research imaging procedures, regulating and developing imaging protocols (Reid & Edwards, 2011). Nevertheless, the onus lies on individual radiographers to change their practice vis-à-vis what they know through published radiography literature. Regarding Rogers' (2003) diffusion of innovation, attributes of the individual practitioner are fundamental to RU. This is where the enormity of the barriers to RU within the diagnostic radiographers lies and is further explored.

Joyce and O'Leary (2014) investigated diagnostic radiographers in Ireland to ascertain why increased source-to-image distance for certain examinations was not used even though it is a useful technique for reducing radiation doses to patients. Their investigation found that tradition and capacity to change practice were major barriers to using this technique. Most surprisingly, the majority of the respondents were not even aware of the technique.

Elliott et al. (2009), on the other hand, investigated sonographers' engagement, attitude and perceived barriers to RU using a self-designed questionnaire in the UK. The majority of the participants had a positive attitude towards research, however, 34.4% of the 218 respondents agreed or strongly agreed that seeing patients was more important than research. Remarkably, a similar percentage (35.6%) was found amongst 114 diagnostic radiographers in Korea (Ooi et al., 2012). More than half of the respondents felt their college training did not prepare them to do research. This may be because some of these sonographers qualified with DCR and progressed to

do sonography as a postgraduate certificate or Diploma which did not entail a research module.

One major perceived barrier was that sonographers who are advanced clinical practitioners felt they lacked the authority to change practice (45%). On the other hand, it emerged in the Korean study (Ooi et al., 2012) that 60% (n=114) of the sample agreed or strongly agreed that they lacked the authority to change practice. Their study also showed that a majority of sonographers felt they had little or no support from colleagues for RU. This barrier was also perceived amongst radiographers in Sweden, Ireland and Korea respectively (Ahonen & Liikanen, 2010; Elliott et al., 2009; Ooi et al., 2012).

2.8 Professional dominance

The concept of EBP is such that current research evidence should rather inform practice for the benefit of the patient. Implicit in this concept is that one has the authority to implement these informed decisions. However, the issue of authority is not addressed by this EBP. It has been suggested that perhaps one of the main barriers to implementation of EBP is the power and authority within the structures that exist in various divisions within the NHS Organisation (Lipman, 2000). In other words, there is the issue of professional dominance in which other professions (take directives from) or are subordinate to others, yet still, these subordinated professions paradoxically claim autonomy over their practices.

The struggle for professional autonomy by professions which fall under the rubric of non-medical professions within the health service organisation in part was because of medical dominance (Ovretveit, 1985). The work of Freidson (1970) which became known as the medical dominance perspective clarified this theory. According to

Freidson (1970), the only profession that is truly autonomous is medicine. Its autonomy transcends the division of labour into the hospital settings where it directs and evaluates the work of others without being subjected to the same scrutiny (Freidson, 1970). The landscape may appear to have shifted through healthcare reforms (Ovretveit, 1985), allowing for professions such as physiotherapy, for example, to gain full autonomy in their practice. Professions such as nursing do not have full autonomy over their practice and are dominated by medicine (Boyce, 2006). The dynamics of control for which medicine exerts over the nursing profession exits among other health professionals.

The radiography profession is to radiology what the nursing profession is to medicine in terms of dominance because it is where their respective knowledge-base emanated from. Although radiography, like nursing, has taken full responsibility for training and education of their professionals for some time, it is distinctly difficult to own or monopolise over the knowledge because they work hand-in-hand with radiology. For instance, radiology departmental techniques and protocols are approved by radiologists although they may be reviewed by radiographers. This, among other elements, acts as barriers to research utilisation among allied health professions and nursing because of the inherent lack of authority to solely change practice. It is not surprising that out of the thirty articles reviewed 13 of them cited lack of authority to change practice as a major barrier to research utilisation as well as half of the twenty nursing citations (Table 2.1).

2.9 The timeliness of the study

It has been suggested that barriers to RU in other disciplines may be reflected in similar clinical settings (Hafslund, Clare, Graverholt, & Wammen Nortvedt, 2008).

However, there is a paucity of literature on factors that affect RU within the diagnostic radiography workforce in the UK. To date only two studies have been conducted in the UK (Challen et al., 1996; Elliott et al., 2009). The study by Challen et al. (1996) was conducted with radiographers who had qualified with DCR and research was not integrated into the curriculum. The study by Elliott et al. (2009) only examined sonographers, who are a subset of diagnostic radiographers and are considered more autonomous than the other specialities within the diagnostic radiography workforce. The gaps identified in the literature suggest that, in comparison to other health professions, barriers to research utilisation have not been extensively explored to identify specific barriers to the diagnostic radiography workforce to help facilitate research utilisation. Hence, this research has the potential to foster intervention strategies through the identified barriers for policymakers such as the SCoR, radiology service managers and radiographers who are in a position to influence research utilisation.

2.10 Research questions

The current study aims to answer these questions:

1. What are the commonly perceived barriers to research utilisation amongst UK diagnostic radiographers?

2. What is the attitude amongst diagnostic radiographers towards research and utilisation?

3. How do diagnostic radiographers compare across the area of practice, job scale, and level of education in research skills?

4. How do diagnostic radiographers compare across the area of practice, job scale, and level of education, in attitude towards research and utilisation?

CHAPTER THREE
Research Design

3.0 Overview

This chapter discusses theoretical issues and practical matters concerning data collection.

3.1 Aims of the Study

Having worked as a diagnostic radiographer for some years before the commencement of this doctorate, the researcher had observed in practice the lack of research activities. This coupled with successive consecutive publications of research strategies by the Society and College of Radiographers in an attempt to facilitate the uptake and utilisation of prompted the researcher to investigate perceived barriers to research utilisation in diagnostic radiography with these objectives:

1. investigate the commonly perceived barriers to research utilisation
2. determine differences in knowledge of research skills
3. evaluate attitudes towards research utilisation
4. find out any correlation between the level of highest educational qualification and perceived knowledge of research skills
5. find out any correlation between the level of highest educational qualification and attitude to research utilisation
6. determine any correlations between the area of practice and attitude to research utilisation

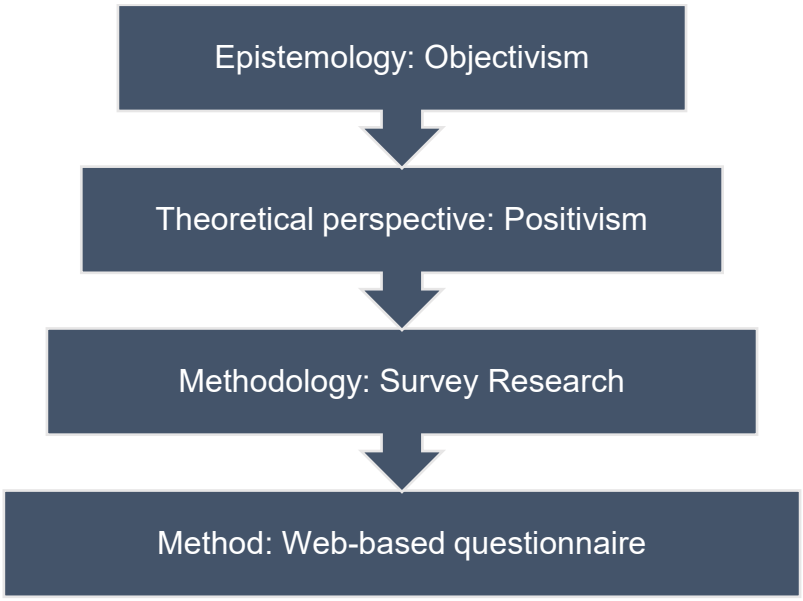
3.2 Terminologies defined

It is important to clarify the issue of misuse of the terms *methodology* and *method*. They are often used imprecisely or interchangeably (Appleton, 2009). Methodology is, therefore, the rationale and philosophy that inform the study design and how it must be conducted, including the ontological and epistemological perspectives of the researcher (Appleton, 2009). *Methods,* on the other hand, constitute techniques used to gather and analyse data related to some research question (Crotty, 1998).

3.3 The research process

There is no clear-cut approach to the research process as there are a plethora of writings especially with regards to theory and research. They can be sometimes confusing. In Crotty's (1998) schema, those methods that the researcher wishes to use to collect the data and the methodology to employ *this method* within are described, followed by the theoretical assumptions. This chapter follows Crotty's conceptualisation of the research process (1998) as shown in Fig 3.1.

Fig 3.1: Schema of the research project



It is apparent that researchers bring several assumptions to the chosen methodology (Bowling, 2014; Crotty, 1998). These assumptions are philosophical in nature. They are defined by how we understand what human knowledge is, what lies within that knowledge, and what status can be ascribed to it (Crotty, 1998). Hence, the first step of this research process deals with questions of epistemology, followed by a theoretical framework that informs the basis for the study. The last step is to select those methods that will be used in collecting the data for the chosen research design.

3.4 Epistemology: Objectivism

Epistemology primarily deals with issues about the creation and dissemination of knowledge of a field of inquiry. Epistemology, therefore, aims to provide the philosophical context in determining what kinds of knowledge are legitimate and adequate (Gray, 2013).

The premise of this definition of knowledge as 'justified true belief' is summarised next. Since one cannot say they know of something without it being true, this knowledge accordingly requires a 'truth' that what is known exists (Steup, 2016). However, for one to lay claim to the 'truth' in their understanding, this knowledge requires 'belief.' Nevertheless, there are not enough grounds to believe in what one knows if this 'belief' has not been justified hence, the third element justification.

Objectivism, emanating from the works of Ayn Rand (1905-1982) is the epistemological position of this research. It holds that reality exist independent of consciousness; implying research is about discovering the objective reality of what there is to know (Gray, 2013). There is anecdotal evidence that research utilisation amongst radiographers, in general, falls short in comparison to other healthcare counterparts, although a recent survey shows advances in therapy radiography

(Probst et al., 2015). It is against this background that the researcher sought to discover the extent of the factors hindering research utilisation amongst diagnostic radiographers.

3.5 Theoretical Perspectives: Positivism

While the term positivism cannot be fully credited to Auguste Comte, according to Crotty (1998), he popularised it. Positivism connotes the phrase positive science, which presupposes there is a negative science. Positivism, thus, propounds the theory that only ideas that have been discovered through verifiable tests can be classed as knowledge. Since there are several ways to know what there is to know, there are criticisms of this theoretical perspective, chiefly from constructionism. Positivism inherently uses quantitative methods while emphasising positive science (Bowling, 2014).

Positivism comes from the belief that scientific knowledge is both accurate and certain (Crotty, 1998). Crotty asserts that this scientific knowledge is completely opposite to the opinions, beliefs, feelings and assumptions that we form through the personal understanding we hold. In social science, however, positivism holds the view that human behaviour is a reaction to external stimuli (Bowling, 2014). Bowling explains that this human behaviour can be subjected to observation and measurement of the associated phenomenon as in empirical research. Tools that are often used to undertake these measurements in social sciences include surveys, experimental methods and statistical technique analysis (Bowling, 2014). Survey as an empirical research method stems from the fact that it means ‘to look’; it brings with it the idea of empirical research because it purposefully seeks the necessary information from the relevant people (Denscombe, 2014).

Firstly, because no study has examined perceived barriers amongst diagnostic radiographers in a very long time within the profession, and also against the backdrop that the dynamics involved in the training of radiographers have changed over nearly three decades, a positivist approach was adopted for a broader perspective. Secondly, it was the aim of the study to offer some explanation regarding barriers to research utilisation in diagnostic radiography and generalise the findings to the whole profession.

3.6 What is a Survey?

Definitions of the survey are not lacking. Nonetheless, the definition which sums up this research methodology is the collection of quantified data from a population of interest for the purposes of description (Sapsford, 2007). The two main attributes of survey research are that it involves systematic data collection and standardisation of the process (Gray, 2013; Sapsford, 2007).

Typically, surveys aim to measure attributes, attitude, behaviour, knowledge and beliefs (Bowling, 2014; de Vaus, 2016) by asking the population the same questions related to desired characteristics in which the researcher is interested. This research attempts to collect data about diagnostic radiographers' perception of barriers to research utilisation in their department, including their knowledge of, and attitude to research utilisation.

3.6.1 Types of Survey

There are two broad categories of surveys: descriptive and analytical (Gray, 2013).

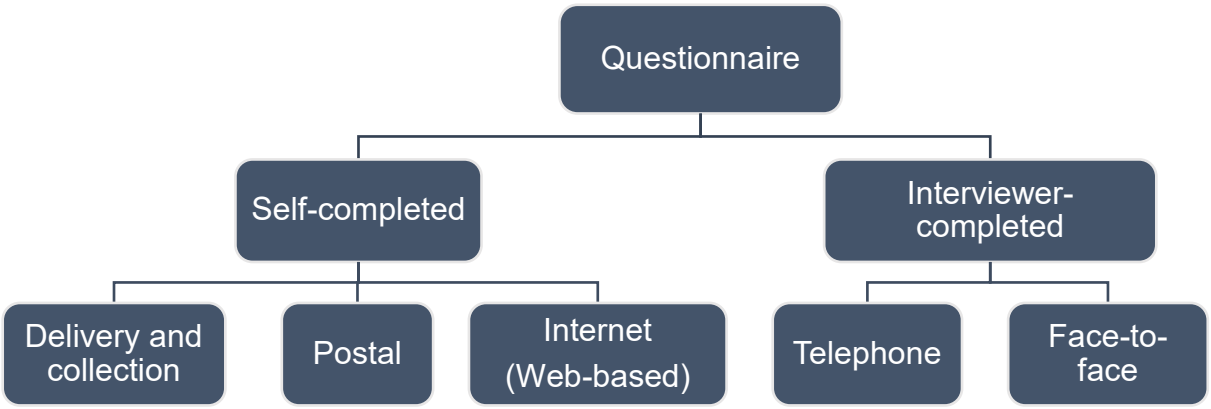
Descriptive surveys collect data from a selected sampled population and descriptive measures are calculated. It is sometimes known as cross-sectional due to data collected at one point in time from the population of interest (Bowling, 2014).

Analytical surveys, on the other hand*,* collect data at more than one point in time to investigate causal associations. These surveys are also known as longitudinal surveys (Bowling, 2014). All factors considered this research followed that of the descriptive survey as data was collected at one point in time.

3.6.2 Data collection tools

The questionnaire in survey research is the standard data collection tool (Saunders, Thornhill, & Lewis, 2016). There are many forms of the survey questionnaire. They arise from how they will be completed i.e. self-completed or interviewer-completed leading to five different methods in the administration of a questionnaire as shown in the diagram below (Fig 3.2). The choice of any one of these methods in answering the research questions depends on several factors such as cost, time constraints and sample size. In this case, the aim was to reach as many radiographers as possible.

Fig 3.2: Methods for a questionnaire administration in a survey research



3.7 Methods: Web-based Questionnaire

The Web-based Questionnaire (WBQ) is fast gaining ground as the commonest and most expeditious form of survey data collection tool in recent times due to the technological environment in which we live. It can reach more respondents than any of the other methods in Fig 3.2. Also, it is cost-effective regarding money, time and materials to use. Another important aspect of WBQ is that it allows for easy analysis as raw data is readily available once completed. This contrast with other delivery methods where the responses collected must be painstakingly entered into computer software for analysis.

There are also online software companies that provide a platform to host the questionnaire and its development by providing a plethora of templates that suit the needs of all consumers. Where necessary, the researcher can design their preferred templates too. Gray (2013) describes one major disadvantage of WBQ which must be guarded against as the difficulty in controlling who participates in the survey. Another major disadvantage in WBQ (which requires the use of an email) is that all potential participants should have an email address to avoid selection bias. Both the former and

the latter suppositions were overcome because all NHS clinical staff and for that matter radiographers have NHS email account as part of the communication structures of the organisation. In view of this, it was unlikely that unwanted participants would have completed the survey especially when search filters were used to select only diagnostic radiographers (detailed description in Section 3.9).

With respect to the response rate in WBQ, they are notoriously low (O'Leary, 2014). Some authors (Saunders et al., 2016) have given a response rate as low as 10%. For example, a Society of Radiographers survey in 2012 yielded an 11% response rate from a sample of 1,278 (SCoR, 2012). Saunders et al. (2016) cited a computer firewall as one issue that leads to low response rate as some organisations block certain websites from being accessed on their internet servers. Against this backdrop and amongst other factors such as password-protected surveys, Gray (2013) argued that there is conflicting evidence as to whether the use of WBQ affects response rates positively or negatively. Nonetheless, Gray (2013) propounded that response rates for WBQ are likely to be influenced by access to the internet, computer literacy and the desire to complete the survey.

3.7.1 Advantages of WBQ

Major advantages include:

- A significant amount of information can be gathered from diagnostic radiographers within a short period.
- Although surveys are cost-effective, they are highly dependent on the mode of data collection. WBQ can be cheaper compared to the postal questionnaire so long as the official permitted limit of the numbers of responses is not exceeded.

In this case, the first 100 responses were free. Nonetheless, a one-month subscription to Survey Monkey® was still cheaper than if it were to be a postal questionnaire.

- Data was collected in real-time and summary analysis was available on Survey Monkey®.

3.7.2 Disadvantages of WBQ

They include:

- There was no feature on the survey-administered platform to prevent over responses in relation to the required sample size. Therefore, it required continuous look-out of the responses to avert this problem.
- It has been argued that, because the answers are not collected in a face-to-face manner, it is difficult to determine if the answers provided were honest (Denscombe, 2014).
- Email and survey overload tend to affect the response rate.
- Only prospective participants who checked their emails were likely to respond and that they had to do it at a protected time. However, this selection bias was counteracted with a mobile-friendly version so that participants who wished to complete the questionnaire away from the workplace could do so anywhere on their mobile electronic devices.

3.8 Sample size

Prior to the commencement of this project, the registered radiographers in the UK were 29,805 as of February 20, 2016 (HCPC, 2016). The sample size required for the target population to achieve statistical significance was calculated using Survey Monkey sample size calculator which resulted in 380 as follows:

$$Sample\ Size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

At 95% confidence level, ***Z***-score = ***z*** = 1.96;
e is margin of error = 5%;
N is estimated population size = 29,805;
p (power) was assumed at a normal distribution of (50%).
When figures were inputted, required *Sample Size* = 379.27, approximated to 380.

3.9 Sampling procedure

Simple random sampling was used in this survey. The NHS Global Address List (GAL) was used as the medium for contacting radiographers. The NHS GAL is an address book containing all NHS staff across the country. This address book is only accessible through Microsoft Outlook by NHS employees. A systematic search in GAL was therefore done in selecting the number of participants required as shown below in Fig 3.4. The search pulled the list of Radiographers in the GAL in a random order (i.e. the contact address list was not in an orderly fashion).

Some important considerations (which include estimated response rate, non-response and non-completion) have to be made in deciding how many questionnaires have to

be sent out to the survey respondents (Denscombe, 2014; Fox, Hunn and Mathers, 2009; Saunders et al., 2016). Saunders et al. (2016) provide this formula for calculating the actual number of participants that should be targeted to receive the questionnaire:

$$n^a = \frac{n}{r_e\%}$$

***n*ª** is the targeted participants that received the survey link

n is the minimum required sample size, 380

***r*e** is the estimated response rate in percentage, 35%.

After imputation of figures, the number of potential participants that received the survey was 1,080.

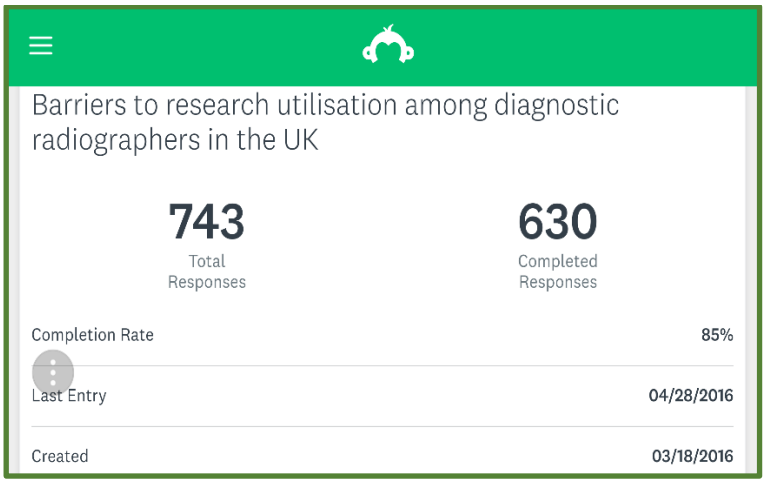
Using the survey by the Society of Radiographers (SCoR, 2012) as an example where the response rate was 11% and with the typical response rate for online surveys ranging between 10% and 40%, an arbitrary response rate of 35% was chosen to be the expected response rate in deciding how many radiographers needed to be invited to participate in the survey (formula presented above).

This led to a sample of 1,080 being used for the survey out of all diagnostic radiographers on NHS GAL. Therefore, the first 1,080 radiographers were then selected and emailed the web link to the survey. Of these, 60 of the emailed addresses returned as undeliverable rendering a usable sampled population of 1,020 receiving the survey web link.

3.10 Response and Completion Rate

A total of 743 responses were received out of the 1,020 respondents, equating to 72.8% response rate. However, only 630 participants completed the survey thereby yielding an 84.8% completion rate.

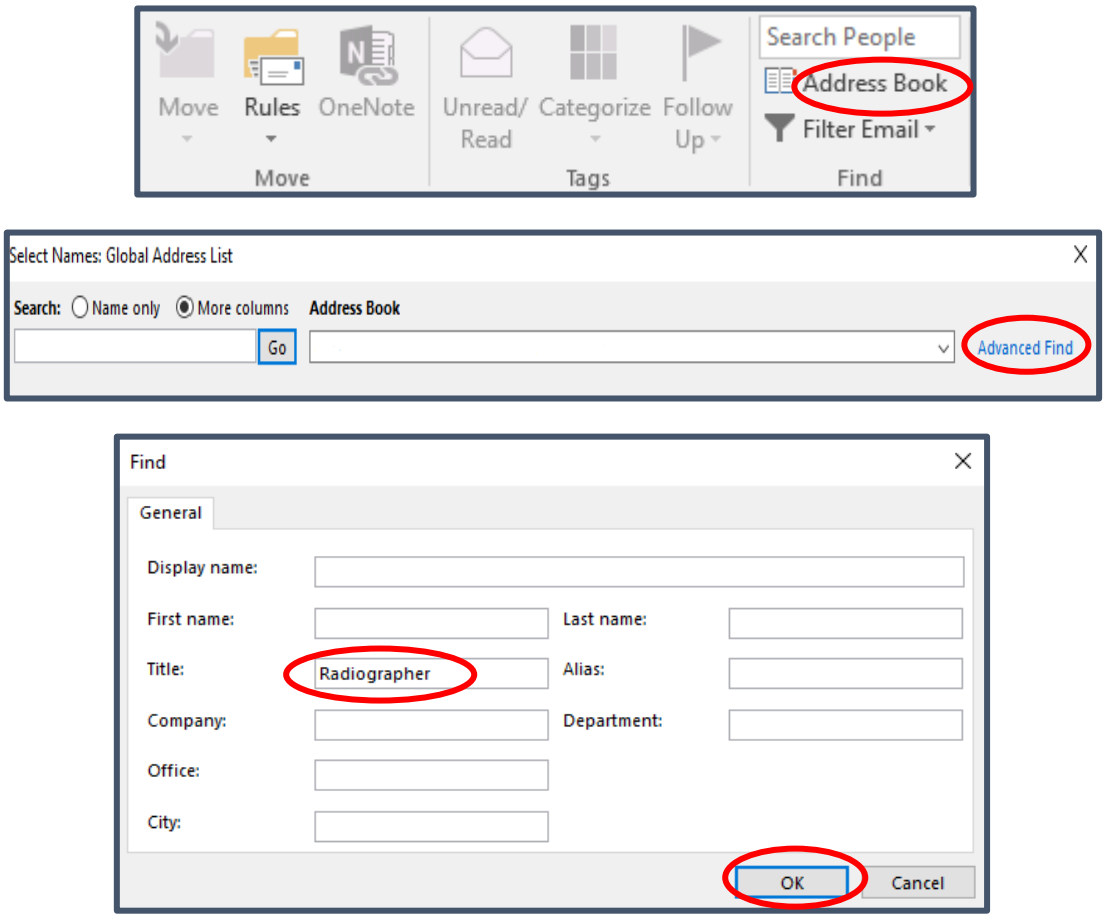
Figure 3.3: Response and completion rate



3.11 Sampling strategy

Since some hospitals use different titles in the labelling of the e-mail addresses, three separate searches were conducted using the syntax: “diagnostic radiographer”, “diagnostic imaging” and “radiographer” to capture all radiographers on the list. Nonetheless, the contact address list from the search activity required filtering as there were suffixes attached to some of the professional titles in the contact list. Suffixes which gave an indication that the contacts were not diagnostic radiographers were removed. Examples of these suffixes were *therapeutic, therapy, student, helper, assistant, assistant practitioner.* Others included *secretary, coding, support officer, pathway tracker, reports clerk, and bank.*

Figure 3.4: Searching NHS Global Address List for respondents



3.12 Instrumentation

A search through the literature showed that there were two main types of psychometric scale that could be used to examine perceived barriers to research utilisation within the healthcare settings. These were the BARRIERS Scale (developed by Funk et al., 1991a) and Evidence-based Practice Questionnaire put together by Upton and Upton (2006). The decision to use the BARRIERS Scale was based on the frequency of its usage (please see *Table 2.1a and b*) and how it has been subjected to rigorous testing by other researchers (Kajermo et al., 2010; Temel et al., 2010 and Williams et al., 2015). Besides, all the studies that were reviewed which used EBPQ additionally used BARRIERS Scale. Closer examinations of the 24 items used in the EBPQ showed 11

of the questions were also part of the BARRIERS Scale. The EBPQ measures perceived barriers to research utilisation using three concepts: knowledge, practice and attitude. Five out of the 14 knowledge questions appear in different guises in the six practice questions. For instance, the question regarding whether respondents can convert information needs into a research question is reframed into can you "formulate clear research questions" in the knowledge factor questions.

In view of these limiting factors in the EBPQ, the BARRIERS Scale (Funk et al., 1991a) was adopted as the psychometric tool in soliciting for data in this study (Appendix I). It was developed by Funk and colleagues to identify barriers that prevented nurses from undertaking EBP. This scale has been used by researchers in different healthcare professions, settings and globally for similar purposes (Anuradha, Jacob, Shyamkumar, & Sridhar, 2013; Brown et al., 2010; Brown et al., 2009; Oh, 2008; Yava et al., 2009). It consisted of 29 items asking respondents to rate from 0 to 5 the extent to which they perceived these items to be a barrier towards research utilisation. Permission was granted by the original authors of the scale (Appendix II). All the questions asked were closed-ended questions (Appendix III).

3.13 Reliability and content validity: Pilot study revisited

A pilot study was conducted in the healthcare facility of the researcher. It was conducted as part of a Module on the topic *Critical Reflection on the proposed use of data collection and analysis methods* in preparation towards the research project. The pilot study included 35 health professionals from nursing, physiotherapy, occupational therapy, and radiography.

3.14 The Pilot Study

Initially, 40 self-completed questionnaires were printed and placed in the hospital cafeteria so that prospective participants could take one and complete and then return it to the location, but it became apparent that it was not going to work as they were not returned. Then it was decided to go around the wards and departments to approach and persuade prospective participants to complete the questionnaire. Due to their busy schedule, it was also decided to record their names and visit them later to retrieve the completed questionnaires. Thirty-five out of the 40 questionnaires were retrieved. In this pilot project, all the BARRIERS Scale questions were used in its original format. However, because the original questionnaire was intended for nurses; questions that had nurses as the subject were removed and replaced with the first-person singular *I*.

3.15 Challenges in the pilot study

The main challenge in the pilot study was non-completion and apparent lack of interest in completing open-ended questions. There were a lot of uncompleted questions by the participants even though they were asked to complete all the questions. As a result, it also became apparent that if all the questions were to be completed, then the format of the questionnaire had to be electronic in which case participants would be prevented from skipping a question by making all the questions 'skip-free.'

There were open-ended options for some of the questions, but they were not filled by all the participants and as such, they were removed. For example, in the pilot study (as in the BARRIERS Scale), respondents were further asked if there were "any other things [they thought were] barriers to research utilisation" (Appendix I). The respondents were tasked to list and rank those barriers on a scale of 1 to 5. It was found that none of the thirty-five respondents made any input. This item too was

removed because the participants might have felt overburdened. Moreover, the BARRIERS Scale did not include any other item apart from the 29 items that were used in the original research, so it was decided that may be the authors did not discover any further barriers.

In addition, respondents were then asked to rank the 29 items (which they had already ranked) into three categories of “greatest”, “second greatest” and “third greatest” barriers. Interestingly, this part of the ranking was discordant with the ranks they had assigned to the 29 items. For instance, questions that had not been ranked a 4 (greater extent), were occasionally ranked as “greatest, or second greatest or third greatest” barriers. The idea behind this part of the questionnaire was to be able to identify three of the 29 items that were perceived as the greatest barrier. This defeated the purpose of the ranking because if an item had not been ranked amongst the 29 items as a 4, it could not be deemed a greatest barrier in the second aspect of the ranking. Besides, the question itself lacked clarity as it did not ask respondents to rank the 29 items which had been ranked a 4 in the latter classification (greatest or second greatest or third greatest). Rather, they were asked “[w]hich of the above items do you feel are the *three greatest barriers* to [the] use of research?” Here, it was believed respondents were asked to engage in a difficult exercise and would require very motivated individuals to go through all the questions they had ranked and pick three of them to re-rank into greatest, second greatest and third greatest barriers (Appendix I) hence, its removal from the main project. There was the conviction that it was enough to deduce from the rankings, which of the 29 items were greatest amongst the commonly identified barriers by cumulative frequency or aggregation (so 40% or higher responses was thought to be the benchmark in deciding greatest barriers).

It was decided that the hand delivery method would not be proficient if the target sample size of 380 were to be attained. Besides, the participants for the project work would span across the length and breadth of the country.

Certain words used in the BARRIERS Scale questionnaire were checked to be translatable into British understanding. The word ‘physician’ was replaced because in the BARRIERS Scale it examined nurses in American healthcare settings where the word can be identified with a medical doctor (the preferred choice in the UK healthcare lexicon). Nevertheless, in the context of this study, the physician was replaced with the radiologist who is the equivalent of a medical doctor/physician for a radiography-based survey. The other words were thought to have similar meanings in British settings, so they were not changed.

The scale was then modified in accordance with the set objectives of this study. Unlike the original BARRIERS Scale where all the 29 items were randomly arranged (making up a four-factor solution i.e. the construct), in this study, the items were sub-grouped into barriers relating to the organisation setting, knowledge of research skills and attitude to research utilisation to form a three-factor solution. In the BARRIERS Scale, there were questions relating to the characteristics of the adopter (the nurse), organisation, innovation (research) and communication. It was decided that some of the questions which had been assigned a certain construct in the original scale did not fit. In all, a total of 28 items were included but after factor analysis 23 items were deemed appropriate for statistical analysis. Apart from omitting some items from the scale, most of the modification related to wording. The word ‘nurse’ was removed from all items. This study did not include one aspect from the original scale where respondents were further asked to rank three of the 29 items they deemed “greatest”,

"second greatest" and "third greatest" barriers. The Cronbach's Alpha for the study would also be calculated during the data analysis phase.

3.16 The questionnaire design and administration: Pilot and post-pilot

Every attempt was made to make the questionnaire very appealing to respondents as it increases the response rate (O'Leary, 2014). It was designed on the Survey Monkey® platform. Survey Monkey allows only 10 questions and 100 responses for a basic account; however, because the study had 9 questions on demographic characteristics and 28 BARRIERS Scale items with an expectant 380 responses, it was deemed necessary to have a premium account.

Every question was designed in such a way that respondents were unable to skip to the next question to avoid unanswered item(s). The questionnaire had six short-length pages. All pages had a header and footer which contained a Sheffield Hallam University logo.

The first page welcomed respondents to the survey by explaining the purpose of the study and assuring them of anonymity. It also had a one-line sentence imploring respondents that the survey must only be completed once by any individual (Appendix IV). Pages two and three had questions regarding demographic characteristics of the respondents. Although the pilot study used the same format as appeared in the BARRIERS Scale i.e. all the 29 items and their numerical order, it was felt that the items should be categorised under the three determining factors (organisational settings, knowledge of research skills and attitude to research utilisation) to make the survey more organised and appealing. As a result, page four contained eight questions on perceived barriers to research utilisation in the organisational settings whereas page five had seven items about perceived knowledge of research skills. The final

page dealt with attitude to research utilisation and it consisted of eight items. Respondents were asked to rank a five-point Likert scale response of ***strongly disagree, disagree, do not know, agree*** and ***strongly agree*** for the individual 28 as opposed to what was used in the BARRIERS Scale (no extent, a little extent, a moderate extent, a greater extent, and no opinion). The question (item) randomisation technique feature for questions and responses order in Survey Monkey® was utilised to ensure that respondents had to carefully select their preferred answers. In other words, item randomisation was used to prevent bias introduced by order or because of survey fatigue (Lavrakas, 2008).

Importantly, Survey Monkey® ensured the questionnaire was optimised for desktop, tablet and mobile use.

The web link to the survey was attached in an email (Appendix IV) to all 1,080 respondents. The email explained the purpose of the study, anonymization and how they were selected. The content advised respondents not to complete the questionnaire if they were therapy radiographers.

The questionnaire was administered on February 29th, 2016 and closed on March 30th, 2016. Analysis of the questionnaire is presented in chapter four.

3.17 Statistical analysis

IBM® Statistical Package for Social Sciences® (SPSS) version 24 was used to analyse data that were collected using Survey Monkey® (SM). At the time, it was not possible to export the data directly into SPSS. Nonetheless, SM converted the data for export to Microsoft Excel Worksheet format (.xlsx) which was compatible with SPSS.

After the data was exported into SPSS, individual responses were given a unique number to allow for easy identification. All variables were assigned codes. For example, the female was given the code 1 and 2 for a male.

The results from SPSS were not readily transferable to Microsoft Word and therefore required further editing in accessible formats so they were exported to Microsoft Excel Worksheet to create tables and figures compatible in Microsoft Word.

SPSS was used for all descriptive and inferential statistics. The median was used as the central tendency measurement for the ordinal responses (Likert scale) and was tabulated alongside frequency and percentages.

Inferential statistics were undertaken using the Kruskal-Wallis Test[11] (KWT) to determine significant differences between two or more groups and the Mann-Whitney U Test[12] (MWUT) was used to analyse significant levels within subgroups (Allen, 2017). Spearman's correlational analysis was also undertaken to determine any associations between demographic characteristics and the three concepts of barriers in the organisation, knowledge of research skills and attitude to research utilisation. Ordinal regression analysis was also performed to aid prediction in how demographic characteristics influenced barriers in the organisational settings, knowledge of research skills and attitude to research utilisation.

The top five barriers will be identified as those responses that were 40% or more in agreement or disagreement with the statements depending on how they were worded.

[11] KWT is a rank-based non-parametric test that can be used to find out if there are statistically significant levels between two or more groups of an independent variable on an ordered dependent variable.
[12] MWUT is like KWT, except it allows for comparison between only two interested groups.

The responses, agree and strongly agree were combined to represent agreement while ‘disagree’ and ‘strongly disagree’ were combined to mean disagreement.

3.18 Demographics: Agenda for change (AfC)

This study emphasised on the job scale of the respondents chiefly because AfC (Job Evaluation Group, 2018) spells out the qualifications and experiences required to perform roles at each level. Although AfC does not explicitly state the responsibilities required of each banding, job evaluation is based on two major parameters – weighting factors and factor levels. The weighting factors (in addition to assigned levels) determine the Band for the pay scale. Agenda for Change, therefore, considers the knowledge, responsibility, skills and effort required for the intended job – in other words, Knowledge and Skills Framework (KSF). Suffice it to say that implicit in AfC is that practitioners of higher banding are required to possess higher KSF qualities.

According to AfC, Level 5 (Band 5), the starting point for nursing, allied health professionals, for example, requires a degree or its equivalent for entry. The difference between Band 5 and 6, 6 and 7, 7 and 8 is that there must be additional knowledge than what was initially required for entry into the basic level. AfC suggests additional knowledge for Band 6 should equate to a post-registration qualification such as postgraduate diploma but insists that it is not duly required. In contrast to Band 6 post holders, there must be some form of theoretical or conceptual knowledge acquired through training post-registration qualification. Although a post-registration qualification may not be required for Band 6 post holders or higher, doing the job for a long time does not always result in additional knowledge (Job Evaluation Group, 2018). The amount of responsibility that is placed on individual banding in terms of research is not elaborated except that much is expected at higher banding. AfC refers

to Level 6 post holders as those with specialist knowledge, Level 7 as needing highly developed specialist knowledge. For Level 8 it is expected that the individual post-holder would have specialist knowledge over more than one discipline.

3.19 Ethical Considerations

Ethical approval was granted by the Sheffield Hallam University Research Ethics Committee (SHUREC) during the proposal writing stage of the study. Three main components of the content submitted to SHUREC are presented below.

- Respondents were made aware that the data for the survey was collected anonymously. To ensure this, respondents were not asked to provide their names or any form of identification.
- The introductory letter for the survey explicitly stated that the survey was conducted as part of an academic doctoral endeavour (Appendix IV).
- Respondents were also made aware that findings might be published for the purposes of disseminating important information regarding the profession to help policymakers streamline developmental projects towards research utilisation within the profession.

CHAPTER FOUR

Results

4.0 Overview

The findings are presented in tables and figures. Kruskal Wallis test was used to analyse groups for statistical significance (Appendix V). The Mann-Whitney U test was used for subgroups analysis for significant differences (Appendix VI). Likert scale responses were combined for 'agree' and 'strongly agree' to represent *agreement* whereas 'disagree' and 'strongly disagree' represented *disagreement*. Responses that were 40% or more in agreement or disagreement with the statement were considered to be a barrier.

It was noted that three subgroups in the highest qualification and area of practice categories were underrepresented. There were only 8 doctorate holders out of the 630 respondents, and in the area of practice category, only four respondents were from research. Due to the small number of respondents they were excluded from their respective categories because they skew the results.

In this chapter, PhD and Doctorate are used interchangeably to represent Doctor of Philosophy and Doctor of Professional Studies or Professional Doctorate.

Abbreviations used in tables and graphs

Dip	Diploma
PgC/D	Postgraduate certificate or Diploma
MSc	Master of Science
PhD	Also, Professional Doctorate
NI	Nuclear Imaging
BI	Breast Imaging
GR	General Radiography
CSI	Cross-sectional Imaging
US	Sonography
Fluoro	Fluoroscopy
Rep	Reporting
Res	Res

4.1 Reliability analysis

The properties of the initial 28 items were analysed using SPSS for Cronbach's alpha which is a measure of internal consistency based on the average of inter-item correlations as is presented in Table 4.1.

Table 4.1: Reliability statistics for the BARRIERS Scale

Scale	Mean Score	Variance	Cronbach's Alpha	Number of Items
Organisational settings	22.46	20.392	0.624	8
Knowledge of research skills	22.42	10.715	0.503	7
Attitude to research utilisation	29.40	55.826	0.938	8
Total	74.28	67.231	0.652	23

Cronbach's alpha for the psychometric scale shows a moderate strength of measurement at α=0.652, however, the scale is stronger for attitude to research utilisation subscale at α=0.938.

4.2 Survey Results

Results from the survey were collected between March and April 2016. The survey web link was randomly emailed to radiographers across the UK using the NHS webmail. A total of 1,080 radiographers received the survey web link of which 1,020 were deliverable. There were 740 responses with 630 successful completions. This resulted in a 72.8% response rate and 84.8% completion rate.

Table 4.2 highlights the distribution of the various groups in this survey. A greater proportion of them were females (n=489, 77.6%) with the remaining being males (n=141, 22.4%). Most of the respondents were <31 years (n=184, 29.2%). There was nearly the same representation for those at ages 31-40 (n=161, 25.6%) and >50 (n=158, 25.1%).

Of the 630 respondents, the majority 296(47%) were Band 6 position holders followed by Band 7 (n=178, 28.3%). Those who had been qualified for <5 years and >22 years were the most represented, thus, 164(26.0%) and 177(28.1%) respectively.

There were more BSc holders (n=280, 44.4%) than any other highest educational qualification. Only 8(1.3%) had attained a doctorate degree. Surprisingly, only four (0.6%) of the respondents were working in a research capacity. Most respondents worked in general radiography (n=209, 33%).

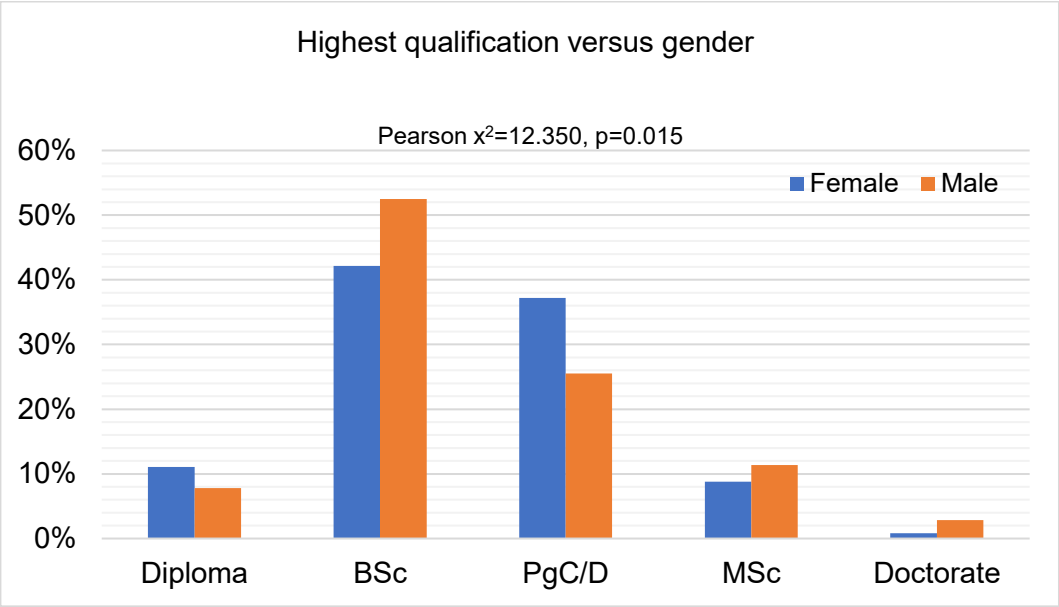
Table 4.2: Demographic characteristics of respondents

Groups	Subgroups (N=630)	Frequency n	Percentage %
Gender	Female	489	77.6
	Male	141	22.4
Age range	<31	184	29.2
	31-40	161	25.6
	41-50	127	20.2
	>50	158	25.1
Years of qualification	< 5	164	26.0
	5-10	140	22.2
	11-16	88	14.0
	17-22	61	9.7
	>22	177	28.1
Job scale	Band 5	106	16.8
	Band 6	296	47.0
	Band 7	178	28.3
	Band 8	50	7.9
Highest qualification	Diploma	65	10.3
	BSc	280	44.4
	Pg Certificate/Diploma	218	34.6
	MSc	59	9.4
	Doctorate	8	1.3
Area of practice	General Radiography	209	33.2
	Fluoroscopy	61	9.7
	Cross-sectional Imaging	154	24.4
	Reporting	39	6.2
	Breast Imaging	49	7.8
	Research	4	0.6
	Sonography	61	9.7
	Nuclear Imaging	23	3.7
	Others	30	4.8

Three hundred and ninety-six (62.3%) said they had not been involved in formal research as opposed to 234(37.1%). However, of the 234 respondents, 56(23.9%) had one publication each. Ten or more publications had been achieved by 3(1.3%).

There was an even distribution of doctorate holders within gender, thus four each. Of the 59 respondents having an MSc degree, 43(72.9%) were females (Figure 4.1).

Figure 4.1: Highest qualification versus gender



The figure above shows there were more males with BSc (n=74, 52.5%) as the highest qualification than females (n=206, 42.1%). On the other hand, there were more females with PgC/D (n=182, 37.2%) as the highest qualification than males (n=36, 25.5%). Pearson chi-square analysis shows strong evidence of a relationship between gender and highest qualification.

Table 4.3: Crosstabulation for the area of practice and job scale

	Job scale n(%)			
Area of practice	Band 5	Band 6	Band 7	Band 8
General Radiography	98(46.9)	88(42.1)	19(9.1)	4(1.9)
Fluoroscopy	1(1.6)	45(73.8)	11(18.0)	4(6.6)
Cross-sectional Imaging	4(2.6)	105(68.2)	37(24.0)	8(5.2)
Reporting	0(0.0)	3(7.7)	30(76.9)	6(15.4)
Breast Imaging	0(0.0)	26(53.1)	18(36.7)	5(10.2)
Research	0(0.0)	1(25.0)	2(50.0)	1(25.0)
Sonography	1(1.6)	3(4.9)	42(68.9)	15(24.6)
Nuclear Imaging	2(8.7)	11(47.8)	9(39.1)	1(4.3)
Others	0(0.0)	14(46.7)	10(33.3)	6(20.0)
Total	106(16.8)	296(47.0)	178(28.3)	50(7.9)

Pearson x^2=375.338; p<0.001

Chi-square analysis as depicted in Table 4.3 shows strong evidence of a relationship between the major area of practice and job scale. There were three major areas of practice that were mostly Band 6 dominated. These were fluoroscopy (n=45, 73.8%), cross-sectional imaging (n=105, 68.2%) and breast imaging (n=26, 53.1%). The majority of Band 7 radiographers also work in either Reporting (n=30, 76.9%) or Sonography (n=42, 68.9%).

Table 4.4: Crosstabulation for job scale and highest qualification

	Highest qualification n(%)				
Job scale	Diploma	BSc	PgC/D	MSc	Doctorate
Band 5	1(0.9)	96(90.6)	5(4.7)	3(2.8)	1(0.9)
Band 6	37(12.5)	165(55.7)	82(27.7)	11(3.7)	1(0.3)
Band 7	23(12.9)	18(10.1)	107(60.1)	27(15.2)	3(1.7)
Band 8	4(8.0)	1(2.0)	24(48.0)	18(36.0)	3(6.0)
Total	65(10.3)	280(44.4)	218(34.6)	59(9.4)	8(1.3)

Pearson x^2=276.397; p=0.000

Chi-square analysis shows strong evidence of a relationship between job scale and highest qualification. Most Band 5 and 6 holders had BSc as highest qualification thus, 96(90.6%) for the former and 165(55.7%) for the latter. On the other hand, most Band 7 and 8 holders had PgC/D (see Table 4.4). Table 4.4 depicts that there is a positive relationship between job scale and highest qualification.

Table 4.5: Crosstabulation for the area of practice and highest qualification

	Highest qualification n(%)				
Area of practice	Diploma	BSc	PgC/D	MSc	Doctorate
General Radiography	28(13.4)	143(68.4)	23(11.0)	13(6.2)	2(1.0)
Fluoroscopy	11(18.0)	33(54.1)	16(26.2)	1(1.6)	0(0.0)
Cross-sectional imaging	11(7.1)	81(52.6)	47(30.5)	15(9.7)	0(0.0)
Reporting	1(2.6)	1(2.6)	28(71.8)	8(20.5)	1(2.6)
Breast imaging	1(2.0)	8(16.3)	36(73.5)	4(8.2)	0(0.0)
Research	0(0.0)	0(0.0)	2(50.0)	1(25.0)	1(25.0)
Sonography	4(6.6)	3(4.9)	42(68.9)	10(16.4)	2(3.3)
Nuclear imaging	2(8.7)	1(4.3)	15(65.2)	3(13.0)	2(8.7)
Others	7(23.3)	10(33.3)	9(30.0)	4(13.3)	0(0.0)
Total	65(10.3)	280(44.4)	281(34.6)	59(9.4)	8(1.3)

Pearson x^2=256.302; p=0.000

Table 4.5 also shows that most respondents working in general radiography (n=143, 68.4%), fluoroscopy (n=33, 54.1%) and cross-sectional imaging 81(52.6%) were BSc holders. On the other hand, the highest educational qualification for the majority of respondents working in reporting, breast imaging, research and sonography was PgC/D holders. There were no doctorate holders working in the areas of fluoroscopy, cross-sectional imaging and breast imaging.

Table 4.6: Crosstabulation of the number of years qualified and job scale in relation to the highest qualification

		Job Scale			
Years qualified*	Highest qualification	Band 5 n(%)	Band 6 n(%)	Band 7 n(%)	Band 8 n(%)
<5	Dip	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	BSc	79(94.0)	59(86.8)	1(8.3)	0(0.0)
X^2=69.218	PgC/D	3(3.6)	9(13.2)	11(91.7)	0(0.0)
	MSc	1(1.2)	0(0.0)	0(0.0)	0(0.0)
	PhD	1(1.2)	0(0.0)	0(0.0)	0(0.0)
05-10	Dip	0(0.0)	1(1.1)	0(0.0)	0(0.0)
	BSc	17(89.5)	68(75.6)	5(20.8)	0(0.0)
	PgC/D	1(5.3)	17(18.9)	14(58.3)	4(57.1)
X^2=51.705	MSc	1(5.3)	4(4.4)	4(16.7)	2(28.6)
	PhD	0(0.0)	0(0.0)	1(4.2)	1(14.3)
11-16	Dip	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	BSc	0(0.0)	23(51.1)	6(17.6)	0(0.0)
	PgC/D	1(50.0)	19(42.2)	20(58.8)	6(85.7)
X^2=23.103	MSc	1(50.0)	2(4.4)	7(20.6)	0(0.0)
	PhD	0(0.0)	1(2.2)	1(2.9)	1(14.3)
17-22	Dip	0(0.0)	4(16.0)	2(7.1)	0(0.0)
	BSc	0(0.0)	12(48.0)	2(7.1)	0(0.0)
	PgC/D	0(0.0)	9(36.0)	19(67.9)	2(25.0)
X^2=36.405	MSc	0(0.0)	0(0.0)	5(17.9)	6(75.0)
	PhD	0(0.0)	0(0.0)	0(0.0)	0(0.0)
>22	Dip	1(100.0)	32(47.1)	21(26.3)	4(14.3)
	BSc	0(0.0)	3(4.4)	4(5.0)	1(3.6)
	PgC/D	0(0.0)	28(41.2)	43(53.8)	12(42.9)
X^2=24.939	MSc	0(0.0)	5(7.4)	11(13.8)	10(35.7)
	PhD	0(0.0)	0(0.0)	1(1.3)	1(3.6)

*Statistically significant levels detected (p≤0.05)

The majority of Band 7 and 8 radiographers had more than 22 years of working experience. Of these more than half (n=43, n=53.8%) of Band 7 and a greater proportion of Band 8 (n=12, 42.9%) had PgC/D as the highest qualification. In addition, PgC/D was also the highest qualification for those Band 7 with 5-22 years of working experience.

4.3 Perceived barriers to RU in the organisational settings

This section presents responses in a frequency distribution.

Table 4.7: Summary of responses to barriers in the organisational settings

Organisational settings barriers	Respondents (%)
We are too busy for research matters	317(50.3)
There is no documented need to change practice	107(17.0)
Administration will not allow implementation of new ideas	153(24.3)
Doctors will not cooperate with new ideas	183(29.0)
Other radiographers not supportive of new ideas	189(30.0)
I do not have the authority to change practice	289(45.9)
The department makes time for research matters	193(30.6)
No knowledgeable radiographer to review research with	153(24.3)

From Table 4.7, over half 317(50.3%) of the respondents perceived their departments were too busy for research matters. Only 107(17%) perceived there was no documented need to change practice. Interestingly, 289(45.9%) felt they did not have the authority to change practice, while 189(30%) shared the view that other radiographers were not supportive of new ideas and that doctors will not cooperate with new ideas 183(29%).

Table 4.8: Kruskal Wallis test of significance for organisational settings

Groups	Subgroups	n	Mean rank	x^2	p-value
Gender	Female	489	317.05	0.160	0.689
	Male	141	310.11		
Age range	<31	184	316.14	10.060	0.018*
	31-40	161	320.65		
	41-50	127	349.80		
	>50	158	281.94		
Highest qualification	Diploma	65	282.15	7.025	0.135
	BSc	280	331.19		
	PgC/D	218	308.68		
	MSc	59	292.37		
	Doctorate	8	393.50		
Job scale	Band 5	106	330.25	6.839	0.077
	Band 6	296	329.31		
	Band 7	178	288.00		
	Band 8	50	300.39		
Years qualified	<5	164	325.87	2.992	0.559
	5-10	140	326.14		
	11-16	88	322.35		
	17-22	61	302.18		
	>22	177	298.66		
Practice	GR	209	331.50	12.516	0.130
	Fluoro	61	280.66		
	CSI	154	331.00		
	Reporting	39	250.45		
	BI	49	284.85		
	Research	4	232.13		
	US	61	316.87		
	NI	23	331.33		
	Others	30	326.13		

*Statistically significant difference detected in the group (p≤0.05)

Apart from the age range category (Chi-square=10.060; p=0.018), KWT, as shown in the table above, there was no statistically significant difference for the total score of organisation settings across the remaining five groups.

An MWUT (Appendix VI) was conducted to compare differences in perception of barriers in the organisational setting. There were no statically significant differences in all subgroups with the exception of the respondents with Band 5 and Band 6 in the job scale category where mean ranks for Band 5=221.14 and Band 6=194.47 at p=0.041) showed that Band 5s perceived more barriers than Band 6s.

Figure 4.2: Busy department

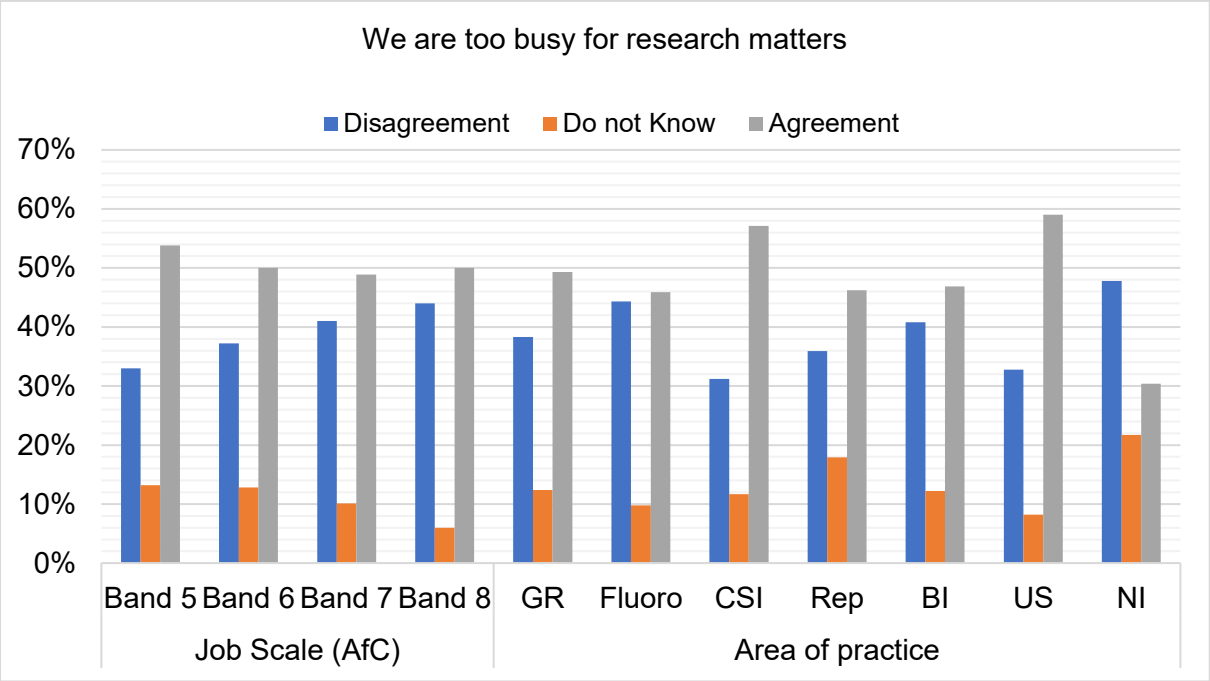
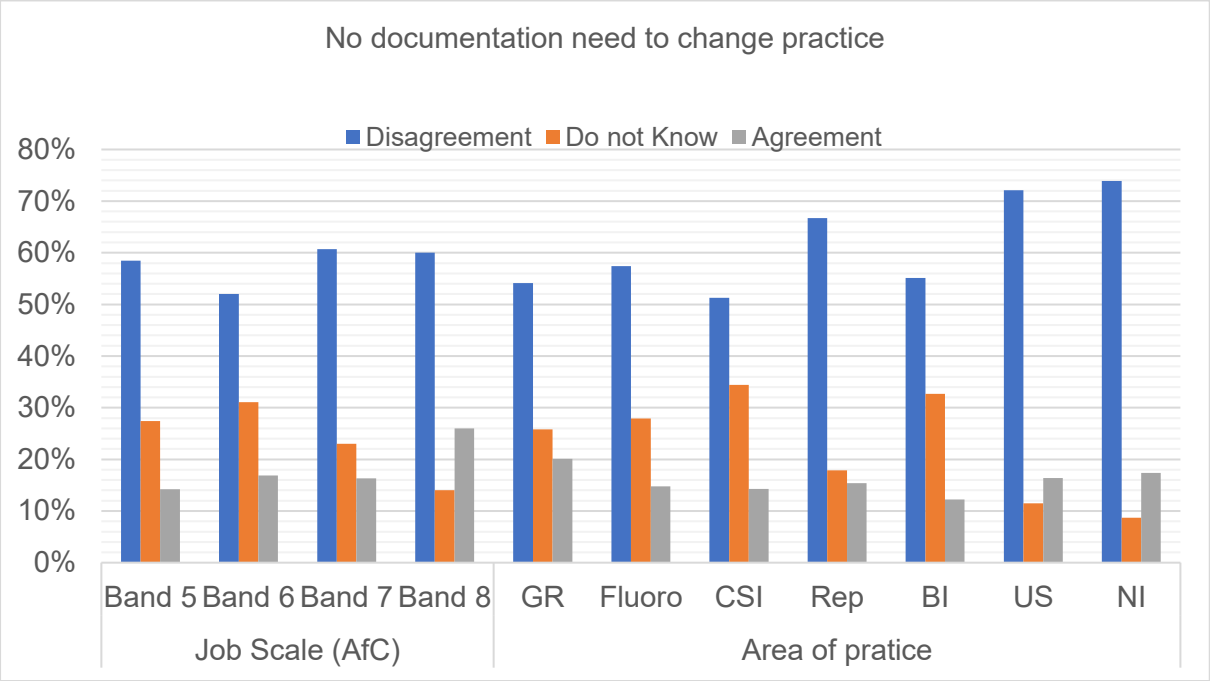


Figure 4.2 shows that respondents in all areas of practice perceived their department to be too busy for research-related matters. However, more than half of those working in sonography (n=36, 59.0%) and cross-sectional imaging (n=88, 57.1%) were more likely to agree. MWUT showed that at 3.10-3.28 confidence interval, there were statistically significant differences between respondents working in cross-sectional imaging and nuclear imaging (p=0.028), as well as sonography and nuclear imaging

(0.048). Over 50.0% of respondents in the job scale category felt they were too busy for research matters. Another interesting data from the graph is that the level of disagreement with the statement 'we are too busy for research matters' increased with higher job status.

Figure 4.3 No documented need to change practice



Although few, more Band 8 respondents (n=13, 26.0%) were of the opinion that there was no documented need to change practice in the job scale category (Figure 3). With respect to the area of practice, there were statistically significant differences at the 95% CI (2.39-2.55) for general radiography and sonography (p=0.030) as well as cross-sectional imaging and sonography (p=0.030) (Appendix VI).

Figure 4.4: Administration will not support new ideas

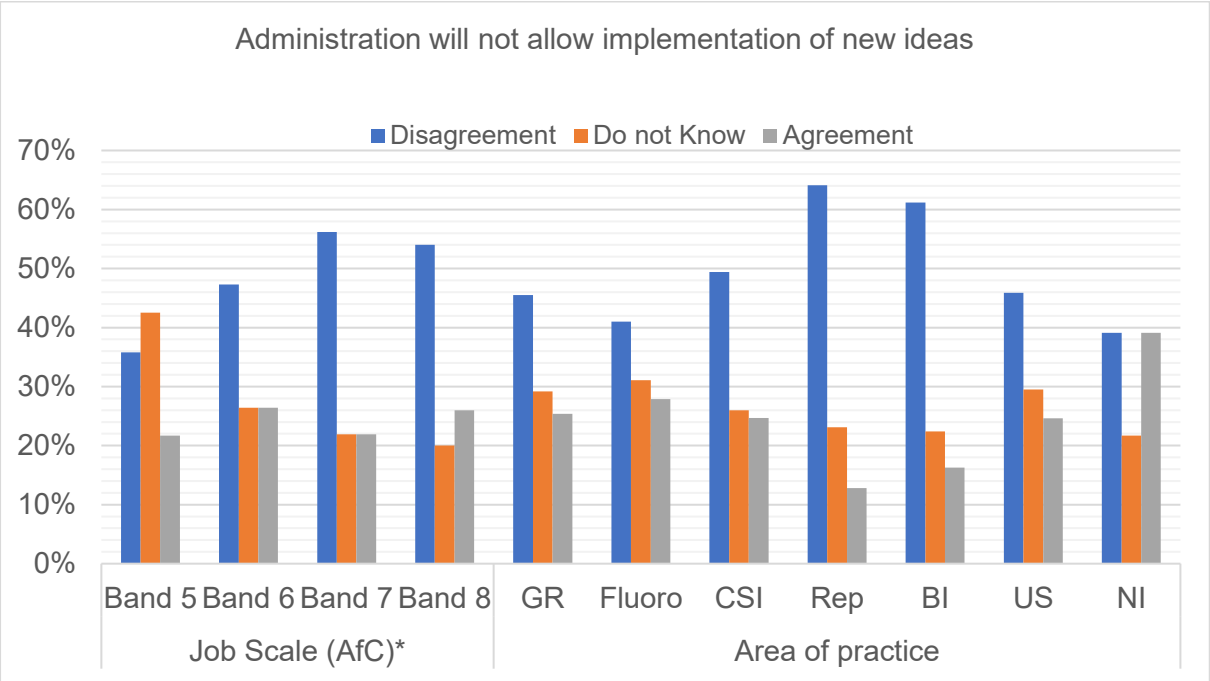
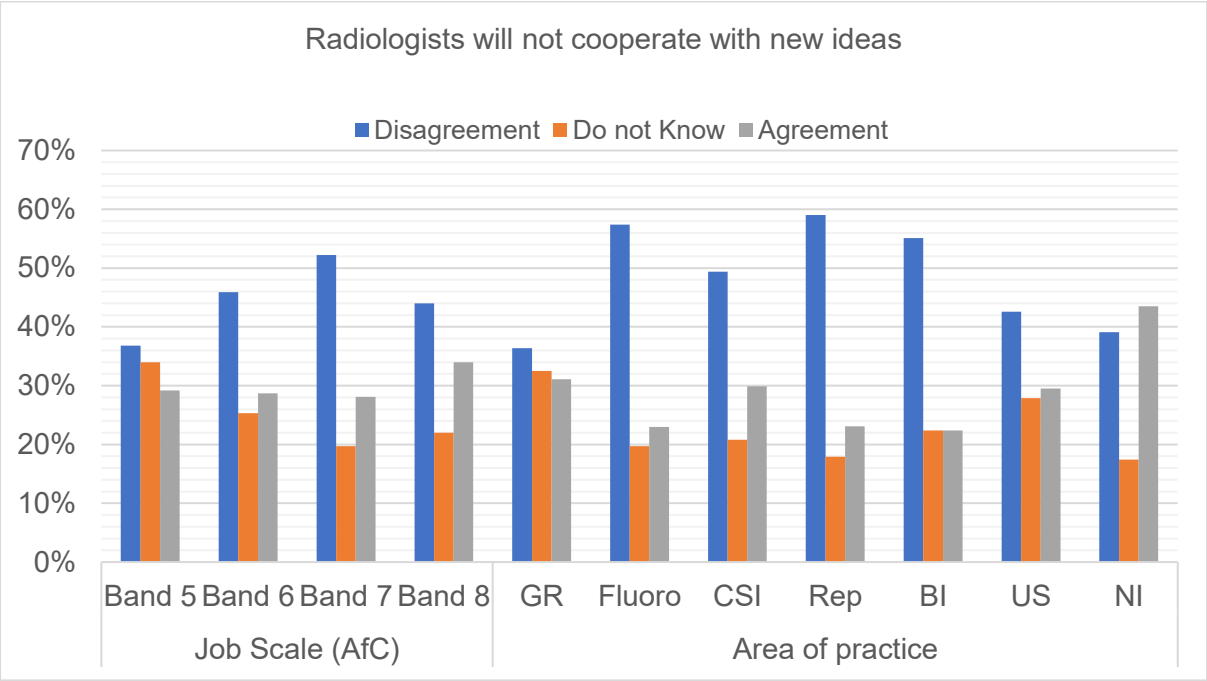


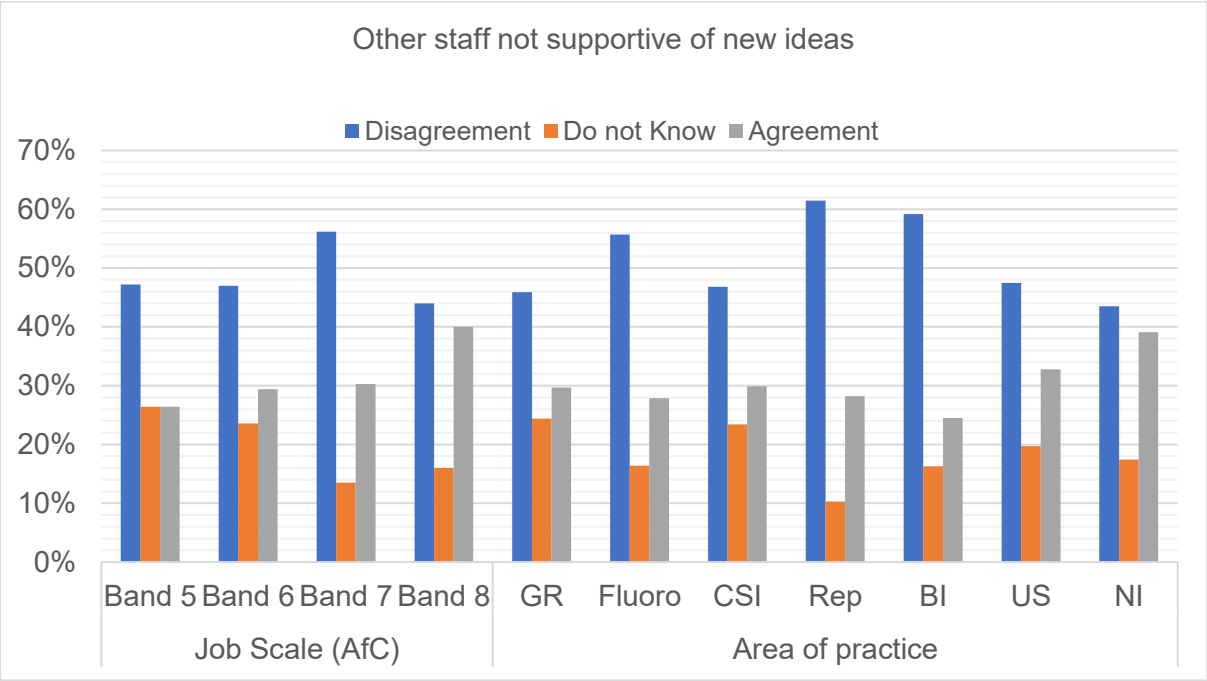
Figure 4.4 shows that except for those working in reporting and breast imaging, about a quarter of those in each of the remaining working domains perceived administration would not allow the implementation of new ideas. It is worth mentioning that, this was felt much strongly amongst respondents in nuclear imaging (n=9, 39.1%). MWUT showed no statistical differences in any of the groups. The data also shows that the lower the job status the higher level of uncertainty regarding whether the administration will support the implementation of new ideas or not.

Figure 4.5: Doctors will not cooperate with new ideas



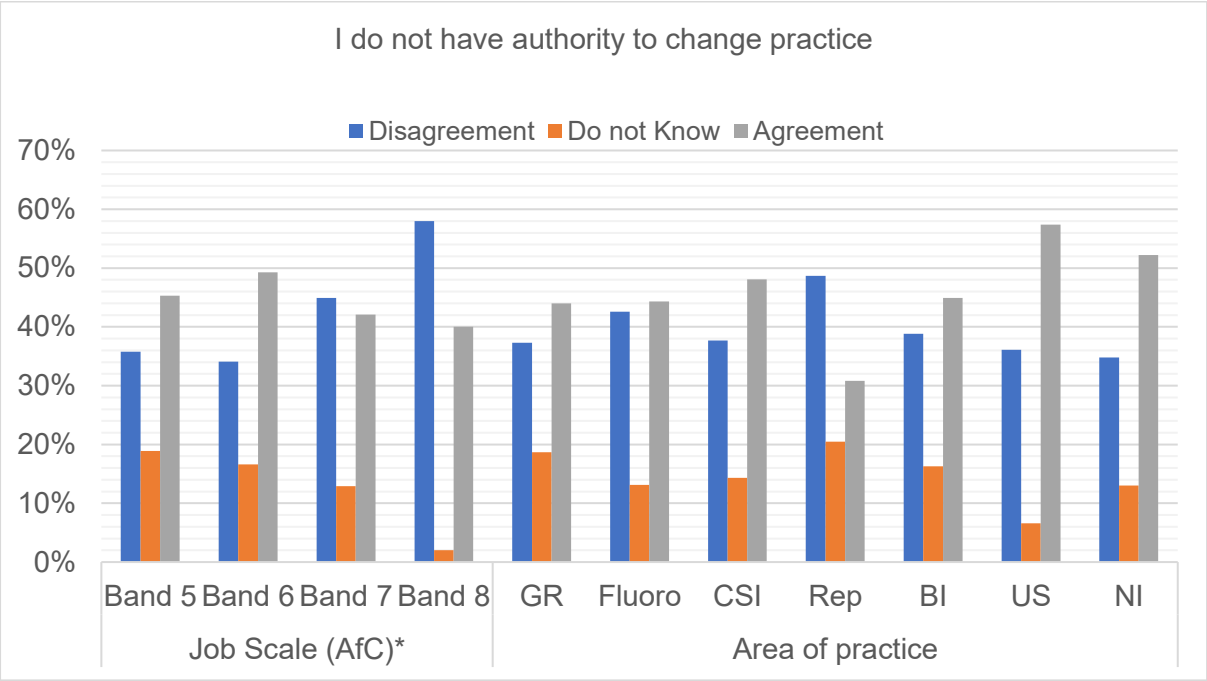
The figure above shows that Band 8 respondents were more likely to agree or strongly agree (n=17, 34.0%) that doctors would not cooperate with new ideas. With regards to the area of practice, those in nuclear imaging (n=10, 43.5%) agreed or strongly agreed more. No statistically significant differences were found within either group.

Figure 4.6: Colleagues supporting new ideas



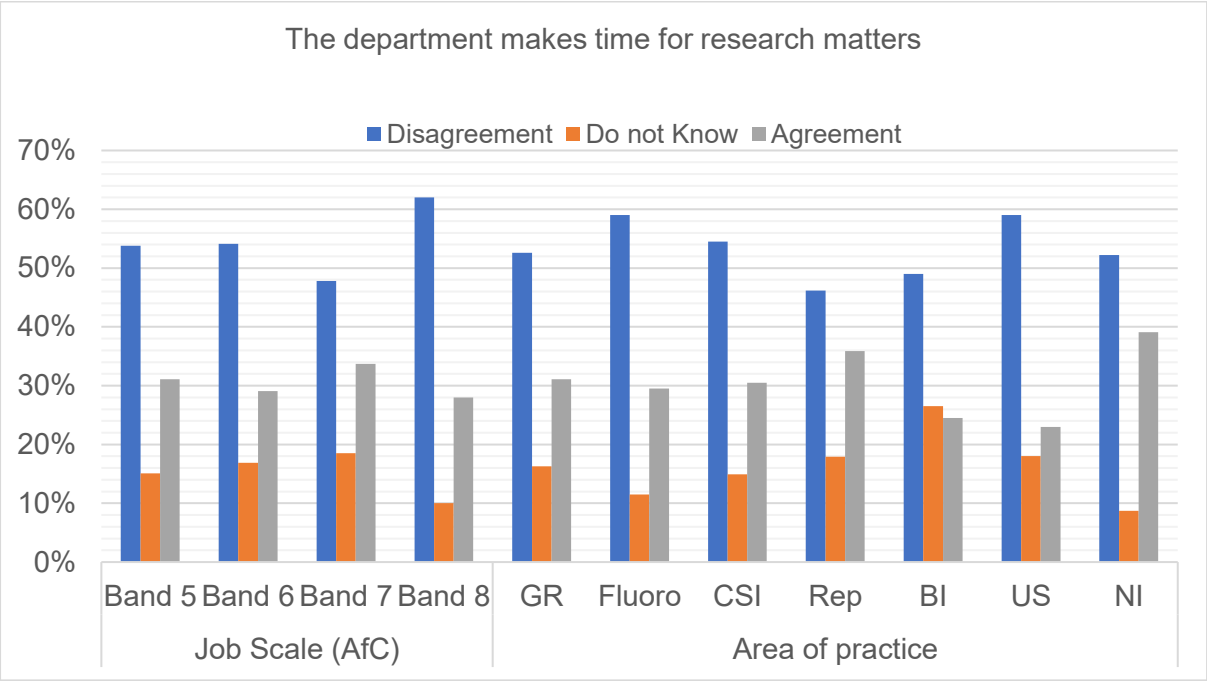
The graph above shows that nearly two-thirds of the respondents in both categories shared the view that their colleagues were supportive of new ideas. Band 8 respondents (n=24, 48%) were the least to share this view in the job scale category. Interestingly the level of agreement increased with job scale. That is, the higher the job scale the higher the agreement.

Figure 4.7: Lacking the authority to change practice



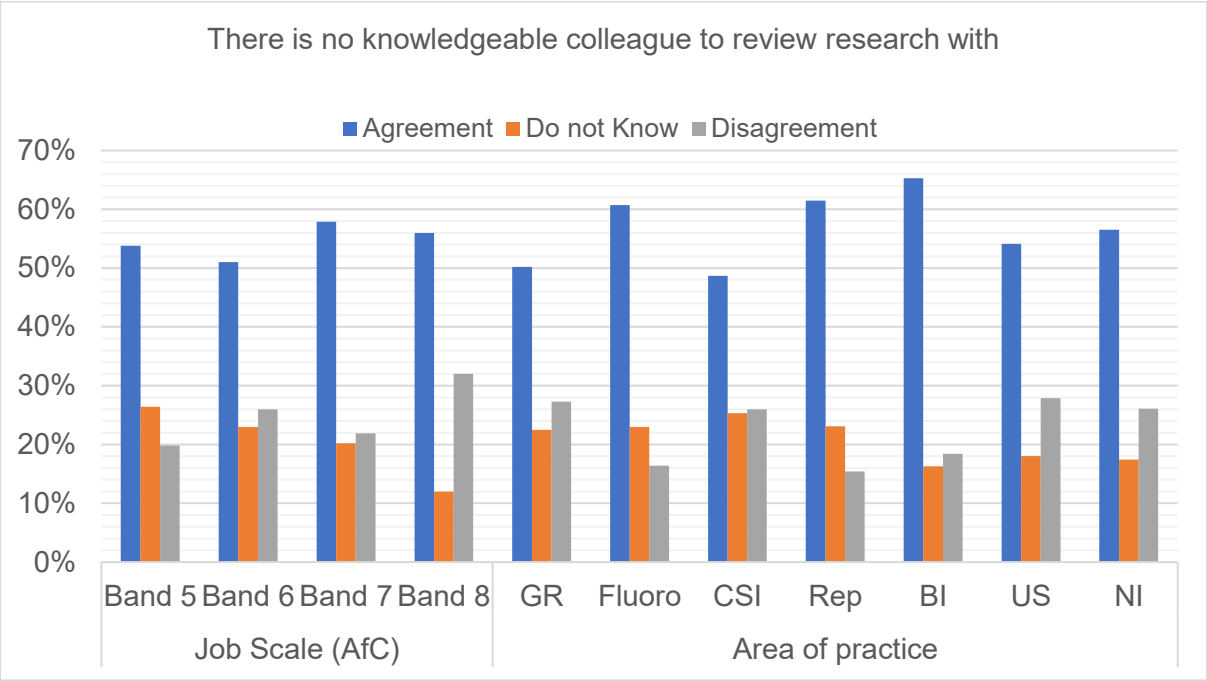
As depicted in Figure 4.7, almost half of Band 6 radiographers shared the view that they did not have the authority to change practice. Interestingly, 20(40.0%) of Band 8 respondents also affirmed the statement. More than half of the respondents working in sonography (n=35, 57.4%) had the view that they did not have the authority to change practice.

Figure 4.8: Department making time for research matters



Except for Band 7 respondents, over half of the remaining subgroups in the job scale category disagreed that their departments made time for research matters. This was the same for the area of practice category apart from respondents in reporting and breast imaging disagreeing less.

Figure 4.9: Reviewing research related to practice



The figure above shows most respondents in the two categories were of the view that their departments had colleagues who were knowledgeable in research.

4.4 Perceived knowledge of research

This section presents results in a frequency distribution.

Table 4.9: Summary of respondents' perceived knowledge of research skills

Knowledge of research skills	Respondents (%)
I can critically appraise the literature	416(66)
I am uncertain whether to believe research findings^	336(53.3)
I can develop my own research questions	275(43.7)
I can interpret statistics	319(50.6)
I can judge the quality of an article	367(58.3)
I can see the implications of the research findings	377(59.8)
Relevant literature is not easy to find^	320(50.8)

The table above is a summary of respondents' perceived knowledge of research skills. Of the 630, 416(66.0%) could perform a critical appraisal. With respect to interpreting statistics approximately half believed they could perform this task. Half of the respondents felt relevant literature was easy to find.

Table 4.10: Kruskal Wallis test of significance for perceived knowledge of research skills

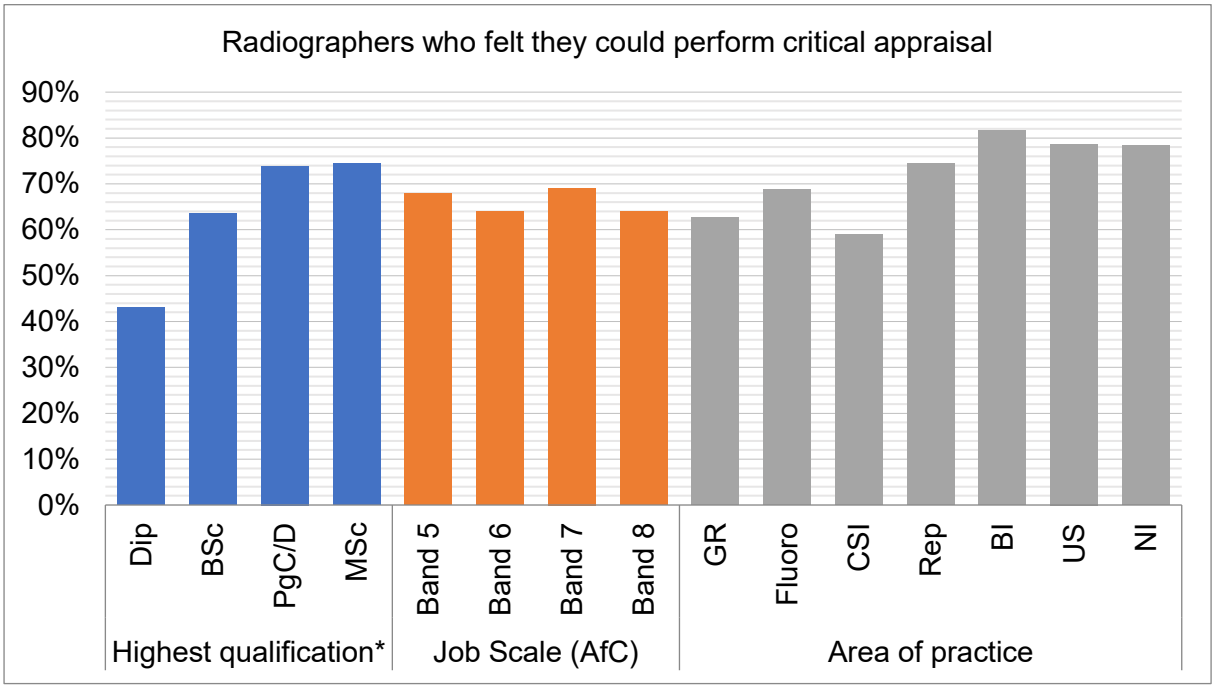
	Subgroups	n	Mean rank	x^2	p-value
Gender	Female	489	300.71	14.567	0.000*
	Male	141	366.78		
Age range	<31	184	316.33	1.074	0.783
	31-40	161	326.92		
	41-50	127	307.60		
	>50	158	309.25		
Highest qualification	Diploma	65	289.42	5.290	0.259
	BSc	280	311.85		
	PgC/D	218	314.70		
	MSc	59	359.75		
	Doctorate	8	350.56		
Job scale	Band 5	106	342.8	5.875	0.118
	Band 6	296	298.65		
	Band 7	178	328.26		
	Band 8	50	311.95		
Years qualified	<5	164	331.83	3.426	0.489
	5-10	140	305.52		
	11-16	88	331.55		
	17-22	61	308.52		
	>22	177	302.69		
Practice	GR	209	325.49	8.085	0.425
	Fluoro	61	331.52		
	CSI	154	295.29		
	Rep	39	345.6		
	BI	49	320.2		
	Res	4	283.75		
	US	61	315.84		
	NI	23	340.43		
	Others	30	254.68		

*Statistically significant difference detected in the group (p≤0.05)

Apart from the gender category ($p<0.05$), there was no significant level in any of the categories.

A further comparison involving subgroups was done using an MWUT to identify differences in knowledge of research skills amongst those with the highest educational qualification, but no statistically significant differences were found within this subgroup.

Figure 4.10: Doing critical appraisal



*Statistically significant difference existed amongst the group

Respondents with a Diploma had the lowest agreement of being able to perform critical appraisal (n=28, 43%) in this category. At 95% CI of 3.462-3.611, there were statistically significant differences (Appendix VI) in relation to respondents who held Diploma and BSc (p=0.018), Diploma and PgC/D (p=0.000), Diploma and MSc (p=0.005) as well as BSc and PgC/D (p=0.019).

More than half of the respondents in this category shared the view that they could perform a critical appraisal. Nevertheless, the greater number of respondents felt they could develop their own research questions.

Figure 4.11: Believing research findings

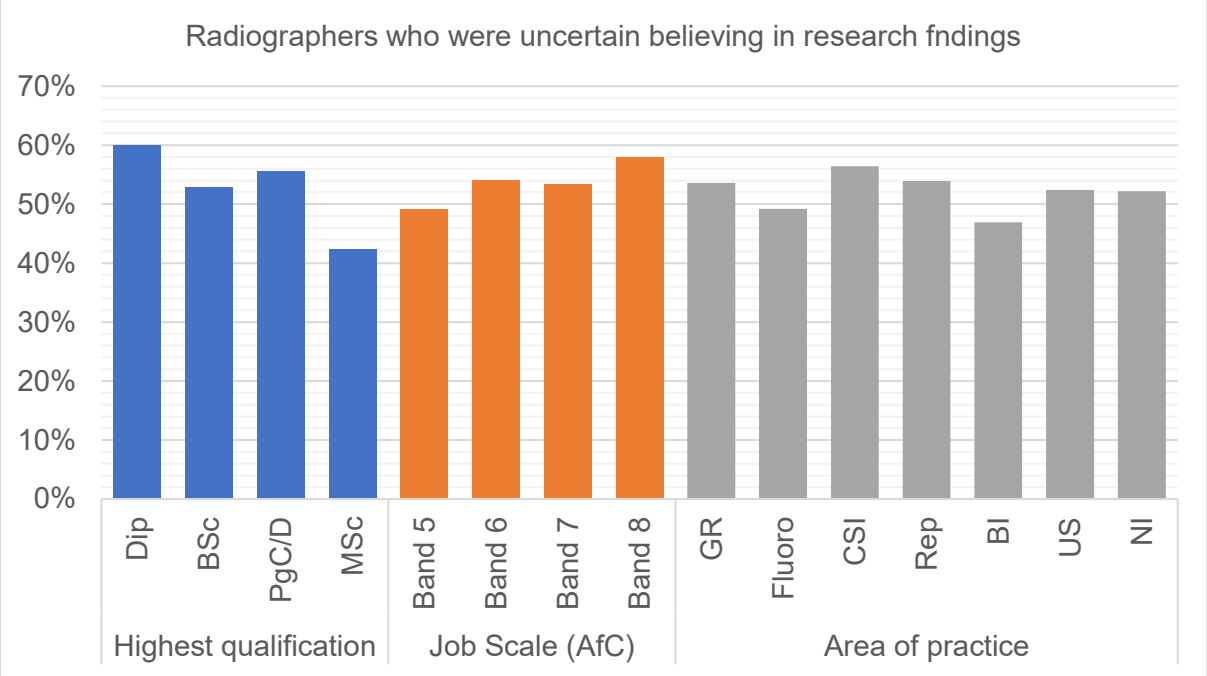


Figure 4.11 depicts respondents who were uncertain whether to believe in the research findings. This had no statistically significant findings. There was an upward trend in the level of uncertainty for job scale except for Band 7 radiographers. On the other hand (except for BSc holders) there was a downward trend in the level of uncertainty reducing as higher qualification was gained.

More than half of the respondents in general radiography (53%), cross-sectional imaging, reporting, sonography and nuclear imaging felt uncertain believing in research findings.

Figure 4.12: Developing research questions

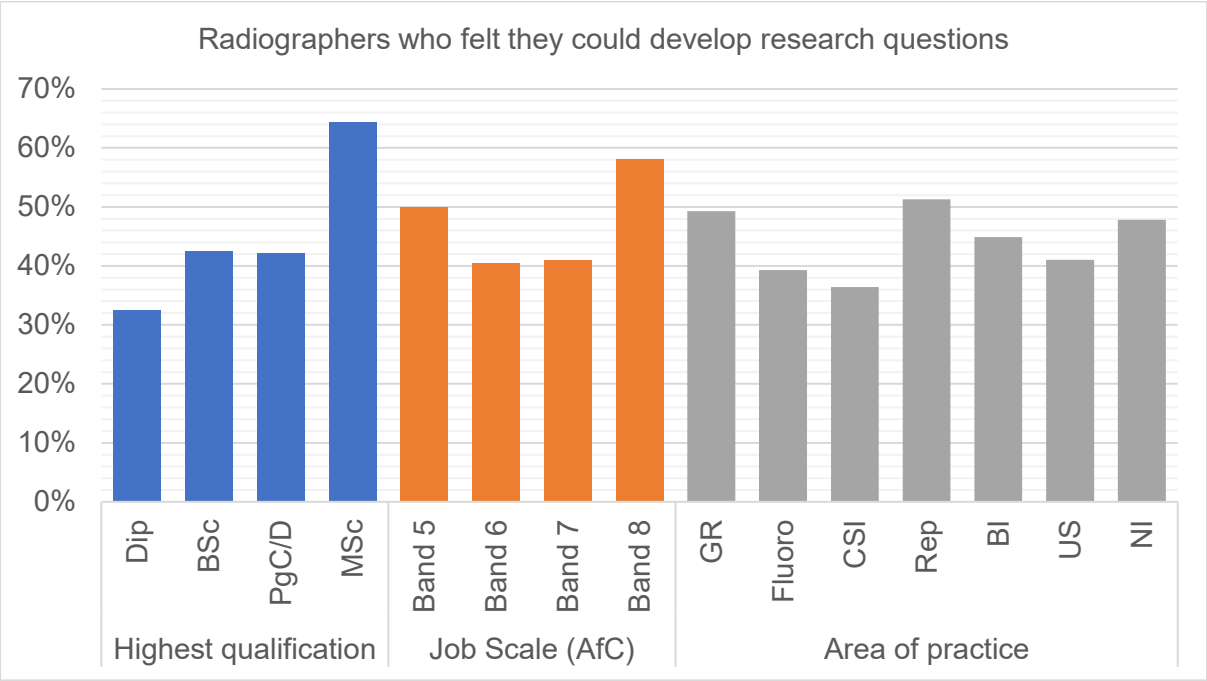
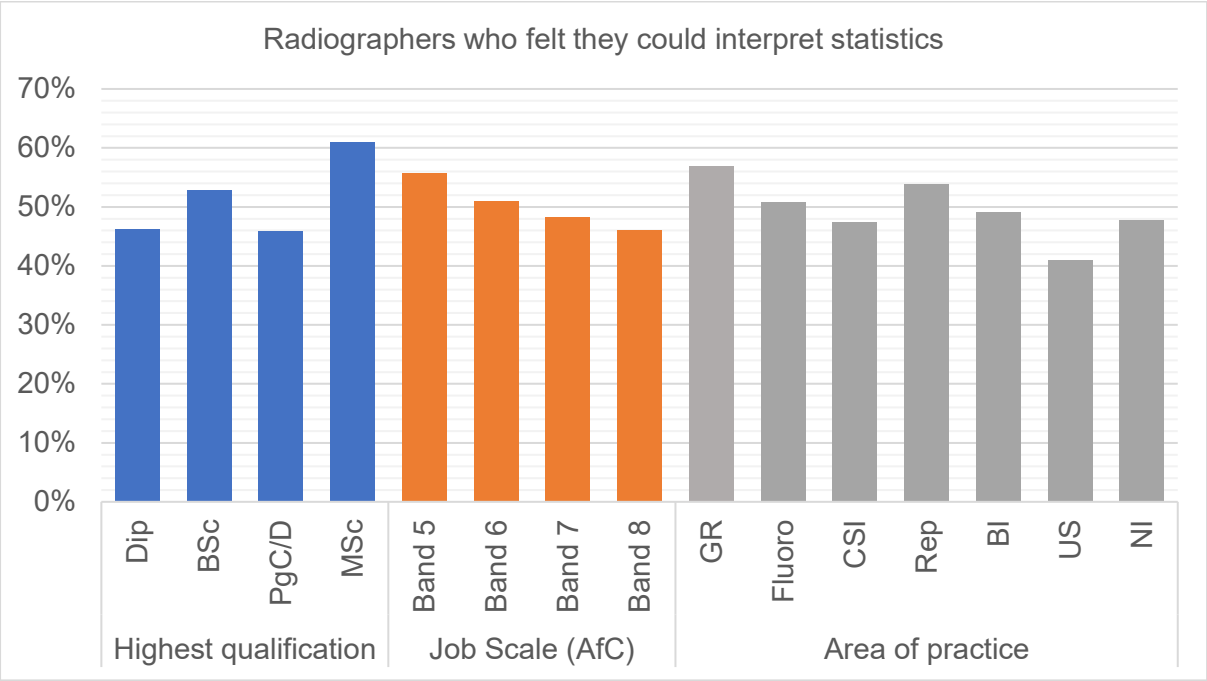


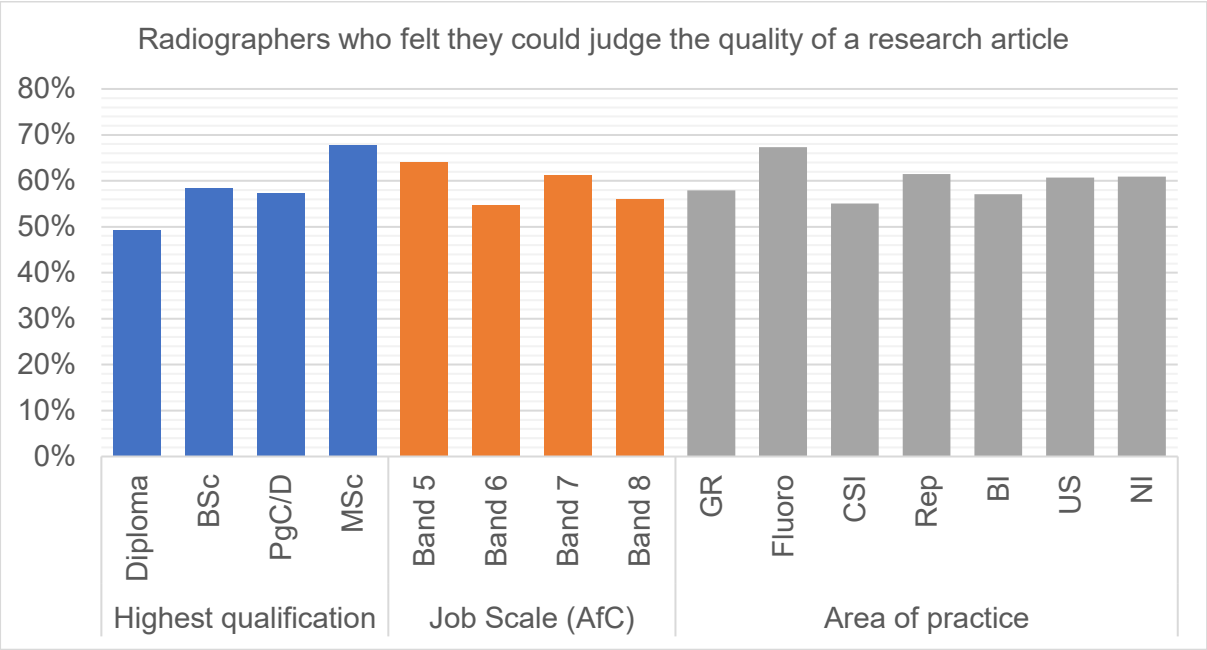
Figure 4.12 illustrates that 201(41.1%) felt they could develop research questions but there was no statistical significance. With respect to age range category, there was no trend in the order of capability in developing research questions. MSc holders (n=38, 64.4%) perceived themselves as more capable than Diploma (n=21, 32.4%), BSc (n=119, 42.5%) and PgC/D (n=92, 42.2%). Further subgroups analysis (MWUT) indicated that at 95% confidence interval of 3.14-3.29, there were statistically significant differences between MSc and Diploma (p=0.006) as well as MSc and BSc (p=0.007). Interestingly, more Band 5s (n=53, 50.0%) had the view that they could perform this task than Band 6 (n=120, 40.5%) and Band 7 (n=73, 41.0%).

Figure 4.13: Interpreting statistics



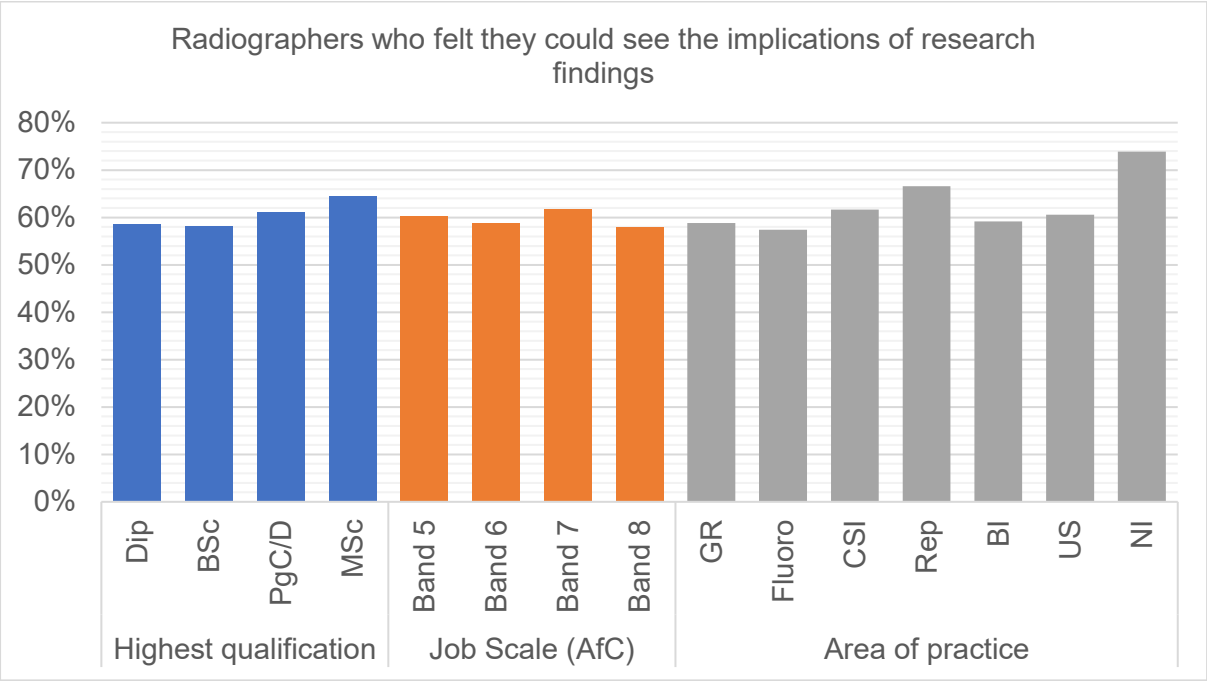
Most respondents were of the view that they could interpret statistics. With respect to the job scale subgroup, there was a downward trend in perceived capability as the scale increased.

Figure 4.14: Judging the quality of a research article



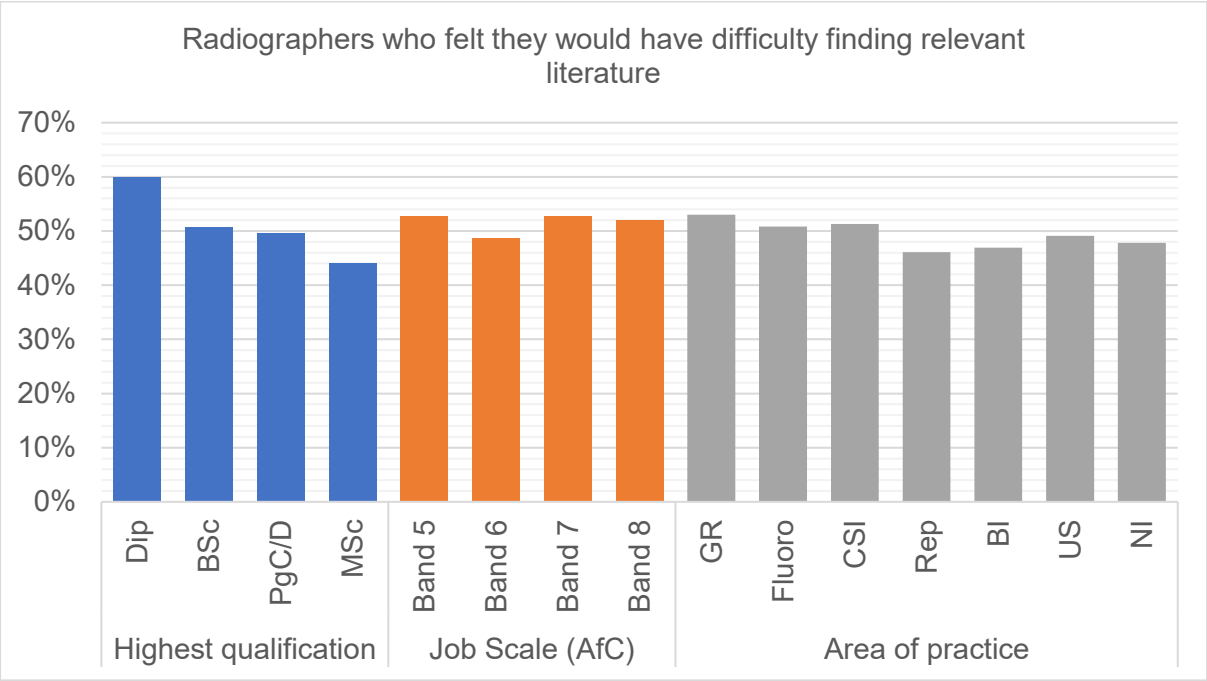
Judging the quality of a research article appeared to be dependent on the level of qualification. MWUT showed a statistically significant difference ($p<0.05$) between Diploma (n=32, 49.2%) and MSc degree holders 40(67.8%).

Figure 4.15: Knowing the implications of research findings



Most respondents across this category (Figure 4.15) shared the view that they could see the implications of research findings when they read research articles. The MWUT analysis did not show any statistically significant levels.

Figure 4.16: Finding relevant literature



Respondents across each category felt it was not easy to find relevant literature. There appears to be a corresponding decrease in percentage for highest qualification with the difficulty (Diploma (n=39, 59.9%), BSc (n=142, 50.7%), PgC/D (n=108, 49.6%), and MSc (n=26, 44.0%)).

More than half of the respondents in general radiography (n=111, 53.0%), fluoroscopy (n=31, 50.8%) and cross-sectional imaging (n=79, 51.3%) felt they had difficulty.

4.5 Attitude to research utilisation

This section presents the respondents' attitude to research utilisation.

Table 4.11: Summary of the respondents' attitude to research utilisation

Attitude to research utilisation	Respondents (%)	Median Score*
Research is not in my scope of practice^	198(31.4)	3
Radiologists/physicists must review research in my practice^	127(20.2)	3
I recognise the need to change practice	452(71.7)	3
Research-related matters is a waste of time^	112(17. 8)	3
Research findings make valuable contributions to practice	503(79.8)	3
There are some areas in my practice that need research	408(64.8)	3
Research utilisation improves practice	475(75.4)	3
I am not responsible for changing practice^	126(20)	3

*1 – Disagree/Strongly Disagree; 2 – Do not know; 3 – Agree/Strongly Agree
^Reverse coded

In general, there was a very positive attitude to research utilisation. Nevertheless, about one-third of the respondents, 198(31.4%) shared the view that research was not in their scope of practice. Some respondents (n=127, 20.2%) held the opinion that research within their practice must be reviewed by radiologists or physicists. There were 112(17.8%) who felt research-related matters were a waste of time.

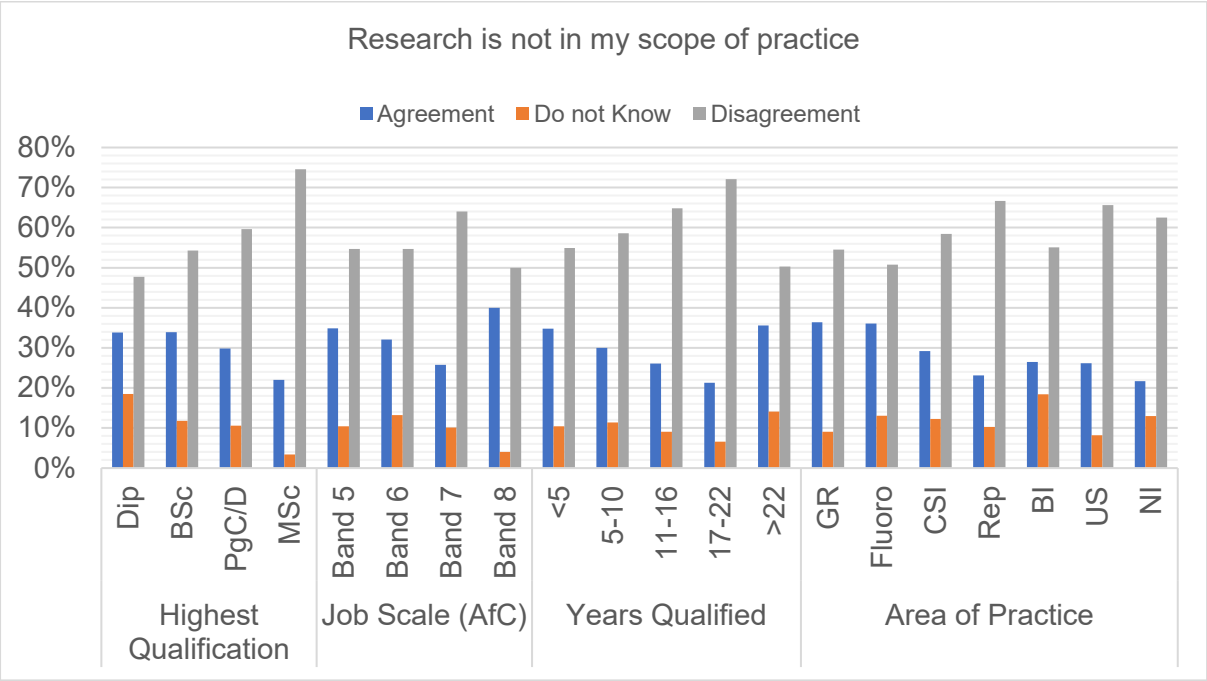
Table 4.12: Kruskal Wallis test of significance for attitude to research utilisation

	Subgroups	n	Mean rank	X^2	p-value
Gender	Female	489	311.09	1.289	0.256
	Male	141	330.80		
Age range	<31	184	315.82	15.054	0.002*
	31-40	161	359.70		
	41-50	127	287.85		
	>50	158	292.31		
Highest qualification	Diploma	65	230.13	24.826	0.000*
	BSc	280	307.49		
	PgC/D	218	331.81		
	MSc	59	380.42		
	Doctorate	8	366.31		
Job scale	Band 5	106	335.96	6.616	0.085
	Band 6	296	295.79		
	Band 7	178	331.84		
	Band 8	50	330.60		
Years qualified	<5	164	326.84	14.002	0.007*
	5-10	140	330.64		
	11-16	88	349.45		
	17-22	61	321.7		
	>22	177	273.99		
Practice	GR	209	304.63	16.128	0.041*
	Fluoro	61	303.17		
	CSI	154	296.96		
	Rep	39	373.37		
	BI	49	316.7		
	Res	4	300.75		
	US	61	381.43		
	NI	23	341.41		
	Others	30	282.33		

*Statistically significant differences were detected in the group (p≤0.05)

KWT for six categories showed there were statistically significant differences in age range, highest qualification, number of years qualified and area of practice. MWUT was performed to compare the differences in attitude within the job scale and years of qualification categories.

Figure 4.17 Research is not in my scope of practice

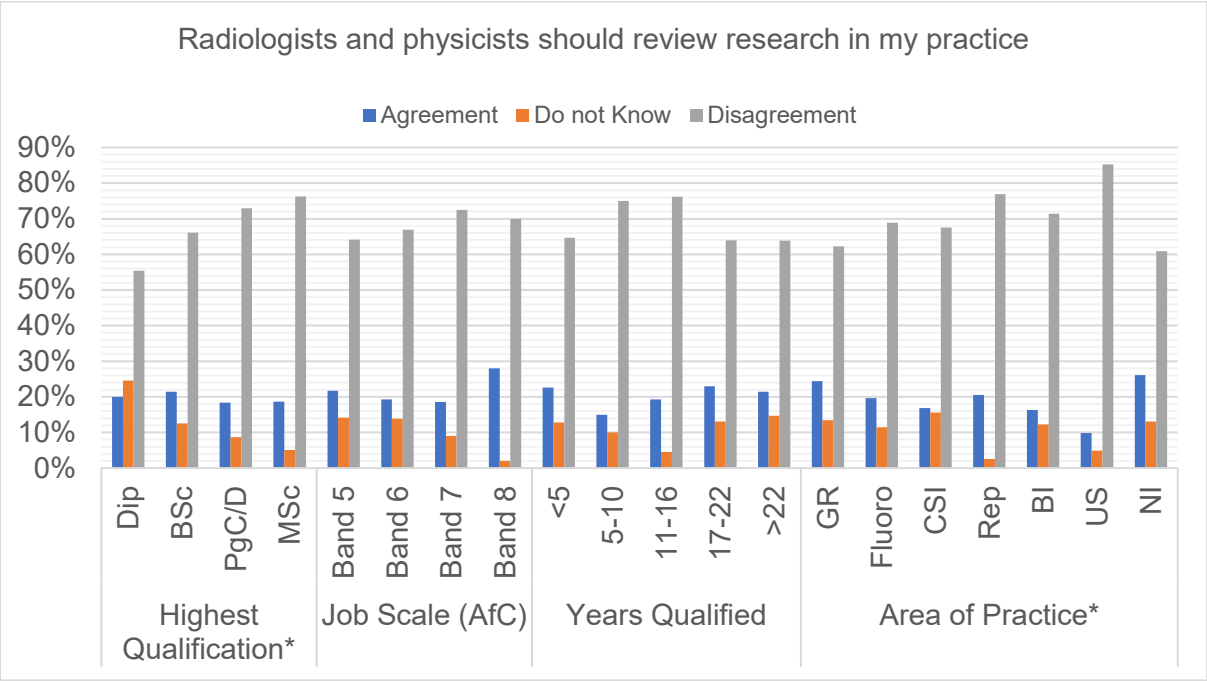


The graph above shows that the majority of respondents in all the categories were in disagreement that research was not in their scope of practice. For the highest qualification category, the level of disagreement increased with increased highest qualification.

Apart from those with >22 years of qualification, the level of disagreement with the statement increased with more years of experience. The reverse was also true for the statement.

MWUT showed there were statistically significant differences between general radiography and reporting (p=0.021) and fluoroscopy and reporting (p=0.033) regarding the level of agreement with the statement.

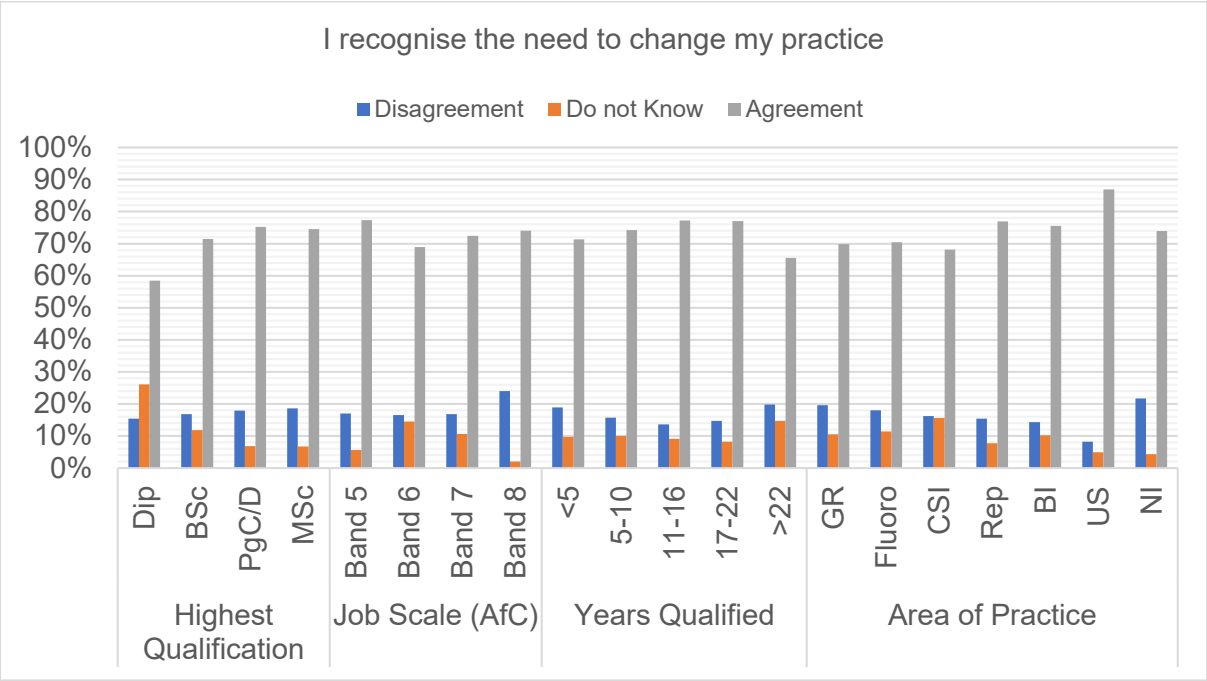
Figure 4.18 Who must review research articles?



The graph above shows no established relationship between respondents who felt research must be reviewed by radiologists or physicists across all the categories.

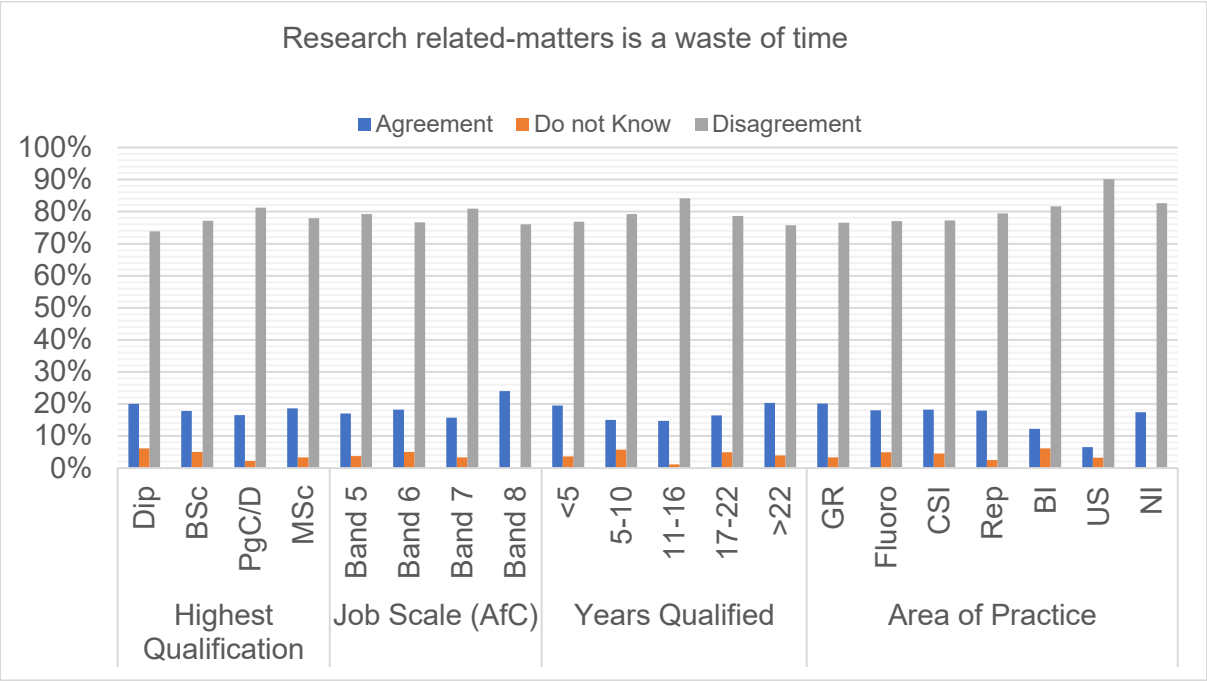
The majority of respondents in all the categories were in disagreement with this statement. For the highest qualification, the level of disagreement increased with the level of qualification.

Figure 4.19: Recognising the need to change practice



The majority of the respondents across all the categories in Figure 4.19 felt they could recognise the need to change practice to commensurate with research findings. In the job scale category, most of them were Band 5 (n=82, 77.4%).

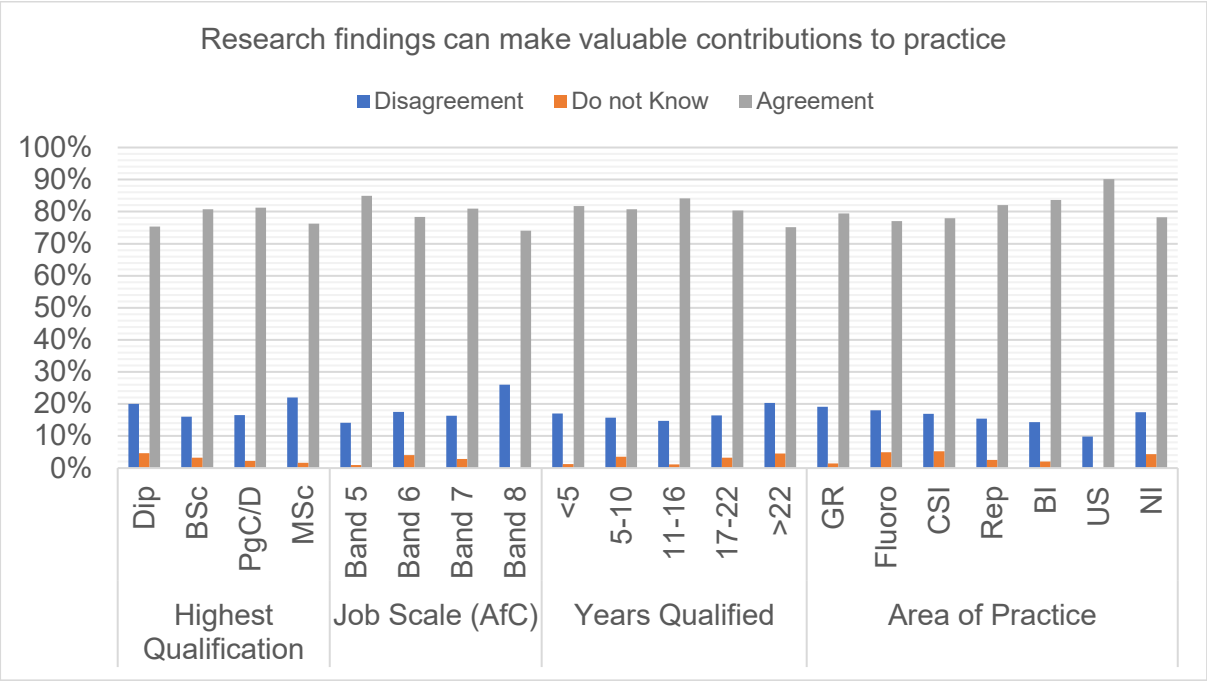
Figure 4.20: Research is a waste of time



The majority of respondents across all the categories were in disagreement that research-related matters were a waste of time. Nevertheless, a few felt it was a waste of time of which there were more Band 8 radiographers (n=12, 24.0%) sharing this opinion. There were statistically significant differences between Diploma and BSc (p=0.001), and Diploma and MSc (p=0.006).

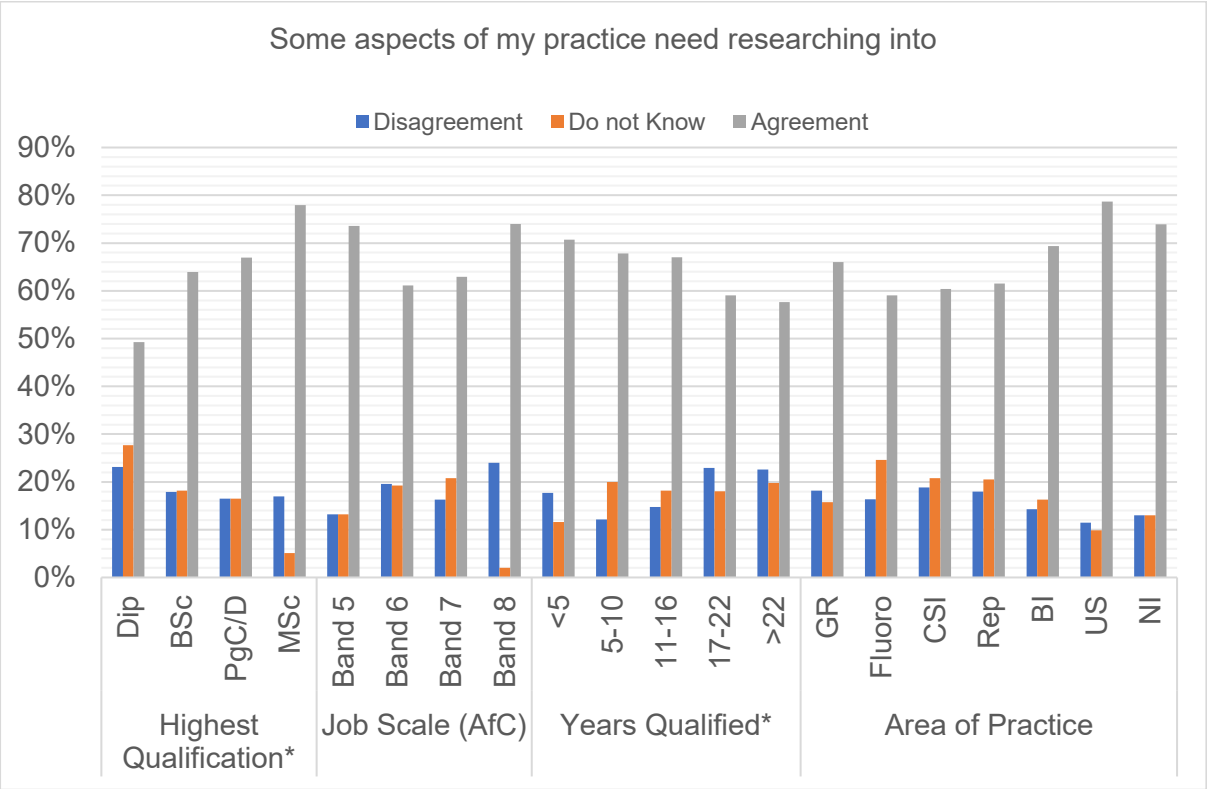
In the area of practice category, at the following *p values,* 0.017, 0.027 and 0.047 there were statistically significant differences between general radiography and sonography, fluoroscopy and sonography, as well as cross-sectional imaging and sonography respectively (Appendix VI).

Figure 4.21: Research can make a valuable contribution to practice



More than 74% in all the categories felt research could make valuable contributions to practice. Within the area of practice category, those respondents in sonography (n=55, 90.0%) were more likely to agree 90(84.9%). The Band 5 respondents also agreed more than those with Band 8 (n=37, 74.0%).

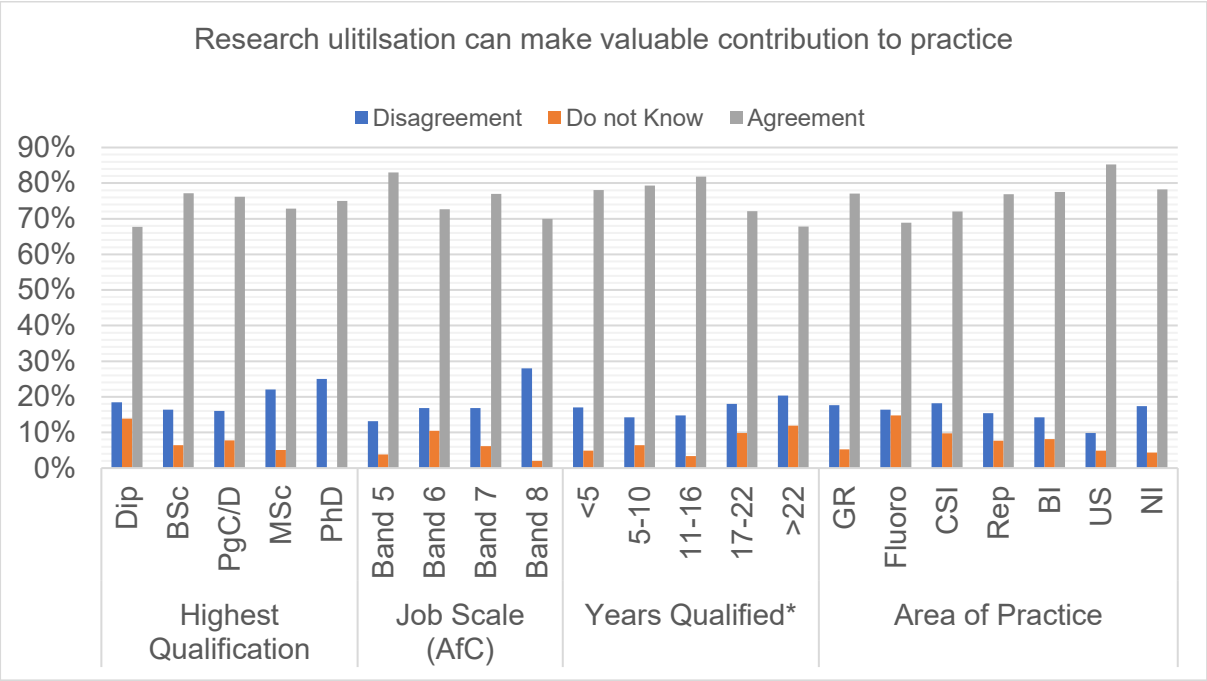
Figure 4.22: Some areas in my practice need researching



The figure above shows that there appeared to be a relationship between the highest qualification and those who felt there were areas in their practice that needed to be researched. There were statistically significant differences in relation to BSc, PgC/D and MSc at $p<0.05$.

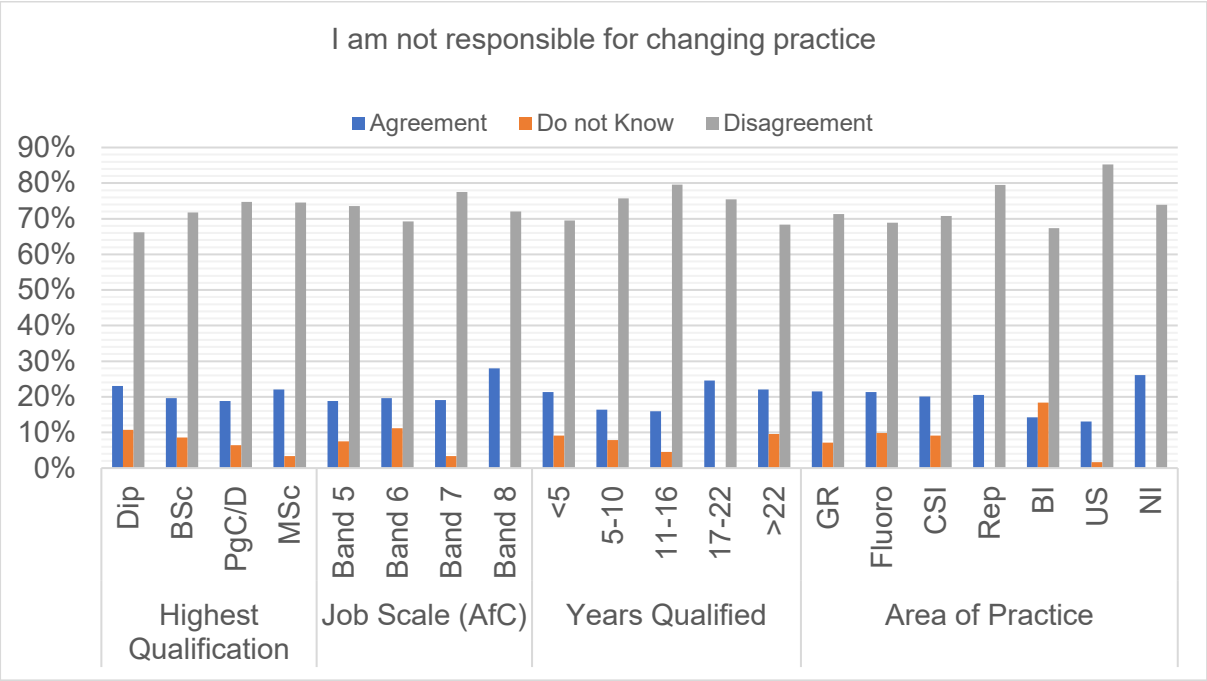
In the job scale category, most respondents with Band 8 (n=37, 74.0%) and Band 5 (n=78, 73.6%) were in agreement with the statement. With respect to the years of qualification category, the level of agreement decreased as years of qualification increased. MWUT showed there were statistically significant differences between <5 and >22, as well as 5-10 and 17-22 years of qualification at $p<0.05$.

Figure 4.23: Research utilisation improves quality of care



More Band 5 respondents 88(83.0%) agreed with the statement that research utilisation improves practice than the remaining bands. When compared to Band 6 (n=215, 72.7%), this was statistically significant at $p<0.05$. There was less agreement for Diploma holders (n=44, 67.7%) and was, at the same time, statistically significant in relation to BSc, PgC/D and MSc at $p<0.05$. Surprisingly, respondents working in research 2(50.0%) were also less likely to agree in the area of practice category. MWUT showed statistically significant differences between cross-sectional imaging and sonography, as well as cross-sectional imaging and general radiography ($p<0.05$).

Figure 4.24: Not responsible for changing practice



The majority of respondents in all the categories as shown in the figure above indicates a higher level of disagreement regarding the statement 'I am not responsible for changing practice.' In the job scale category, there were more Band 8 respondents (n=14, 28.0%) who were of the view that changing practice was not their responsibility. There was less agreement with this statement from sonography (n=8, 13.1%) in the area of practice category.

4.6 Commonly identified perceived barriers

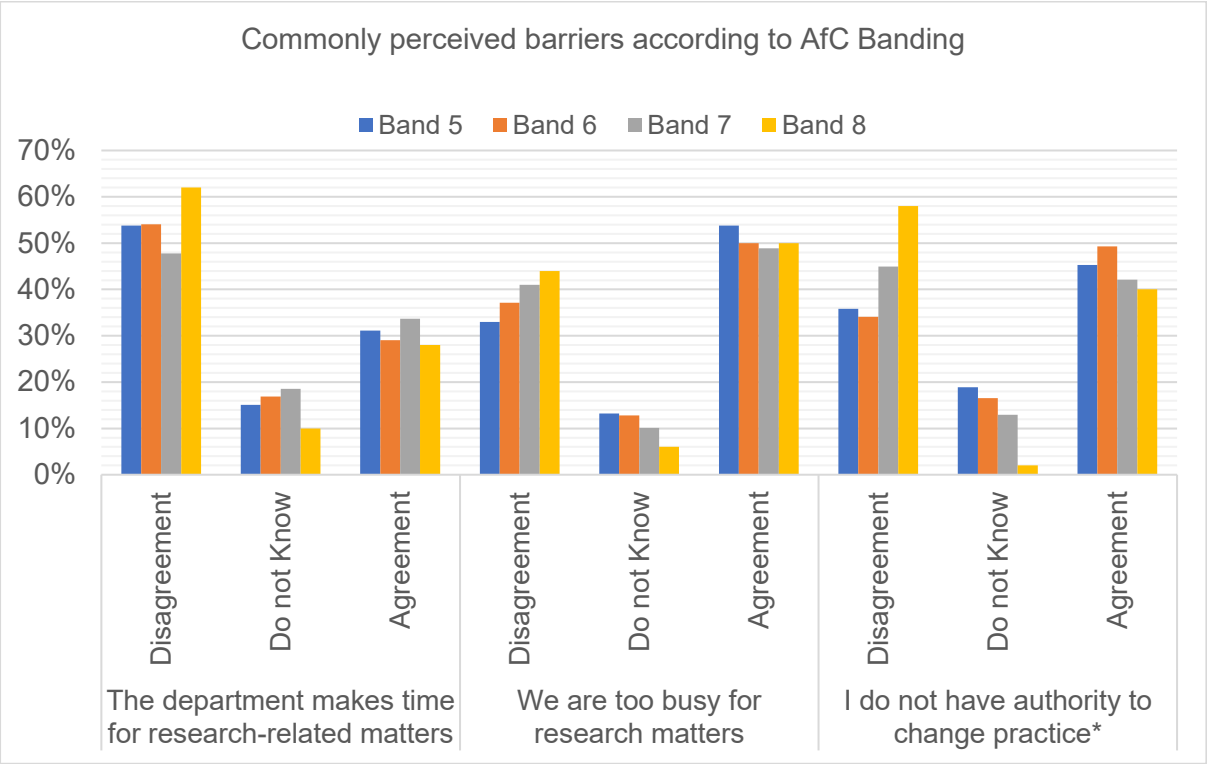
The commonly perceived barriers were decided by selecting responses that had forty per cent or more agreement of disagreement with the statements.

Table 4.13: Commonly perceived barriers

Commonly perceived barriers	Radiographers citing as top barrier n(%)
Department did not make time for research-related activities	437(69.4)
Developing research questions	355(56.3)
Uncertain believing in research findings	336(53.3)
Finding relevant literature is not easy	320(50.8)
Workload	317(50.3)
Interpreting statistics	311(49.4)
Lacking the authority to change practice	289(45.9)

The most commonly perceived barriers to RU amongst respondents showed the majority of radiographers felt their departments were not making time for research-related activities.

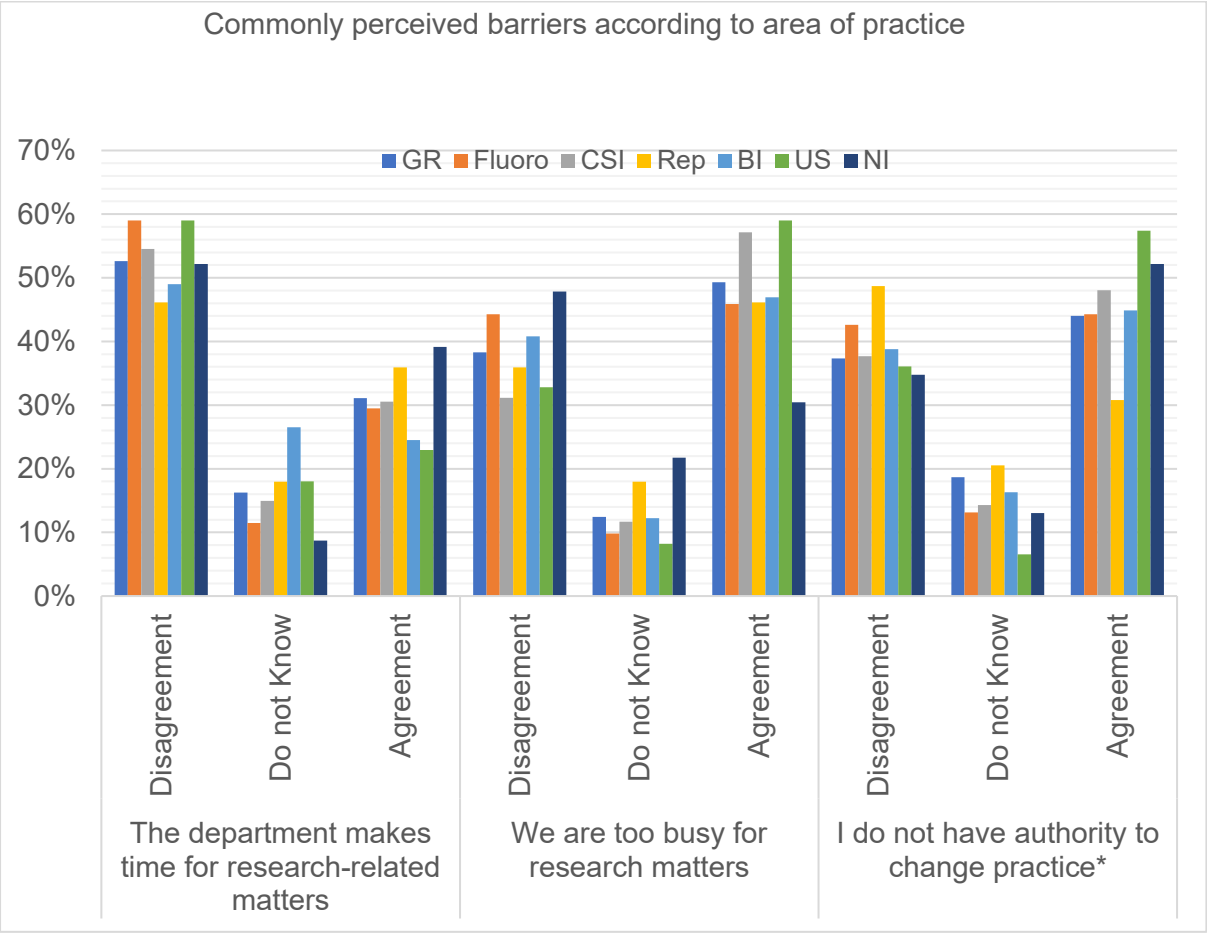
Figure 4.25 Commonly perceived barriers according to AfC Banding



denotes chi-square statistics significant at the 0.05 level

The graph above shows that the majority of radiographers were of the view that the department did not make time for research matters. Most importantly, Band 8 radiographers shared this view the most. It also emerged that Band 8 radiographers were more likely to agree that the department was too busy for research matters. There was a statistically significant difference $p<0.05$ for job scale with regards to lacking the authority to changing practice as the level of agreement decreased with seniority.

Figure 4.26: Commonly perceived barriers in the area of practice category



denotes chi-square statistics significant at the 0.05 level

The graph above shows that approximately half of the respondents in the area of practice category disagreed that their department made time for research matters. Those in fluoroscopy and ultrasound agreed more. With regards to being too busy for research matters, those in cross-sectional imaging and ultrasound were more likely to agree than their colleagues. Radiographers in ultrasound, nuclear imaging and cross-sectional imaging were more likely to hold the view that they did not have the authority to change practice – this was statistically significant at $p<0.05$. Although the majority of respondents agreed that they were too busy for research-related matters, those in cross-sectional imaging and ultrasound agreed more.

4.7 Correlational analysis

The table below presents a correlational analysis of eight variables using Spearman's rho technique.

Table 4.14: Spearman's rho correlations for demographic characteristics, perceived knowledge of research skills and attitude to research utilisation

	1)	2)	3)	4)	5)	6)	7)	8)
1) Highest qualification	1.000							
2) Gender	-0.013	1.000						
3) Age range	0.109**	-0.008	1.000					
4) Job scale	0.450**	-0.011	0.395**	1.000				
5) Area of practice	0.416**	-0.052	0.252**	0.568**	1.000			
6) Years qualified	0.208**	-0.079*	0.792**	0.569**	0.362**	1.000		
7) Knowledge of research skills	0.071	0.152**	-0.023	-0.005	-0.041	-0.051	1.000	
8) Attitude to research utilisation	0.180**	0.045	-0.078	0.027	0.076	-0.105**	0.416**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There was a very weak positive correlation between the highest educational qualification and knowledge of research skills at 0.071. A negative correlation existed between knowledge of research skills and job scale as well as the area of practice. The correlation between the highest level of educational qualification and attitude to research utilisation was positive but weak. However, there was a positive moderate relationship between knowledge of research skills and attitude to research utilisation.

Table 4.15: Spearman's rho correlations for demographic characteristics and commonly perceived barriers

	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
1) Highest qualification	1									
2) Years qualified	0.208**	1								
3) Job scale	0.450**	0.569**	1							
4) Area of practice	0.416**	0.362**	0.568**	1						
5) The department makes time for research-related activities	-0.061	-0.016	0.015	0.017	1					
6) I can develop my own research questions	0.082*	-0.030	0.014	-0.034	.101*	1				
7) Relevant literature is not easy to find	-0.027	0.052	0.003	-0.055	-0.028	-.172**	1			
8) We are too busy for research-related activities	0.002	-0.082*	-0.045	-0.014	-0.373**	-0.083*	0.115**	1		
9) I can interpret statistics	-0.009	-0.061	-0.069	-0.097*	-0.023	0.330**	-0.119**	-0.052	1	
10) I do not have the authority to change practice	-0.014	-0.025	-0.088*	0.007	-0.254**	-0.141**	0.118**	0.275**	-0.114**	1

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 4.15 shows there were no strong associations between the selected demographic characteristics and the commonly perceived barriers. Where associations existed, they were either negatively weakly associations or positively weakly associations.

4.8 Ordinal regression analysis

This section analyses the relationship between dependent variables and the three subscales for the BARRIERS Scale.

Table 4.16: Ordinal regression analysis for barriers in the organisational settings

Variables	Coefficient	Std. Error	β	p-value	Lower CI*	Upper CI*
Age range	0.011	0.101	0.011	0.916	-0.186	0.208
Highest qualification	0.101	0.096	1.101	0.294	-0.087	0.288
Job scale	-0.177	0.124	2.035	0.154	-0.421	0.066
Years qualified	-0.010	0.081	0.016	0.898	-0.170	0.149
General Radiography	-0.120	0.361	0.111	0.739	-0.827	0.587
Fluoroscopy	-0.519	0.392	1.748	0.186	-1.288	0.25
Cross-sectional Imaging	-0.037	0.354	0.011	0.916	-0.730	0.656
Breast Imaging	-0.829	0.432	3.680	0.055	-1.675	0.018
Reporting	-0.524	0.408	1.653	0.199	-1.323	0.275
Sonography	-0.073	0.400	0.033	0.856	-0.856	0.711
Others	Reference					

Note: * denotes Confidence Interval (CI) is set at 95%; Logit analysis: Nagelkerke R2=0.027;
Model-fitting: -2log likelihood 2888.589; x^2 =17.162, p>0.05
Goodness-of-fit: Pearson x^2=7637.98, p<0.05; Deviance x^2=2238.658, p>0.05

The ordinal regression table above shows that there was a weaker positive relationship between barriers between organisational settings and both age ranges (0.011) and highest qualification (0.101). At a significant level of p>0.05 for both independent variables, the observed effects were due to chance.

Table 4.17: Ordinal regression analysis for knowledge of research skills

Variables	Coefficient	Std. Error	β	p-value	Lower CI*	Upper CI*
Female	-0.686	0.174	15.651	0.000	-1.027	-0.346
Male	Reference					
Age range	0.062	0.101	0.382	0.537	-0.135	0.260
Highest qualification	0.198	0.096	4.222	0.040	0.009	0.387
Job scale	0.018	0.125	0.022	0.882	-0.226	0.263
Years qualified	-0.086	0.082	1.097	0.295	-0.246	0.075
General Radiography	0.721	0.362	3.956	0.047	0.010	1.431
Fluoroscopy	0.796	0.394	4.083	0.043	0.024	1.568
Cross-sectional Imaging	0.399	0.355	1.266	0.260	-0.296	1.094
Breast Imaging	0.758	0.433	3.065	0.080	-0.090	1.606
Reporting	0.561	0.409	1.883	0.170	-0.240	1.361
Sonography	0.460	0.401	1.316	0.251	-0.326	1.247
Others	Reference					

Note: * denotes Confidence Interval (CI) is set at 95%. Logit analysis: Nagelkerke R2=0.023.
Model fitting: -2log likelihood:2325.961, x^2=14.396, p>0.05
Goodness-of-fit: Pearson x^2=6917.433, p<0.05; Deviance x^2=2110.551, p>0.05

Table 4.17 shows a positive relationship between the area of practice and the outcome however; only general radiography and fluoroscopy had some effect with p<0.05. This means the observed effect of general radiography and fluoroscopy were not due to chance. They also had stronger positive coefficients, 0.721 and 0.796 respectively suggesting they contributed to an increasing probability of knowledge of research skills. The higher degree of overlap in the confidence interval (0.010-1.431 for the former and 0.024-1.568 for the latter) suggest they are equal in their effect. The highest education qualification category was also associated with a higher probability of knowledge of research skills.

Table 4.18: Ordinal regression analysis for attitude to research utilisation

Variables	Coefficient	Std. Error	β	p-value	Lower CI*	Upper CI*
Female	-0.123	0.171	0.513	0.474	-0.458	0.213
Male	Reference					
Age range	0.051	0.101	0.250	0.617	-0.148	0.249
Highest qualification	0.345	0.097	12.776	0.000	0.156	0.534
Job scale	-0.045	0.124	0.133	0.716	-0.289	0.199
Years qualified	-0.188	0.082	5.169	0.023	-0.349	-0.026
General Radiography	-0.057	0.361	0.025	0.875	-0.764	0.650
Fluoroscopy	0.120	0.392	0.094	0.759	-0.648	0.888
Cross-sectional Imaging	-0.087	0.354	0.061	0.805	-0.780	0.606
Breast Imaging	0.639	0.432	2.192	0.139	-0.207	1.486
Reporting	0.089	0.409	0.047	0.828	-0.713	0.890
Sonography	0.609	0.401	2.309	0.129	-0.177	1.395
Others	Reference					

Note: * denotes Confidence Interval (CI) is set at 95%. Logit analysis: Nagelkerke R2=0.047.
Model fitting: -2log likelihood: 2477.472, Chi-square=29.860, $p<0.05$
Goodness-of-fit: Pearson $x^2=10565.985$, $p>0.05$; Deviance $x^2=2715.681$, $p>0.05$

Table 4.18 shows the highest qualification had a positive relationship with attitude to research utilisation at a coefficient of 0.345. Even though the relationship was moderate, the significance of the test was less than 0.05 suggesting its observed effect was not due to chance. The test also shows that the number of years qualified was statistically significant but its relationship with attitude to research utilisation was weak. No single category in the area of practice was statistically significant to the model, although sonography had a greater probability of being in one of the higher cumulative outcome categories.

CHAPTER FIVE
Discussion

5.0 Overview

This chapter discusses findings emerging from the data analysis. The study sought to find out perceived barriers to research utilisation amongst diagnostic radiographers in the UK.

The response rate for this study was excellent, yet unexpected. The power of the study's effect size was 380. Out of the 1,020 prospective participants that received the web-based questionnaire, 740 attempted to answer the questions but 630 completed them. Arguably, the response rate is an indication of radiographers' interest in the topic or the method of data collection proved effective in this case. Nonetheless, a response bias may have been introduced as those who did not respond may have shared different views on the topics investigated.

Rogers' (2003) theory of diffusion of innovation was used as a conceptual framework to offer explanations to the results obtained. Rogers (2003) emphasised that the adopter (practitioner), the social system and communication channels were three very important components in diffusing new practice or ideas in an organisation.

Important findings emerging from the study are presented in Section 5.1. Section 5.2 briefly presents the seven commonly perceived barriers to research utilisation amongst diagnostic radiographers in the UK. Section 5.3 deals with issues relating to the radiographer as an adopter. This section will also examine the capacity of radiographers in terms of persuasion, decision making and implementation of a new practice. Section 5.4 will discuss how the social system impacts on the diffusion of new practice emphasising time for management, support and workplace culture

bearing in mind the issues of professional dominance and lack of authority. Section 5.5 attempts to throw more light on issues surrounding communication of innovation amongst diagnostic radiographers in the UK.

Lastly, this chapter re-examines the BARRIERS Scale that was used in soliciting for data in this study.

5.1 Important findings from the study

The following emerged as important findings from the study:

- Radiographers showed a positive attitude to research utilisation.
- There were seven main perceived barriers to research utilisation.
- There was no statistically significant difference in perceived knowledge of research skills amongst radiographers in the highest qualification, the area of practice, and job scale subgroups.
- A positive, but poor correlation was found between the highest educational qualification and perceived knowledge of research skills.
- A positive, but poor relationship was found between the highest educational qualification and attitude to research utilisation.
- A positive, but poor relationship was found between the area of practice and attitude to research utilisation.
- The majority of Band 7 and 8 radiographers who were innovation-decision makers had a postgraduate certificate or Diploma as the highest educational qualification.
- Highest education qualification was also associated with a higher probability of knowledge of research skills and attitude to research utilisation.

5.2 Commonly perceived barriers amongst radiographers

Healthcare professionals may have barriers that hinder research utilisation, but these barriers differ in terms of geography and profession (Kajermo et al., 2010; Williams et al., 2015). In this study, the seven commonly perceived barriers found were:

1) the department did not make time for research-related activities
2) developing research questions
3) uncertain believing in research findings
4) finding relevant literature
5) workload
6) interpreting statistics
7) lacking the authority to change practice

In contrast to a systematic review by Kajermo et al. (2010) which found most of the top identified barriers to be amongst the factors in the organisational settings, four of the seven in this study were practitioner-related. Nonetheless, the findings from this study corroborate those of previous studies which found time-related factors to be the greatest perceived barriers that healthcare professionals faced (Brown et al., 2010; Brown et al., 2010; Chien, 2010; Kocaman et al., 2010; Lyons et al., 2011; Tan et al., 2012). In the 30 EBP and RU studies reviewed, 13 of them cited lack of time as amongst the greatest perceived barriers. This was agreed or strongly agreed by all grades of radiographers in this study. The majority of radiographers in the job scale category were also in agreement. This barrier appears to transcend diverse professions, but it was a different concept by the authors. For example, Kocaman et al. (2010) reported this barrier under workload whereas Lyons et al. (2011) categorised it as insufficient. On the other hand, time as a barrier was broadly categorised under constraints by Scurlock Evans et al. (2014).

The other commonly perceived barriers relating to knowledge of research skills were that radiographers lacked important research skills. The majority disagreed or strongly agreed that they could develop research questions, had uncertainty whether to believe in research findings, find relevant literature, and interpret statistics. These barriers could not be readily attributed to any particular subgroup because the differences in the agreement were marginal, hence no statistically significant findings.

5.3 The radiographer as an adopter

According to Rogers (2003), a new practice is not adopted by all individuals in a social system at the same time. This is simply put as the innovativeness (the degree to which an individual is relatively earlier in adopting new practice than other members of a unit). In a social system, such as the diagnostic radiology department, there are certain influencing factors which can arise from the individual or top-level in the organisation (Greenhalgh, 2014; NICE, 2007; Rogers, 2003). The question of who adopts new knowledge or practice suffices as the primary influencing factor in conjunction with several other factors such as their knowledge or awareness of new practice, persuasions, decision making and implementation of a new practice.

Diagnostic radiographers perform examinations using predetermined protocols. As such, there is uniformity in their practice. For example, the kind of clinical condition that justifies a head computerised tomography (CT) scan and the technique required to obtain a desirable scan. For that matter, one radiographer cannot produce a head scan any better than the other if patient conditions, such as mobilisation, remain the same, although this may not hold true for other modalities such as sonography and general radiography which are operator-dependent in image acquisition. The bottom line is that diagnostic radiography is largely protocol driven. The lead radiographer or

radiologist determines what protocol or image sequences are required of individual anatomical parts. These individuals, who make innovation-decisions in a social system, are critical to the adoption process. In a typical diagnostic radiology department, innovation-decision makers would primarily be Band 7 and Band 8 radiographers who practice at advanced and consultant levels. According to Health Education England [HEE] (2017), advanced clinical practitioners are healthcare professionals who have acquired certain skills and knowledge so that they can take on expanded roles and scope of practice. These professionals should have been educated to an MSc level (HEE, 2017). So, it is important to ask the question, 'If protocols are to be evidence-driven then what is the situation regarding knowledge of research skills of radiographers?'

5.3.1 Radiographers' knowledge of research skills

These research strategies by the SCoR (2005; 2010; 2015) included lack of research skills as a fundamental barrier to research utilisation. There were some encouraging findings from this study regarding perceived knowledge of research skills amongst radiographers as 416(66%) of respondents felt they could perform a critical appraisal, see the implications of research findings 377(59.8%) and judge the quality of a research article 367(58.3%). However, four of the seven greatest perceived barriers in this study were found in the research skills scale. There were no significant differences between the subgroups although logistic regression analysis showed that perceived knowledge of research skills was influenced by educational qualification ($p<0.05$, CI=0.009–0.387; Table 4.17). Research utilisation begins with the recognition of a problem (a way of practice) and arriving at a solution (a new way of practice). Research skills is, therefore, an important aspect of the research utilisation process.

Although emphasis is placed on Band 7 and 8 radiographers, those with 5 and 6 have somewhat equal responsibilities.

For instance, obtaining a true projection in general radiography is practitioner-dependant. Snaith (2016) raised the issue of why radiographers continue to obtain a lateral wrist view by flexing the elbow (which most often does not result in a true lateral view) rather than extending the elbow. Regarding the former technique, it can be argued that assuming certain radiographers find it not just convenient to them but can confidently obtain a true lateral view nonetheless, then there is no problem. However, if it requires more repeats than the latter technique (elbow extension) then it becomes apparent that certain factors hinder the use of substantiated evidence in clinical practice. Clearly, this conundrum, however, cannot be a problem with advanced practice initiatives alone. Rather, it is a matter of individuality and how they improve their practice i.e. obtaining a true lateral view. If the practitioner has not become aware of the technique, they invariably cannot perform their routine using this particular technique. It has been argued that (Rogers, 2003) an individual becomes aware of innovation by accident (passively) and that it cannot be sought after until one knows that it exists. On the other hand, others have argued that awareness of innovation is not simply a passive activity (Rogers 2003). It is believed that an individual's predisposition to ideas is influenced by their interests, needs or existing attitudes. This implies that, if the practitioner does not see the need to improve on her lateral wrist projection even though all evidence points to the fact that more attempts are needed to obtain the desired image, then he or she would not seek for the information. Where the opposite is true then the individual can proceed to search for the knowledge by doing a literal search such as "how to obtain a true lateral wrist projection?" for example.

In this study, radiographers appeared to lack some basic research skills such as developing research questions, finding relevant literature and interpreting statistics. Awareness and knowledge of new practices are critical to delivering healthcare that is evidence-based. However, the available evidence suggests that healthcare professionals are usually not aware of new knowledge of their practice (NICE, 2007). As mentioned earlier, there are at least two ways by which a practitioner becomes aware of new knowledge of his or her practice (Rogers, 2003); actively searching the healthcare literature or through an introduction from a colleague or network who has prior knowledge. The first step in RU is recognising a problem or need to discover or verify information for use and develop activities towards a new way of practice (NICE, 2007; Rogers, 2003).

(i) Radiographers' capability of developing research questions

Actively searching involves developing specific research problems into explicit questions and then searching the enormous healthcare literature for their availability. Therefore, the practitioner must be able to develop their own research questions. Radiographers in this study perceived themselves to have sufficient knowledge of research skills (n=275; 43.7%) when compared with the findings by Weng et al. (2013). Weng et al. (2013) found that out of the 5,038 healthcare professionals only 28.7% had sufficient knowledge of research skills. It was encouraging to find that, 73(41%) of the Band 7 and 29(58%) of the Band 8 radiographers perceived themselves capable of developing research questions. It is worth noting that the majority of Band 7 and 8 radiographers with more than 22 years of working experience had PgC/D as the highest educational qualification (Table 4.6). This suggests the probable first educational qualification was most likely Diploma as radiography became all graduate entry in 1993 (Pratt & Adams, 2003).

While it is expected of radiographers who qualified from a higher education programme to possess basic research skills, less than half of the radiographers with BSc as their highest qualification felt they had such skills. Most surprisingly, not all of the doctorate degree holders and research radiographers felt they could do so either. The finding regarding doctorate holders and research radiographers requires some caution during interpretation. First, the number of respondents is too small (Table 4.2) to make generalisaiton, as only 8(1.3%) had a doctorate degree and 4(0.6%) were research radiographers. Second, because the learning process can sometimes be more difficult than one thought, self-awareness is important for any learning. It may be that these respondents may have reflected on their competence after venturing into the research process. As a result, they became consciously-incompetent[13] in terms of how much they knew (Jackson, 2018) about the research process. In the same vein, one can argue that there are those respondents who may perceive themselves capable of performing this task but, in reality, may not, because they are not self-aware of their ability or inability to perform this task. Nevertheless, this finding reflects an earlier study that reported research radiographers can lack basic research skills (Russell et al., 2007) such as developing research questions. The role of the diagnostic research radiographer seems to be underestimated in most radiology departments due to either their scarcity (Price et al., 2009) or lack of knowledge of their benefits on the part of service managers. Reid and Edwards (2011) have

[13] There are four stages of learning as formalised by Noel Birch, popularised by Abraham Maslow (Jackson, 2018). First stage is *unconscious incompetence* - the individual is not aware of their inability at what they are trying to do and frankly believes they are good at it. The second stage is *conscious incompetence* - the individual at this stage has become aware of their incompetence perhaps after realising there is much more than what they initially thought of the task and that they do not really know what they thought they knew. *Conscious competence* is where the individual knows how to perform the task and even dedicates more time at perfecting it. The last stage is *unconscious competence*. Here, the individual has gone past the first three stages and does not even have to make an effort to do the task because it comes naturally to them.

documented the significant impact their roles as diagnostic research radiographers have played in their hospital by developing and regulating imaging protocols and promoting research activity amongst radiographers.

(ii) Radiographers' capability in finding relevant literature

More than half of the respondents (n=320; 50.8%) expressed their perceived difficulty in finding relevant literature which is an expression of a lack of skills in searching the literature. This finding offers some explanation for the seemingly lack of perceived capability in developing research questions. If clear research questions are not developed to formulate precise search terms, then, finding relevant literature will inextricably become an overwhelming task owing to the high number of publications within the healthcare literature. The rate of publications in the *Radiography* journal, for example, has seen a steady increase from 113 in 2013 to 240 in 2018 (Scopus Preview, n.d.) - it does make searching the literature very difficult if it is not done systematically. The overwhelming nature of healthcare literature as a barrier to RU has been reported elsewhere in nursing studies (Cline et al., 2017; Sari et al., 2012; Uysal et al., 2010). In comparison, radiographers in this study reported less difficulty in finding the relevant literature. Cline et al. (2017) reported 91.5% of 337 nursing respondents had difficulty in searching the healthcare literature for evidence in practice. In the other study, Sari et al. (2010) also reported 63.6% of 718 nurses had the same difficulty. Surprisingly, Band 7 and 8 radiographers (innovation-decision makers) in this study reported nearly the same level of difficulty in finding the relevant literature as those with Band 5 and 6. This could be explained by the fact the first pre-professional and postgraduate education of Band 7 and 8 respondents did not necessarily include research as a programme requirement. It can be argued that Band 5 respondents had recently done a dissertation towards their degree hence the

confidence whereas, the Band 7 or 8 (or the research radiographer especially) may understand the complexities of constructing a research question hence, the lack of confidence.

(iii) Radiographers' capability in performing critical appraisal

Burls (2009, p1) defines critical appraisal as:

> *"the process of carefully and systematically examining research to judge its trustworthiness, and its value and relevance in a particular context."*

Critical appraisal skills, as a barrier to RU, have not been typically reported in the related literature. The majority of radiographers in this study perceived themselves to be capable of performing critical appraisal (n=416, 66%). Since radiography has been a degree course for nearly three decades in the UK, this result is unsurprising because basic research skills, such as critical appraisal, are integrated into the curriculum. This finding shows good prospects for RU within the radiology department as the findings indicate only 56(10.3%) held a Diploma as the highest qualification with the majority having more than 22 years of post-qualification experience. It, therefore (in principle), presupposes that the profession in the near future will have every radiographer who would have been through a degree course thereby possessing basic research skills.

(iv) Radiographers' understanding of research implications

There is some indication that respondents perceived themselves capable of performing a critical appraisal, however, more than half of the respondents 336(53.3%) were uncertain whether to believe in research findings. At the same time, 367(58.3%) of the respondents perceived themselves capable of judging the quality and seeing the implications of research findings. The essence of critical appraisal, as argued by Greenhalgh (2014), is to be able to determine which research papers are not

trustworthy because of major weakness in the methodology, or when the results should be used cautiously due to a less robust methodology. Arguably, one reason why doubt is cast upon research findings is the confidence in one's ability to appraise the literature thoroughly; the other reason is that, when practitioners use unsystematic search procedures (Greenhalgh, 2014), there is the tendency to have doubts about the findings because of not knowing the trustworthiness of the sources. In short, research findings can be quite equivocal to the user if they are not confident in their ability to evaluate the entire study.

(v) Radiographers' capability in interpreting statistics

Another perceived barrier to RU in this study was a lack of statistical knowledge as expressed by half of the respondents. Fewer studies have mentioned this as a barrier (Chen et al., 2013; Kajermo et al., 2010; Lyons et al., 2011; Tan et al., 2012). The findings thus reflect the demographic characteristics of the majority of those who held BSc. However, in real-world research (especially in peer-reviewed journals) complex inferential studies are often used to elaborate findings. To both the numerate and the innumerate practitioner, statistical tests and equations in quantitative studies can be daunting to appreciate (Greenhalgh, 2014). Short courses on how to appreciate descriptive and inferential statistics could be introduced to practitioners. Journal clubs could be a good platform for this initiative. More importantly, authors have a tremendous role in ensuring that their work is understood by those who are not technically astute in statistics by simplifying and explaining their data.

5.3.2 Persuasions: Radiographers' attitude to research utilisation

Persuasion is the stage in the diffusion of knowledge process where the individual practitioner forms a favourable or unfavourable attitude towards new idea(s) (Rogers,

2003). The value of health research to human life is appreciated by most of the population in the UK (Charities Aid Foundation, 2017). It can, therefore, be argued that it should be more appreciated by health professionals who are expected to utilise it for improved outcomes for their patients. It takes a change agent to persuade practitioners to adopt a new practice. In his book, the *Wisdom of Crowds*, Surowiecki (2004, p187) argued that in small groups (like the radiology department) "ideas often do not succeed simply on their merits… [Although] its [importance] may seem self-evident, an idea needs a champion in order to be adopted by the group as a whole."

In most radiographic practices this form of change takes place through the adoption of new examination protocols from research evidence. As discussed in Section 5.3, individuals become aware of innovation either by accident (passive) or through their needs or interests actively searches for it. Change agents become the source of awareness of new innovations for those in the former category.

Overall, the respondents showed a positive attitude to research utilisation. This finding is consistent with other studies which have examined knowledge and attitude to research utilisation (Brown et al., 2009; Elliott et al., 2009; Lyons et al., 2011; Moreno-Casbas et al., 2011; Scurlock-Evans et al., 2014). It emerged in this study that attitude to research utilisation was moderately associated with knowledge of research skills (x^2=0.416), whereas regression analysis showed attitude to research utilisation was influenced by educational qualification (p= 0.000; CI=0.156-0.534). The majority of radiographers viewed research as an important factor in patient care and delivery. Furthermore, the respondents agreed that research utilisation would improve and make valuable contributions to practice.

Arguably, the barriers to research utilisation in diagnostic radiography are not attitude-related but rather reflect capacity and capability because positive attitude has long been reported in radiography studies (Challen et al., 1996; Ahonen & Liikanen, 2010). While the respondents in this study showed a positive attitude to research utilisation, there were some perplexing issues. Nearly a third of the radiographers (n=198, 31.4%) felt research was not in their scope of practice. Although this question presents some level of ambiguity as respondents might have taken it to mean doing actual research rather than it encompassing research related activities. Nevertheless, this may be because these respondents were not familiar with the standards of proficiency and the code of professional conduct from the HCPC (2013) and SCoR (2013b) respectively. These standards explicitly expect radiographers to be aware of, engage with, and evaluate research evidence to ensure the quality of practice. Indirect persuasion to adopt new practices is usually done using departmental protocols. Here, the practitioner has no choice but to accept the practice because failure to do so may be viewed as incompetence leading to disciplinary action. That means the lead radiographers in the various subspecialties (whose responsibility is to update imaging protocol and standards of operational procedures) must be aware of the current research evidence. However, 40% of the Band 8 radiographers did not perceive research to be an integral aspect of their scope of practice. It is highly possible that some Band 8 radiographers are purely in managerial positions of which research would not necessarily be a part of their role. However, being in an advanced practice role as a Band 8 also means that one is expected to engage in research in one form or another (SCoR, 2013a; 2013b).

Disappointingly, 127(20.2%) of the radiographers felt that research relating to their practice needed to be reviewed by radiologists or physicists. There is a long-held view

that radiographers in clinical settings prefer to perform their duties as prescribed because of how the profession evolved. A previous study by Elliott et al. (2009), involving 218 sonographers, reported 23.8% shared this view but the current study showed an improved attitude towards research and utilisation, as sonographers were the fewest (9.9%) in the area of practice subgroup to have this opinion.

This study also found that some radiographers (20%) felt it was not their responsibility to change practice. It was even more surprising that some Band 8 respondents (n=37, 26%) held this view. While it is acknowledged that the role of some Band 8 radiographers may have become mostly managerial (rather than clinical) there is a research aspect of the role that cannot be forfeited as it is one of the key domains of the role, be it advanced clinical practice or consultancy.

More perplexing issues arose from the findings. The SCoR (2015) Research Strategy emphasised the role that doctorate holders within the clinical settings would play in terms of research and utilisation. However, some doctorate holders had the view that changing practice was not their responsibility (2 out of 8), radiologists should review research (3 out of 8), and research was not in their scope of practice (3 out of 8) or was a waste of time (2 out of 8). Although the Society of Radiographers encourages radiographers to pursue doctorate degrees there may be some radiographers who have attained their qualifications but have not been employed at a commensurate level which may explain the variance in these findings.

Having knowledge of research skills do not equate to using them, because if the environment is not conducive (as has emerged in this study with organisational barriers like workload and lack of time for research-related matters), practitioners who have knowledge of research skills might even become demotivated towards research

use (NICE, 2007). In addition, strong leadership is required to adopt new practices; nonetheless, there are some new practices that require the co-operation of top organisational management, such as funding (NICE, 2007). Rogers (2003) argued that attitude formation (whether favourable or unfavourable) is immaterial because attitude and action (utilisation) may be disparate unless there is a mechanism at the workplace that would ensure what is known is actually put to use.

Positive attitude to research utilisation is important when considering the adoption of a new practice; nonetheless, if the individual practitioner is not aware of, or has not been exposed to this new practice then it is unlikely adoption will take place. This study, therefore, emphasises that radiology departments must make time for research-related activities in which new knowledge can be shared amongst practitioners.

5.3.3 Decision making and implementation of a new practice by radiographers

Rogers (2003) has described three types of innovation-decisions. While individual practitioners might be responsible for their own practice, the decision to adopt new practice largely rests on the leadership in the various subspecialties within the radiology department and the organisation as a whole. In an ideal situation, individuals in leadership positions would want to have the authority to make certain decisions. However, the hierarchical structures in healthcare settings appear not to allow full authority because healthcare professionals continue to report perceived lack of authority as a major barrier to research utilisation (Chien, 2010; Tan & Hatah, 2017; Yava et al., 2009). In this study, 289(45.9%) felt they lacked the authority to change practice. Radiographers, nurses and other health professionals, work in an environment still dominated by doctors who have been trained to be decision makers rather than followers. It becomes difficult to persuade them to change some aspects

of practice because they feel they are losing their dominance. Although it may appear that radiographers no longer necessarily play the role of followers (but rather have become leaders in the form of advanced and consultant practitioners), doctors continue to dominate the decision-making process (Quick, 2017). While radiographers are described as autonomous practitioners, the SCoR (2013b) code of professional conduct explicitly reminds radiographers to acknowledge the limits in their competence. It is partly for this reason that radiographers will continue to perceive themselves as lacking the authority to change certain aspects of practice. It may make sense for more than 45% of the radiographers with Band 5 (n=106) and Band 6 (n=296) to report perceived lack of the authority to change practice due to their status in the hierarchy, however, it is, arguably inexcusable for more than 40% of Band 7s (n=178) and 8s (n=50) to equally perceive themselves as such. Furthermore, this study found that a staggering 54.7% (n=31) of Sonographers who were advanced clinical practitioners and ought to be making decisions on their own felt they lacked the authority to change their practice. This finding corroborates that of Elliot et al. (2009) in which they reported 45% (n=218) indicating they lacked authority to change practice. Unless radiologists still dictate the underlying protocols, there is no reason why Sonographers should report this as a barrier and makes this quite perplexing. These study findings reiterate the need for discussions amongst stakeholders within the radiology milieu about who should be responsible for image production as pointed out by Snaith (2016). Radiologists in the UK, already have essentially given away plain imaging reporting to radiographers and are concentrating on more pressing issues about patient care and treatment pathways through several avenues (Culpan, Culpan, Docherty, & Denton, 2019). Considering how much radiology has evolved, and for that matter diagnostic radiography, radiographers should have owned the art of image

production therefore not requiring a radiologist to justify radiological requests, at least not in plain imaging. This requires a qualitative study to explore the phenomenon further.

Rogers (2003) argued that, within the social system, hierarchical positions exist for the reason that individuals on a higher job scale can implement new ideas for those beneath them to follow (*authority innovation-decisions*). Diagnostic radiology thrives on technological advancement, but these technologies come at a huge cost and certain innovations within the profession are based on new devices. It is therefore pertinent to consider how authority innovation-decisions affect the adoption of a new practice. For instance, several studies have shown that the use of weight-based iodinated contrast medium for patients undergoing computed tomography scans produces adequate enhancement; it is cost effective and has significant benefits to patients who are vulnerable to kidney-related complications (George, Manghat, & Hamilton, 2016; Lamby et al., 2017; Perrin et al., 2018; Takahashi et al., 2018). If a Band 5 or 6 radiographer became aware of this innovation, that individual cannot single-handedly apply it in practice because it requires certain managerial decisions to be taken in purchasing of new equipment to support the practice. This new practice can only be adopted successfully if certain logistics are available such as weighing scales that are fit for purpose and a contrast injector kit that can dispense the needed amount of iodinated contrast medium at a given time while avoiding wastage. Even the lead radiographer in this subspecialty may be aware of the innovation but until management provides these logistics, the new practice cannot be adopted. This reflects the thoughts of Greenhalgh (2014) that multiple influencing factors operating at a top level in the organisation can impact hugely on RU.

5.4 The social system

According to Rogers (2003) and NICE (2007), the top and bottom level organisational structures are pertinent to the adoption of new practices. First, where necessary, those at the top-level in a social system are responsible for providing logistic support to implement new ideas. Second, those at the bottom of the hierarchy may be the first to become aware of new knowledge and may, therefore, ask for logistics support in order to utilise this knowledge.

5.4.1 Making time for research-related activities

This study has shown that radiographers appeared too busy attending to patients (n=317, 50.3%) and had little or no time for research matters with half of the respondents agreeing or strongly agreeing (n=473, 69.4%). This was similar to findings from many other studies (Chien et al., 2013; Cline et al., 2017; Kajermo et al., 2008; Kajermo et al., 2010; Kocaman et al., 2010; Lyons et al., 2011; Mehrdad et al., 2008; Sari et al., 2012; Scurlock-Evans et al., 2014; Walker et al., 2014; Williams et al., 2015).

Rogers' (2003) theory of innovation makes us understand the importance of the structures within the social system in terms of the role they play in the diffusion, and adoption or abandonment, of a new practice. According to Rogers (2003), there is an enormous responsibility for practitioners in respected positions to use their status or authority to positively influence the diffusion process because they make or initiate particular changes in practice. Yet, it is interesting to note that 25(50%) of the Band 8 and 87(48.9%) of the Band 7 radiographers also felt they were too busy for research matters. Radiology departments are one of the busiest in the acute health setup with two in every five patients undergoing some form of medical imaging (Hospital

Episodes Statistics Team & HSCIS, 2013). Moreover, EBP is time-consuming (NICE, 2007) requiring adequate staffing levels so that a sizeable number of practitioners can be allowed to attend or undertake research-related activities within the department. However, it would not be in the best interest of patient care if it were expected that practitioners used their personal time to develop and use new evidence. For some practitioners, active learning ceases after qualification and employment. They become content and would progress only as and when the opportunity arises. This is more likely to happen in an environment where there is not a culture of active learning. Since the ever-increasing demand for health services is unlikely to dwindle (NHS England, 2015, 2016, 2017), radiology service managers ought to proactively secure time for the purposes of research-related activities. At the moment, protected study time for practitioners across health services is not guaranteed. Sonographers in the study by Elliott et al. (2009) felt they needed protected study time to be able to do research activities as 137(62.9%) reported workload as a major hindrance. Protected study time is beneficial, both to the practitioner, as a means through which they maintain compliance with professional and regulatory requirements, and to the department by using the learning and skills acquired to help improve the standards of service delivery and outcomes. Crucially, the SCoR (2009) had initiated steps to procure protected study time for radiographers that will equate to 10% of hours worked. This is yet to receive support from radiology service managers across the country. As the situation stands, it is also possible that the Society of Radiographers have not done much to push for its implementation. Although, this problem is not peculiar to radiography as nurses have also expressed dissatisfaction with the lack of availability of protected study time (Blakemore, 2016).

5.4.2 Support from colleagues and workplace culture

Findings from other studies have reported lack of support from colleagues or management amongst the top five greatest barriers (Elliott et al., 2009; Gerrish et al., 2008; Hussein et al., 2016; Kajermo et al., 2008; Williams et al., 2015). In contrast, in this study, the majority were in agreement that their colleagues would support them with new ideas. Another important aspect of Rogers' (2003) theory is that communicating new ideas is often effective when it occurs between individuals who perceive themselves to be equal in a given setting, in what is termed as homophily[14] (Lazarsfeld & Merton, 1964). This was very encouraging, in that, there is the opportunity to diffuse ideas or knowledge of new practice in radiology departments by capitalising on this concept of homophily. So radiographers who are not advanced practitioners could become learning representatives for their departments in order to facilitate knowledge sharing. Kajermo et al. (2008) observed that where nurses felt unsupported by their colleagues, they relented from engaging in research-activities. One can presuppose that if one member of the team is introduced to an idea, there is a greater possibility of it being diffused within the social system. It appears the problem is more about the means by which individuals can become aware of the knowledge so that it can be facilitated.

It may be argued that a culture that is resistant to change has been developed over the years. Rogers' (2003) theory identifies such individuals as laggards to the level that they cannot be persuaded to try new innovations. Logically, these attitudes of resistance to change as a result of tradition ('this is how we have always done it') are

[14]Homophily is a concept in human communication which holds that the transfer of ideas occurs most effectively between individuals who think themselves alike. These individuals are similar in certain attributes like education, social status, beliefs, etc. The opposite, heterophily, is the degree of communication to which the individuals who are different in the aforementioned attributes.

blamed on the individual but this phenomenon can be attributed to the social system to which the individual belongs (Rogers, 2003). If the radiology department has not been in the habit of engaging the staff in research activities then such individuals are happy to do their work as it is unless they are encouraged by someone or have the motivation to change.

One way of changing this culture is ensuring that research becomes a day-to-day conversation in departmental meetings (SCoR, 2015). In so doing radiographers will become familiar with (and perhaps embrace) research utilisation as an important concept of practice. Strong leadership is therefore instrumental in ensuring that changes to practice are adopted by all staff, but unfortunately, 20(40%) of the Band 8 and 54(30.3%) of the Band 7 radiographers also had the perception of unsupportive colleagues.

This is where departmental research activities and journal clubs can be exploited as a useful platform to discuss new research evidence and how to integrate them into clinical practice. Journal club, for instance, resonates with the concept of homophily because participants might see themselves as equal to a certain degree having agreed to participate and share opinions and learn from colleagues.

5.5 Communication channels

Diffusion is a form of communication in which a new idea or practice is exchanged amongst individuals belonging to a particular unit (Rogers, 2003). There are two important components to the communication of new practice – a *source* which is the individual with the knowledge and the *channel* through which a message is communicated from the source to the receiver. In that regard, channels to diffuse new knowledge are important to the research utilisation process.

One of the key research strategies of the SCoR (2015) was ensuring that research-related activities become a standing item on departmental meetings. However, this study indicated that 437(69.4%) disagreed or strongly disagreed that the department made time for research-related matters. This is in sharp contrast to the experiences from radiotherapy in which 36(80%) radiotherapy centres had research as a standing item on departmental meetings (Probst et al., 2015). In this study it is worth noting that only 153(24.3%) said there were no knowledgeable radiographers to review research with, implying the majority of them perceived their colleagues to have knowledge of, or about, research skills. This may be especially so since respondents with BSc (44.4%) and MSc (9.4%) had received research-integrated education and therefore could be said to possess the skills to perform a critical appraisal. There is a potential for radiology service managers to use knowledgeable practitioners within their department to carry out diffusion of new practices because findings in this study suggested there were practitioners who perceive themselves as capable of performing critical appraisal (n=416; 66%, Table 4.9). There are instances where communication of research findings to the general staff is all that other practitioners need as a motivation towards utilisation (Moreno-casbas et al., 2011) especially those radiographers who have not got the drive or who do not see the need to look for research evidence.

Although there is an increasing number of research entry in the Radiography Journal (Scopus Preview, n.d.), a greater percentage of these publications emanate from the academia, suggesting there is a disconnect between clinical practice and research at its core. Other than well-elaborated research strategies by the SCoR, research utilisation and uptake have been left in the hands of individual radiographers or imaging departments to work towards the attainment of the objectives. There is no

evidence to suggest collaboration between the SCoR and service managers regarding the research utilisation and uptake. Neither has the SCoR been making outreaches to radiology departments in sensitising or enabling its members to gain research skills towards research utilisation and uptake.

5.6 The BARRIERS Scale

Although many studies using the BARRIERS Scale have usually reported higher Cronbach's coefficients ranging from 0.7 to 0.9, the psychometric property analyses of the 23 items in this study had an aggregate alpha of 0.652 (Table 4.1). However, Bryman (2012) has argued that coefficients as low as 0.6 are acceptable. This means that the internal consistency for the 23 items in this study correlated well with each other.

Items with lower than 0.4 alpha values were removed because they had poor inter-item relatedness thereby affecting the internal reliability of the whole scale (Tavakol & Dennick, 2011). The three-factor solution (organisational setting, knowledge of research skills and attitude to research utilisation) derived in this study is supported by Kirshbaum, Beaver and Luker (2004). The items relating to research attitude had the highest alpha value of 0.93 indicating higher internal consistency (Table 4.1). This meant that the items measuring the attitude concept in this study correlated with each other very well. The lowest alpha coefficient was found within the knowledge of research skills factor which may be accounted for by a number of variables, including fewer items in the scale. According to Goforth (2015), this can be offset by increasing the number of items. Certain items were also categorised differently from the BARRIERS Scale (Funk et al., 1991a; 1991b). For instance, in this study, the item there is 'no knowledgeable staff to review research with' was perceived as an

organisational setting barrier rather than an adopter (arising from practitioner's research values, skills and awareness as categorised by Funk et al.,1991a). One major criticism of the BARRIERS Scale is that it does not discriminate research users from non-users (Bostrom et al., 2008).

CHAPTER SIX
Conclusion

6.0 Overview

This is the first study in the UK to investigate perceived barriers to research utilisation within the entire diagnostic radiography workforce. The Society of Radiographers have shown significant interest in the uptake and utilisation of research within the profession with its four consecutive research strategies in the last two decades (SCoR, 2005; 2010; 2015). Identifying barriers to research utilisation is key towards developing appropriate interventions to aid future professional development. As a result, many healthcare professionals have conducted studies on this as evidenced in the literature review.

Although two studies (Challen et al., 1996; Elliott et al., 2009) have attempted to do this in diagnostic radiography, their scope was quite limited in many ways. The study by Challen et al. (1996) investigated a small sample of radiographers in which not all the respondents had undertaken research as a core module in their radiography education. The other study, by Elliott et al. (2009), only examined perceived barriers amongst sonographers. This current study was planned against these backdrops, to bridge the gap and with a comprehensive aim of studying research utilisation within the UK diagnostic radiography workforce. This study also aimed to generalise the findings to the diagnostic radiography workforce, hence a survey was conducted in which a large sample was obtained for this purpose. The sample size obtained (630) allows for generalisation (with precaution) of the findings as presented in this study.

Section 6.1 presents some of the limitations of this study and offers some recommendations. The next section draws conclusions from the findings with the last section outlining the originality of the study.

6.1 Limitations of the study

- The BARRIERS Scale used in this study does not discriminate research users from non-research users. There has been a report of actual research users reporting fewer perceived barriers to research utilisation than the non-research user (Bostrom et al., 2008). This may explain some of the equivocations in the results.
- Caution should be taken when interpreting the results about knowledge of research skills outcome because respondents reported their perceived knowledge. The true knowledge of the respondents was not verified in this study as perceived knowledge does not equate to research usage.
- It should be taken into account that the number of respondents belonging to the research radiographer and doctorate subgroup was too small to make meaningful comparisons with those in their categories.
- The questionnaire may contain some ambiguity which could have affected responses. For example:

  a) The wording for the initial 28 BARRIERS Scale items in the questionnaire were checked for accuracy and coherence. However; like many survey questionnaires, there is always the possibility for misinterpretation and absence of question clarification by the interviewer to the interviewee. Nevertheless, efforts were made to minimise this problem. Aspects of the questionnaire that may have presented possible interpretations are considered below.

b) Arguable, the word ‘administration’ may have been misinterpreted by the respondents to mean a higher authority particularly in the American context since the psychometric scale emerged from a study concerning nurses in the United States. However, when it was checked for meaning, it had no American connotation to it by all the dictionaries[15] used by the researcher. It is generally defined as the people responsible for running a business, organisation, institution, etc. Even though it is possible for respondents to misinterpret it to mean people in higher authorities beyond their department, the heading for the section of which this question belongs said: “to what extent do you ‘agree’ or ‘disagree’ with the following statements regarding the promotion and utilisation of research *in your department*?” So, it was deemed to be a specific question that would relate to the department of the respondent and not beyond. Nevertheless, it is highly possible for it to be misinterpreted.

c) The original intent for this item, ‘research is not in my scope of practice’ was to find out whether respondents thought research in whatever form was part of their practice. However, respondents may have interpreted it to mean either the actual doing of research or the use of research in their practice. Although all radiographers are mandated to use research evidence to inform practice, not everyone is required to undertake research as part of their practice. Therefore, the most appropriate question or wording should have read: I am required to use research evidence to inform my practice.

d) The demographic data question that solicited for the job scale of respondents rather than their roles was limiting. It limited how much interpretation and

[13] The Oxford Living Dictionaries (Online), The MacMillan Dictionary (Online), and The Collins Dictionary (Online) were used in checking for meaning of certain words that were used in the questionnaire.

responsibilities could be assigned to each individual and make coherent arguments in support or against the findings made. It is possible that not all Band 7 radiographers will be advanced practitioners although, in theory, they should. It was also possible that some Band 6 radiographers would be practicing as advanced practitioners too. However, the current classification used in this study did not allow for this differentiation.

- This study did not ascertain whether respondents with postgraduate certificate or diploma had initially attained BSc (Hons) or Diploma (DCR). If the former was the case, then it would be assumed that respondents may have had training in basic research skills as opposed to the latter. It is therefore advised that care should be taken when interpreting their results about knowledge of research skills and attitude to utilisation.
- Response bias may have been introduced into the study even though there was a very high response rate. It may be assumed that those who did not respond to the survey may have shared different opinions on the topics being examined.
- Ideally, the study would have sought for the job titles of radiographers rather using Agenda for Change banding. In so doing, the study would have been able to juxtapose the responsibilities as enshrined by the HEE's (2017) framework about the roles of advanced and consultant practice. Nevertheless, it was assumed in this study that agenda for change banding would have a similar effect because the weighting factor used in deciding banding also takes into account the responsibilities expected of specific roles.

6.2 Conclusions

The study found seven main perceived barriers to research utilisation. Four of them related to the radiographer as an adopter and these were:

- how to develop research questions
- uncertainty believing in research findings
- find relevant literature
- interpret statistics

The other three were found within the social system: departments did not make time for research-related activities, busy departments (workload) and lack of authority to change practice. These reported barriers signify that radiographers may want to be involved in research-related activities, but the right mechanisms to facilitate it appeared to be absent. If research is to be celebrated, then changes in vision amongst radiography leadership, with practitioners who are research-driven to help propel and actualise the research strategies of the Society of Radiographers. In particular, time constraints and research skills have been the fundamental basis for the SCoR research strategies in all these years. It is an undeniable fact that the demand for health services is ever-increasing; nonetheless, measures to make time for research-related activities should be devised. For instance, time can be freed and dedicated to monthly research meetings and audits by developing effective appointment systems. The latter might be in place in most departments but usually, such meetings are attended by the same interested practitioners. The responsibility lies with advanced practitioners to ensure that every radiographer is encouraged and given research-related opportunities (or, at worst, makes it compulsory for them to attend these meetings).

The main barriers relating to knowledge of research skills were how to develop research questions, find the relevant literature and interpret statistics. As expected, the perceived knowledge of research skills seems to be influenced by the level of highest educational qualification, although there were some anomalies with respect to doctorate holders because of very few respondents. This may be argued to have led to a deficit in research-driven leadership within the diagnostic radiography workforce because many leaders have a postgraduate Certificate or Diploma as their highest qualification and may also have undergone Diploma education for a professional qualification, both of which do not include a research project. Research seminars and symposiums can be utilised to improve the research skills of these practitioners.

This study showed that perceived attitudes towards research utilisation were very positive, but positive attitude does not necessarily mean the individual may also have research skills or the opportunity to utilise them. This rather suggests that the right mechanisms need to be put in place to facilitate utilisation, only then will research utilisation become a reality.

The study concludes that mechanisms to facilitate utilisation of research into practice are lacking, particularly those relating to dissemination. Specifically, radiographers at an advanced level of practice (who are responsible for updating protocols with the knowledge of current research evidence) did not perceive themselves as having research skills and most often also perceived themselves to lack the authority to change practice. There needs to be a shift in the organisational approach towards research utilisation by allowing diagnostic radiographers to have control over their practice. However, this is unlikely to happen if diagnostic radiographers do not show to the multidisciplinary team that they can make important decisions regarding their patient needs with the best current evidence.

6.3 Recommendations from the study

Based on some pertinent issues arising from the study the following recommendations have been made.

- A qualitative approach using interviews or focus groups can be used to further explore these identified perceived barriers.
- Throughout this study, it has become apparent that radiographers in advanced clinical practice (Bands 7 and 8) have reached these levels with a PgC and PgD qualifications (Table 4.6) or progressed perpetually without the need for any formal qualification (as opposed to the Health Education England's (2017) framework for advanced clinical practice) which do not include research components, such as a dissertation. If diagnostic radiography practice is to become evidence-based, then, radiology service managers should be encouraged to enrol prospective candidates into postgraduate programmes that broadly focus on research such as MSc, MRes, MPhil or doctorates. Research skills could also be gained through internship programmes offered by the National Institute for Health Research (NIHR). It is unclear as to why radiology service managers do not fund the dissertation aspect of postgraduate education, therefore, a study can be conducted to explore the pervasiveness of this phenomenon.
- Most importantly, it is not enough to develop research strategies. The SCoR should commit resources in reaching out to its members by way of education through seminars about research skills and strengthening negotiations with service managers into committing to making research-related items a standing item on departmental meetings.

- Future studies looking to explore this phenomenon using the BARRIERS Scale should consider using a three-point scale rather than a five-point because results tend to be marginal, making it extremely difficult for conclusions to be established.
- To generate interest in research, an element of research (uptake or utilisation) could be incorporated into the yearly appraisal. This would also help to identify areas where individuals are lacking in research skills and provide the needed assistance.

6.4 Dissemination of the research

Perceived barriers to research utilisation have been explored in diverse professions within the health care professions, but this study is the first of its kind to investigate perceived barriers to research utilisation amongst diagnostic radiographers in the UK.

In keeping with good research practice and fulfilling a commitment made to the research participants, this research project will be published to create awareness for the radiography profession. The findings from this study were presented on June 12, 2019, at the United Kingdom Imaging and Oncology Conference (UKIO). The Society of Radiographers showed significant interest in this study prior to its commencement, therefore a copy of the thesis will made available to the SCoR's Workforce Development Officer, whereby it is anticipated that the findings of this research may be used to streamline future policy guidance and research strategies.

The research data will be made available at Sheffield Hallam University Research Data Archives (SHURDA) to enhance future research projects. The thesis will be deposited at Elements, also belonging to Sheffield Hallam University.

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Appendix I: The BARRIERS Scale

Barriers and Facilitators to Using Research in Practice

Articles in nursing journals indicate that nurses in practice do not use the results of research to help guide their practice. There are a number of reasons why this might be. We would like to know the extent to which *you* think each of the following situations is a barrier to nurses' use of research to alter/enhance their practice. For each item, circle the number of the response that best represents your view. Thank you for sharing your views with us.

	THIS IS A BARRIER **1. No extent** **2. A little extent** **3. A moderate extent** **4. A greater extent** **5. No opinion**
1. Research reports/articles are not readily available	1 2 3 4 5
2. Implications for practice are not made clear	1 2 3 4 5
3. Statistical analyses are not understandable	1 2 3 4 5
4. The research is not relevant to the nurse's practice	1 2 3 4 5
5. The nurse is unaware of the research	1 2 3 4 5
6. The facilities are inadequate for implementation	1 2 3 4 5
7. The nurse does not have time to read research	1 2 3 4 5
8. The research has not been replicated	1 2 3 4 5
9. The nurse feels the benefits of changing practice will be minimal	1 2 3 4 5
10. The nurse is uncertain whether to believe the results of the research	1 2 3 4 5
11. The research has methodological inadequacies	1 2 3 4 5
12. The relevant literature is not compiled in one place	1 2 3 4 5
13. The nurse does not feel she/he has enough authority to change patient care procedures	1 2 3 4 5
14. The nurse feels results are not generalizable to own setting	1 2 3 4 5
15. The nurse is isolated from knowledgeable colleagues with whom to discuss the research	1 2 3 4 5
16. The nurse sees little benefit for self	1 2 3 4 5
17. Research reports/articles are not published fast enough	1 2 3 4 5
18. Physicians will not cooperate with implementation	1 2 3 4 5
19. Administration will not allow implementation	1 2 3 4 5

20. The nurse does not see the value of research for practice 1 2 3 4 5
21. There is not a documented need to change practice 1 2 3 4 5
22. The conclusions drawn from the research are not justified 1 2 3 4 5
23. The literature reports conflicting results 1 2 3 4 5
24. The research is not reported clearly and readably 1 2 3 4 5
25. Other staff are not supportive of implementation 1 2 3 4 5
26. The nurse is unwilling to change/try new ideas 1 2 3 4 5
27. The amount of research information is overwhelming 1 2 3 4 5
28. The nurse does not feel capable of evaluating the quality of the research 1 2 3 4 5
29. There is insufficient time on the job to implement new ideas 1 2 3 4 5

Are there other things you think are barriers to research utilisation?

If so, please list and rate each on the scale:

30. _____ 1 2 3 4 5
31. _____ 1 2 3 4 5
32. _____ 1 2 3 4 5
33. _____ 1 2 3 4 5

34. Which of the above items do you feel are the *three greatest barriers* to nurses' use of research?

Greatest Barrier ..... Item #: _____

Second Greatest Barrier ..... Item #: _____

Third Greatest Barrier ..... Item #: _____

35. What are the things you think *facilitate* research utilisation?

_____

_____

This questionnaire was adapted from:

Crane, J., Pelz, D., and Horsley, J.A. *CURN Project Research Utilisation Questionnaire*. Ann Arbor, Michigan: Conduct and Utilisation of Research in Nursing Project, School of Nursing. The University of Michigan, 1977.

Thank you for sharing your views! c. 1987, Funk, Champagne, Tornquist & Wiese

Appendix II: Agreement to use the BARRIERS Scale

I agree to the conditions included in the document “Permission to use the BARRIERS Scale”

Name: Prince Akwasi Gyimah

Email address: Prince.A.Gyimah@student.shu.ac.uk

Academic/business affiliation: Sheffield Hallam University

Postal Address: 5 Elizabeth House, Swettenham St., SK11 7BT. Macclesfield, UK.

Phone Number: +44744xxxxxxxxx

Study Title: Barriers to research utilisation amongst diagnostic radiographers in the UK.

Brief Description of Study:

This study forms part of a doctoral project towards the award of a Professional Doctorate degree.

Research capacity and capability within the radiography workforce have been identified as lagging other healthcare professions. Thus, the Society of Radiographers has published four consecutive research strategies in an attempt to enable uptake and utilisation of research. In recent years, there is evidence to suggest that those within therapy have made tremendous gain compared to their diagnostic counterpart. This study, therefore, seeks to find out perceived barriers pertaining to diagnostic radiographers. These barriers will encompass those within departmental settings, knowledge of research skills and attitude to research utilisation.

This study is in partial fulfilment for the award of a professional doctorate degree.

Signature PAGyimah

Email to: sfunk@unc.edu

Please keep a copy of this form in your files. You automatically have permission to use the scale and do not need a response from the authors.

Appendix III: Questionnaire

Demography

*I am a...
Male
Female

*My age range is...
Below 31
31-40
41-50
Above 50

*I have the following qualifications. ***(Please select all that apply)***
Diploma
BSc
MSc
Doctorate
Postgraduate Certificate or Diploma

*What is your band?
Band 5
Band 6
Band 7
Band 8a, b, c

*I have been qualified for.....
Less than 5 years
5-10
11-16
17-22
23 years plus

*Please select major area of practice.
General Radiography
Fluoroscopy
Cross-sectional Imaging
Reporting
Breast Imaging
Research
Sonography
Nuclear Medicine
Prescribing

*Have you ever been involved in any form of research?
Yes
No

*How many publication(s) do you have to your name?

Perceived organisational barriers

*To what extent do you agree or disagree with the following statements regarding the promotion and utilisation of research in your department?

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
I do not have time to read research					
We are too busy at work for research matters					
I have access to research articles					
There is no documented need to change practice					
Administration will not allow implementation of new ideas					
Doctors will not co-operate with new ideas					
Other staff are not supportive of new ideas					
I do not have the authority to change practice					
The department makes time for me to think about research and changes in practice					
No knowledgeable person(s) within my department to review research with					

Perceived knowledge of research skills

*To what extent do you agree or disagree with the following statements regarding your knowledge of research skills?

	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
I can critically appraise the literature					
I am uncertain whether to believe the research findings					
Available research articles I find are not relevant to my practice					
I can develop my own research questions					
I have difficulty in applying research findings to my practice					
I can interpret statistics in research					
I can judge the quality of a research article					
When I read articles, I can clearly see the implications of a research article					
Relevant literature is not easy to find					
I do not have access to resources relating to research					

Attitude towards research

*To what extent do you agree with the following statements on attitude towards research?

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Research is not in my scope of practice					
Evidence to my practice should be reviewed by radiologists or physicists					
I recognise the need to change my own practice in line with research findings					
Research-related matters is a waste of time					
Research findings can make valuable contributions to practice					
There are areas in my practice that need to be researched into					
Research utilisation improves the quality of patient care					
Changing practice is not my responsibility					

Appendix IV: Survey Letter to prospective respondents

GYIMAH, Prince (EAST CHESHIRE NHS TRUST - RJN)

From: Gyimah Prince (EAST CHESHIRE NHS TRUST)
Sent: 26 April 2016 14:36
Subject: Diagnostic Radiography Survey
Importance: High

Hi

Please ignore if you are a THERAPEUTIC RADIOGRAPHER

I am a postgraduate student at Sheffield Hallam University undertaking a research for the award of the degree. I am currently looking for diagnostic radiographers to complete my survey.

I would be very grateful if you could take five minutes of your busy schedule to complete this survey which is collected anonymously.

Project title: Barriers to research utilisation amongst diagnostic radiographers in the UK.

Please click on one of the following links that suit you to the study.

Web Link: https://www.surveymonkey.co.uk/r/NS9G2HM

Mobile Friendly Link: https://www.surveymonkey.com/r/MPS26X9

Many thanks for helping.

Prince Gyimah
Diagnostic Radiographer
East Cheshire NHS Trust
Macclesfield DGH

Appendix V: Kruskal Wallis statistical test of significance for groups

Grouping Variable: Gender

	I do not have time to read research	We are too busy at work for research matters	I have access to research articles	There is no documented need to change practice	Administration will not allow implementation of new ideas	Doctors will not co-operate with new ideas	Other staff are not supportive of new ideas
Chi-Square	1.519	0.635	0.624	0.627	1.189	0.021	0.088
df	1	1	1	1	1	1	1
Asymp. Sig.	0.218	0.425	0.429	0.428	0.276	0.884	0.767

	I do not have the authority to change practice	The department makes time for me to think about research and changes in practice	No knowledgeable person(s) within my department to review research with	I can critically appraise the literature	I am uncertain whether to believe the research findings	Available research articles I find are not relevant to my practice	I can develop my own research questions
Chi-Square	0.036	0.124	1.200	12.109	1.583	0.878	10.503
df	1	1	1	1	1	1	1
Asymp. Sig.	0.849	0.724	0.273	0.001	0.208	0.349	0.001

	I have difficulty in applying research findings to my practice	I can interpret statistics in research	I can judge the quality of a research article	When I read articles, I can clearly see the implications of a research article	Relevant literature is not easy to find	I do not have access to resources relating to research	Research is not in my scope of practice
Chi-Square	2.065	10.173	9.250	4.731	1.948	1.469	0.013
df	1	1	1	1	1	1	1
Asymp. Sig.	0.151	0.001	0.002	0.030	0.163	0.225	0.909

	Research to my practice must be reviewed by radiologists or physicists	I recognise the need to change my own practice in line with research findings	Research-related matters are a waste of time	Findings can make valuable contributions to practice	There are areas in my practice that need to be researched into	Utilisation improves the quality of patient care	Changing practice is not my responsibility
Chi-Square	0.045	1.492	3.176	1.481	6.466	1.839	0.213
df	1	1	1	1	1	1	1
Asymp. Sig.	0.832	0.222	0.075	0.224	0.011	0.175	0.644

Grouping Variable: Age range

	I do not have time to read research	We are too busy at work for research matters	I have access to research articles	There is no documented need to change practice	Administration will not allow implementation of new ideas	Doctors will not co-operate with new ideas	Other staff are not supportive of new ideas
Chi-Square	1.085	6.433	4.655	2.988	10.927	13.073	9.480
df	3	3	3	3	3	3	3
Asymp. Sig.	0.781	0.092	0.199	0.394	0.012	0.004	0.024

	I do not have the authority to change practice	The department makes time for me to think about research and changes in practice	No knowledgeable person(s) within my department to review research with	I can critically appraise the literature	I am uncertain whether to believe the research findings	Available research articles I find are not relevant to my practice	I can develop my own research questions
Chi-Square	9.116	8.320	1.701	2.313	4.097	1.255	4.818
df	3	3	3	3	3	3	3
Asymp. Sig.	0.028	0.040	0.637	0.510	0.251	0.740	0.186

	I have difficulty in applying research findings to my practice	I can interpret statistics in research	I can judge the quality of a research article	When I read articles I can clearly see the implications of a research article	Relevant literature is not easy to find	I do not have access to resources relating to research	Research is not in my scope of practice
Chi-Square		1.566	2.151	5.421	4.466	2.939	11.099
df	3	3	3	3	3	3	3
Asymp. Sig.	0.250	0.667	0.542	0.143	0.215	0.401	0.011

	Research to my practice must be reviewed by radiologists or physicists	I recognise the need to change my own practice in line with research findings	Research-related matters are a waste of time	Findings can make valuable contributions to practice	There are areas in my practice that need to be researched into	Utilisation improves the quality of patient care	Changing practice is not my responsibility
Chi-Square	4.172	3.074	5.722	2.834	15.970	12.861	6.633
df	3	3	3	3	3	3	3
Asymp. Sig.	0.243	0.380	0.126	0.418	0.001	0.005	0.085

Grouping Variable: Highest Qualification

	I do not have time to read research	We are too busy at work for research matters	I have access to research articles	There is no documented need to change practice	Administration will not allow implementation of new ideas	Doctors will not co-operate with new ideas	Other staff are not supportive of new ideas
Chi-Square	4.627	14.181	0.786	12.682	15.246	3.328	8.716
df	4	4	4	4	4	4	4
Asymp. Sig.	0.328		0.940	0.013	0.004	0.504	0.069

	I do not have the authority to change practice	The department makes time for me to think about research and changes in practice	No knowledgeable person(s) within my department to review research with	I can critically appraise the literature	I am uncertain whether to believe the research findings	Available research articles I find are not relevant to my practice	I can develop my own research questions
Chi-Square	7.745	5.305	0.453	21.430	4.417	2.098	12.605
df	4	4	4	4	4	4	4
Asymp. Sig.	0.101	0.257	0.978	0.000	0.353	0.718	0.013

	I have difficulty in applying research findings to my practice	I can interpret statistics in research	I can judge the quality of a research article	When I read articles I can clearly see the implications of a research article	Relevant literature is not easy to find	I do not have access to resources relating to research	Research is not in my scope of practice
Chi-Square	3.558	5.317	6.348	0.984	4.727	7.736	12.098
df	4	4	4	4	4	4	4
Asymp. Sig.	0.469	0.256	0.175	0.912	0.317	0.102	0.017

	Research to my practice must be reviewed by radiologists or physicists	I recognise the need to change my own practice in line with research findings	Research-related matters are a waste of time	Findings can make valuable contributions to practice	There are areas in my practice that need to be researched into	Utilisation improves the quality of patient care	Changing practice is not my responsibility
Chi-Square	13.337	7.784	12.830	9.140	19.509	9.850	6.666
df	4	4	4	4	4	4	4
Asymp. Sig.	0.010	0.100	0.012	0.058	0.001	0.043	0.155

Grouping Variable: Job scale

	I do not have time to read research	We are too busy at work for research matters	I have access to research articles	There is no documented need to change practice	Administration will not allow the implementation of new ideas	Doctors will not co-operate with new ideas	Other staff are not supportive of new ideas
Chi-Square	0.962	2.332	1.708	4.062	5.547	3.875	3.335
df	3	3	3	3	3	3	3
Asymp. Sig.	0.811	0.506	0.635	0.255	0.136	0.275	0.343

	I do not have the authority to change practice	The department makes time for me to think about research and changes in practice	No knowledgeable person(s) within my department to review research with	I can critically appraise the literature	I am uncertain whether to believe the research findings	Available research articles I find are not relevant to my practice	I can develop my own research questions
Chi-Square	7.622	1.237	2.584	3.947	0.737	5.802	4.447
df	3	3	3	3	3	3	3
Asymp. Sig.	0.055	0.744	0.460	0.267	0.864	0.122	0.217

	I have difficulty in applying research findings to my practice	I can interpret statistics in research	I can judge the quality of a research article	When I read articles I can clearly see the implications of a research article	Relevant literature is not easy to find	I do not have access to resources relating to research	Research is not in my scope of practice
Chi-Square	8.314	4.883	6.636	3.122	0.315	2.981	5.204
df	3	3	3	3	3	3	3
Asymp. Sig.	0.040	0.181	0.084	0.373	0.957	0.395	0.157

	Research to my practice must be reviewed by radiologists or physicists	I recognise the need to change my own practice in line with research findings	Research-related matters are a waste of time	Findings can make valuable contributions to practice	There are areas in my practice that need to be researched into	Utilisation improves the quality of patient care	Changing practice is not my responsibility
Chi-Square	4.627	6.320	1.324	11.484	7.122	5.188	5.899
df	3	3	3	3	3	3	3
Asymp. Sig.	0.201	0.097	0.723	0.009	0.068	0.159	0.117

Grouping Variable: Years Qualified

	I do not have time to read research	We are too busy at work for research matters	I have access to research articles	There is no documented need to change practice	Administration will not allow implementation of new ideas	Doctors will not co-operate with new ideas	Other staff are not supportive of new ideas
Chi-Square	2.708	5.728	0.350	3.161	7.144	1.145	2.226
df	4	4	4	4	4	4	4
Asymp. Sig.	0.608	0.220	0.986	0.531	0.128	0.887	0.694

	I do not have the authority to change practice	The department makes time for me to think about research and changes in practice	No knowledgeable person(s) within my department to review research with	I can critically appraise the literature	I am uncertain whether to believe the research findings	Available research articles I find are not relevant to my practice	I can develop my own research questions
Chi-Square	3.418	2.215	0.822	4.647	4.254	5.897	4.161
df	4	4	4	4	4	4	4
Asymp. Sig.	0.490	0.696	0.936	0.325	0.373	0.207	0.385

	I have difficulty in applying research findings to my practice	I can interpret statistics in research	I can judge the quality of a research article	When I read articles I can clearly see the implications of a research article	Relevant literature is not easy to find	I do not have access to resources relating to research	Research is not in my scope of practice
Chi-Square	4.559	3.606	4.294	7.295	8.590	3.851	5.633
df	4	4	4	4	4	4	4
Asymp. Sig.	0.336	0.462	0.368	0.121	0.072	0.427	0.228

	Research to my practice must be reviewed by radiologists or physicists	I recognise the need to change my own practice in line with research findings	Research-related matters are a waste of time	Findings can make valuable contributions to practice	There are areas in my practice that need to be researched into	Utilisation improves the quality of patient care	Changing practice is not my responsibility
Chi-Square	3.527	6.387	7.639	10.194	12.468	16.289	4.735
df	4	4	4	4	4	4	4
Asymp. Sig.	0.474	0.172	0.106	0.037	0.014	0.003	0.316

Grouping Variable: Major Area of Practice

	I do not have time to read research	We are too busy at work for research matters	I have access to research articles	There is no documented need to change practice	Administration will not allow implementation of new ideas	Doctors will not co-operate with new ideas	Other staff are not supportive of new ideas
Chi-Square	12.223	9.822	13.039	14.545	13.523	13.253	5.694
df	8	8	8	8	8	8	8
Asymp. Sig.	0.142	0.278	0.111	0.069	0.095	0.103	0.681

	I do not have authority to change practice	The department makes time for me to think about research and changes in practice	No knowledgeable person(s) within my department to review research with	I can critically appraise the literature	I am uncertain whether to believe the research findings	Available research articles I find are not relevant to my practice	I can develop my own research questions
Chi-Square	8.131	4.795	8.437	20.822	4.855	15.828	7.603
df	8	8	8	8	8	8	8
Asymp. Sig.	0.421	0.779	0.392	0.008	0.773	0.045	0.473

	I have difficulty in applying research findings to my practice	I can interpret statistics in research	I can judge the quality of a research article	When I read articles I can clearly see the implications of a research article	Relevant literature is not easy to find	I do not have access to resources relating to research	Research is not in my scope of practice
Chi-Square	7.376	8.431	4.038	9.175	3.144	16.566	10.916
df	8	8	8	8	8	8	8
Asymp. Sig.	0.497	0.393	0.854	0.328	0.925	0.035	0.206

	Research to my practice must be reviewed by radiologists or physicists	I recognise the need to change my own practice in line with research findings	Research-related matters are a waste of time	Findings can make valuable contributions to practice	There are areas in my practice that need to be researched into	Utilisation improves the quality of patient care	Changing practice is not my responsibility
Chi-Square	17.490	11.190	17.128	4.036	14.673	8.103	9.978
df	8	8	8	8	8	8	8
Asymp. Sig.	0.025	0.191	0.029	0.854	0.066	0.423	0.267

Kruskal Wallis mean ranks for gender

Gender		N	Mean Rank
I do not have time to read research	Female	489	320.02
	Male	141	299.82
	Total	630	
We are too busy at work for research matters	Female	489	312.54
	Male	141	325.75
	Total	630	
I have access to research articles	Female	489	312.66
	Male	141	325.34
	Total	630	
There is no documented need to change practice	Female	489	318.45
	Male	141	305.27
	Total	630	
Administration will not allow implementation of new ideas	Female	489	319.51
	Male	141	301.59
	Total	630	
Doctors will not co-operate with new ideas	Female	489	316.04
	Male	141	313.63
	Total	630	
Other staff are not supportive of new ideas	Female	489	314.41
	Male	141	319.27
	Total	630	
I do not have the authority to change practice	Female	489	314.79
	Male	141	317.97
	Total	630	
The department makes time for me to think about research and changes in practice	Female	489	314.18
	Male	141	320.06
	Total	630	
No knowledgeable person(s) within my department to review research with	Female	489	319.56
	Male	141	301.44
	Total	630	
I can critically appraise the literature	Female	489	303.37
	Male	141	357.59
	Total	630	
I am uncertain whether to believe the research findings	Female	489	320.09
	Male	141	299.59
	Total	630	

Available research articles I find are not relevant to my practice	Female	489	318.76
	Male	141	304.18
	Total	630	
I can develop my own research questions	Female	489	303.49
	Male	141	357.16
	Total	630	
I have difficulty in applying research findings to my practice	Female	489	320.76
	Male	141	297.26
	Total	630	
I can interpret statistics in research	Female	489	303.83
	Male	141	355.98
	Total	630	
I can judge the quality of a research article	Female	489	304.61
	Male	141	353.26
	Total	630	
When I read articles I can clearly see the implications of a research article	Female	489	307.86
	Male	141	342.00
	Total	630	
Relevant literature is not easy to find	Female	489	320.60
	Male	141	297.83
	Total	630	
I do not have access to resources relating to research	Female	489	319.90
	Male	141	300.24
	Total	630	
Research is not in my scope of practice	Female	489	315.92
	Male	141	314.06
	Total	630	
Research to my practice must be reviewed by radiologists or physicists	Female	489	314.73
	Male	141	318.17
	Total	630	
I recognise the need to change my own practice in line with research findings	Female	489	311.31
	Male	141	330.04
	Total	630	
Research-related matters are a waste of time	Female	489	309.06
	Male	141	337.82
	Total	630	
Findings can make valuable contributions to practice	Female	489	311.09
	Male	141	330.79
	Total	630	

There are areas in my practice that need to be researched into	Female	489	306.20
	Male	141	347.76
	Total	630	
Utilisation improves the quality of patient care	Female	489	310.59
	Male	141	332.51
	Total	630	
Changing practice is not my responsibility	Female	489	313.82
	Male	141	321.34
	Total	630	

Kruskal Wallis mean ranks for age range

Age range		N	Mean Rank
I do not have time to read research	</=30	184	313.01
	31-40	161	315.36
	41-50	127	328.62
	>/=51	158	307.99
	Total	630	
We are too busy at work for research matters	</=30	184	316.86
	31-40	161	319.06
	41-50	127	341.30
	>/=51	158	289.55
	Total	630	
I have access to research articles	</=30	184	313.21
	31-40	161	330.28
	41-50	127	289.77
	>/=51	158	323.78
	Total	630	
There is no documented need to change practice	</=30	184	321.02
	31-40	161	295.22
	41-50	127	321.23
	>/=51	158	325.13
	Total	630	
Administration will not allow implementation of new ideas	</=30	184	318.26
	31-40	161	333.35
	41-50	127	335.33
	>/=51	158	278.15
	Total	630	
	</=30	184	312.76

Doctors will not co-operate with new ideas	31-40	161	315.50
	41-50	127	358.38
	>/=51	158	284.23
	Total	630	
Other staff are not supportive of new ideas	</=30	184	317.87
	31-40	161	307.92
	41-50	127	352.28
	>/=51	158	290.90
	Total	630	
I do not have the authority to change practice	</=30	184	305.99
	31-40	161	327.16
	41-50	127	347.36
	>/=51	158	289.09
	Total	630	
The department makes time for me to think about research and changes in practice	</=30	184	329.27
	31-40	161	319.82
	41-50	127	276.26
	>/=51	158	326.60
	Total	630	
No knowledgeable person(s) within my department to review research with	</=30	184	305.48
	31-40	161	322.07
	41-50	127	328.35
	>/=51	158	310.15
	Total	630	
I can critically appraise the literature	</=30	184	321.26
	31-40	161	327.59
	41-50	127	305.54
	>/=51	158	304.47
	Total	630	
I am uncertain whether to believe the research findings	</=30	184	301.51
	31-40	161	305.54
	41-50	127	335.16
	>/=51	158	326.15
	Total	630	
Available research articles I find are not relevant to my practice	</=30	184	304.75
	31-40	161	316.36
	41-50	127	321.57
	>/=51	158	322.26
	Total	630	

I can develop my own research questions	</=30	184	315.14
	31-40	161	334.54
	41-50	127	289.52
	>/=51	158	317.41
	Total	630	
I have difficulty in applying research findings to my practice	</=30	184	297.89
	31-40	161	310.64
	41-50	127	333.02
	>/=51	158	326.88
	Total	630	
I can interpret statistics in research	</=30	184	327.85
	31-40	161	313.87
	41-50	127	304.73
	>/=51	158	311.45
	Total	630	
I can judge the quality of a research article	</=30	184	322.29
	31-40	161	326.48
	41-50	127	306.25
	>/=51	158	303.84
	Total	630	
When I read articles I can clearly see the implications of a research article	</=30	184	327.28
	31-40	161	330.87
	41-50	127	293.69
	>/=51	158	303.66
	Total	630	
Relevant literature is not easy to find	</=30	184	298.93
	31-40	161	313.49
	41-50	127	340.38
	>/=51	158	316.85
	Total	630	
I do not have access to resources relating to research	</=30	184	310.46
	31-40	161	320.17
	41-50	127	334.36
	>/=51	158	301.45
	Total	630	
Research is not in my scope of practice	</=30	184	305.68
	31-40	161	350.45
	41-50	127	286.96
	>/=51	158	314.26

	Total	630	
Research to my practice must be reviewed by radiologists or physicists	</=30	184	314.29
	31-40	161	334.08
	41-50	127	293.01
	>/=51	158	316.06
	Total	630	
I recognise the need to change my own practice in line with research findings	</=30	184	321.77
	31-40	161	328.57
	41-50	127	309.64
	>/=51	158	299.59
	Total	630	
Research-related matters are a waste of time	</=30	184	303.03
	31-40	161	342.46
	41-50	127	304.86
	>/=51	158	311.10
	Total	630	
Findings can make valuable contributions to practice	</=30	184	318.89
	31-40	161	331.58
	41-50	127	301.84
	>/=51	158	306.15
	Total	630	
There are areas in my practice that need to be researched into	</=30	184	312.85
	31-40	161	358.47
	41-50	127	303.03
	>/=51	158	284.82
	Total	630	
Utilisation improves the quality of patient care	</=30	184	320.57
	31-40	161	351.15
	41-50	127	295.17
	>/=51	158	289.61
	Total	630	
Changing practice is not my responsibility	</=30	184	311.98
	31-40	161	344.36
	41-50	127	302.81
	>/=51	158	300.38
	Total	630	

Kruskal Wallis mean ranks for highest qualification

Highest Qualification		N	Mean Rank
I do not have time to read research	Diploma	65	282.00
	BSc	280	322.79
	PgC/D	218	317.85
	MSc	59	300.38
	Doctorate	8	380.25
	Total	630	
We are too busy at work for research matters	Diploma	65	261.13
	BSc	280	327.68
	PgC/D	218	327.77
	MSc	59	266.16
	Doctorate	8	360.25
	Total	630	
I have access to research articles	Diploma	65	312.52
	BSc	280	309.78
	PgC/D	218	321.07
	MSc	59	323.13
	Doctorate	8	332.00
	Total	630	
There is no documented need to change practice	Diploma	65	355.38
	BSc	280	331.76
	PgC/D	218	295.81
	MSc	59	271.20
	Doctorate	8	285.50
	Total	630	
Administration will not allow implementation of new ideas	Diploma	65	270.40
	BSc	280	332.90
	PgC/D	218	301.39
	MSc	59	313.86
	Doctorate	8	469.69
	Total	630	
Doctors will not co-operate with new ideas	Diploma	65	285.31
	BSc	280	318.10
	PgC/D	218	319.13
	MSc	59	314.02
	Doctorate	8	381.63
	Total	630	

Other staff are not supportive of new ideas	Diploma	65	282.65
	BSc	280	307.10
	PgC/D	218	323.29
	MSc	59	348.58
	Doctorate	8	420.19
	Total	630	
I do not have the authority to change practice	Diploma	65	289.13
	BSc	280	328.84
	PgC/D	218	308.78
	MSc	59	291.20
	Doctorate	8	425.19
	Total	630	
The department makes time for me to think about research and changes in practice	Diploma	65	339.70
	BSc	280	320.53
	PgC/D	218	303.03
	MSc	59	324.39
	Doctorate	8	217.06
	Total	630	
No knowledgeable person(s) within my department to review research with	Diploma	65	309.35
	BSc	280	318.25
	PgC/D	218	313.75
	MSc	59	319.80
	Doctorate	8	285.44
	Total	630	
I can critically appraise the literature	Diploma	65	245.85
	BSc	280	304.25
	PgC/D	218	341.61
	MSc	59	349.89
	Doctorate	8	309.88
	Total	630	
I am uncertain whether to believe the research findings	Diploma	65	319.23
	BSc	280	318.20
	PgC/D	218	323.33
	MSc	59	277.45
	Doctorate	8	257.88
	Total	630	
Available research articles I find are not relevant to my practice	Diploma	65	333.97
	BSc	280	316.46
	PgC/D	218	312.15

	MSc	59	297.71
	Doctorate	8	354.38
	Total	630	
I can develop my own research questions	Diploma	65	300.79
	BSc	280	305.42
	PgC/D	218	311.32
	MSc	59	388.26
	Doctorate	8	365.19
	Total	630	
I have difficulty in applying research findings to my practice	Diploma	65	330.12
	BSc	280	318.03
	PgC/D	218	314.01
	MSc	59	284.47
	Doctorate	8	377.88
	Total	630	
I can interpret statistics in research	Diploma	65	314.99
	BSc	280	322.60
	PgC/D	218	296.89
	MSc	59	346.55
	Doctorate	8	349.19
	Total	630	
I can judge the quality of a research article	Diploma	65	281.72
	BSc	280	317.82
	PgC/D	218	310.98
	MSc	59	351.33
	Doctorate	8	367.75
	Total	630	
When I read articles I can clearly see the implications of a research article	Diploma	65	311.40
	BSc	280	313.30
	PgC/D	218	313.94
	MSc	59	332.23
	Doctorate	8	345.13
	Total	630	
Relevant literature is not easy to find	Diploma	65	334.66
	BSc	280	314.97
	PgC/D	218	316.02
	MSc	59	283.80
	Doctorate	8	397.94
	Total	630	

I do not have access to resources relating to research	Diploma	65	344.71
	BSc	280	328.45
	PgC/D	218	299.09
	MSc	59	283.30
	Doctorate	8	309.81
	Total	630	
Research is not in my scope of practice	Diploma	65	286.66
	BSc	280	303.04
	PgC/D	218	322.48
	MSc	59	378.91
	Doctorate	8	328.31
	Total	630	
Research to my practice must be reviewed by radiologists or physicists	Diploma	65	271.55
	BSc	280	302.48
	PgC/D	218	333.86
	MSc	59	362.27
	Doctorate	8	282.88
	Total	630	
I recognise the need to change my own practice in line with research findings	Diploma	65	267.24
	BSc	280	316.63
	PgC/D	218	320.72
	MSc	59	341.36
	Doctorate	8	335.13
	Total	630	
Research-related matters are a waste of time	Diploma	65	252.82
	BSc	280	312.09
	PgC/D	218	330.15
	MSc	59	338.38
	Doctorate	8	376.06
	Total	630	
Findings can make valuable contributions to practice	Diploma	65	256.76
	BSc	280	321.83
	PgC/D	218	319.11
	MSc	59	334.61
	Doctorate	8	332.13
	Total	630	
There are areas in my practice that need to be researched into	Diploma	65	243.22
	BSc	280	312.62
	PgC/D	218	323.39

	MSc	59	370.47
	Doctorate	8	383.31
	Total	630	
Utilisation improves the quality of patient care	Diploma	65	256.61
	BSc	280	319.49
	PgC/D	218	321.55
	MSc	59	341.75
	Doctorate	8	295.75
	Total	630	
Changing practice is not my responsibility	Diploma	65	280.38
	BSc	280	306.61
	PgC/D	218	328.87
	MSc	59	344.76
	Doctorate	8	331.94
	Total	630	

Kruskal Wallis mean ranks for job scale

Job scale		N	Mean Rank
I do not have time to read research	Band 5	106	327.92
	Band 6	296	309.43
	Band 7	178	317.72
	Band 8	50	317.18
	Total	630	
We are too busy at work for research matters	Band 5	106	330.29
	Band 6	296	318.71
	Band 7	178	308.89
	Band 8	50	288.65
	Total	630	
I have access to research articles	Band 5	106	312.67
	Band 6	296	307.76
	Band 7	178	326.53
	Band 8	50	328.02
	Total	630	
There is no documented need to change practice	Band 5	106	305.25
	Band 6	296	329.64
	Band 7	178	298.26
	Band 8	50	314.87
	Total	630	

Administration will not allow implementation of new ideas	Band 5	106	337.42
	Band 6	296	322.62
	Band 7	178	292.23
	Band 8	50	309.72
	Total	630	
Doctors will not co-operate with new ideas	Band 5	106	336.40
	Band 6	296	316.76
	Band 7	178	297.19
	Band 8	50	328.92
	Total	630	
Other staff are not supportive of new ideas	Band 5	106	312.70
	Band 6	296	321.05
	Band 7	178	299.68
	Band 8	50	344.90
	Total	630	
I do not have the authority to change practice	Band 5	106	328.42
	Band 6	296	329.26
	Band 7	178	297.56
	Band 8	50	270.51
	Total	630	
The department makes time for me to think about research and changes in practice	Band 5	106	313.01
	Band 6	296	311.35
	Band 7	178	327.26
	Band 8	50	303.47
	Total	630	
No knowledgeable person(s) within my department to review research with	Band 5	106	306.80
	Band 6	296	326.58
	Band 7	178	301.90
	Band 8	50	316.75
	Total	630	
I can critically appraise the literature	Band 5	106	327.51
	Band 6	296	301.90
	Band 7	178	328.99
	Band 8	50	322.52
	Total	630	
I am uncertain whether to believe the research findings	Band 5	106	304.78
	Band 6	296	315.46
	Band 7	178	318.47
	Band 8	50	327.87

	Total	630	
Available research articles I find are not relevant to my practice	Band 5	106	292.29
	Band 6	296	330.55
	Band 7	178	302.87
	Band 8	50	320.58
	Total	630	
I can develop my own research questions	Band 5	106	326.38
	Band 6	296	303.97
	Band 7	178	316.86
	Band 8	50	355.83
	Total	630	
I have difficulty in applying research findings to my practice	Band 5	106	275.51
	Band 6	296	331.10
	Band 7	178	312.71
	Band 8	50	317.86
	Total	630	
I can interpret statistics in research	Band 5	106	344.27
	Band 6	296	314.79
	Band 7	178	307.96
	Band 8	50	285.56
	Total	630	
I can judge the quality of a research article	Band 5	106	344.01
	Band 6	296	301.22
	Band 7	178	327.15
	Band 8	50	298.11
	Total	630	
When I read articles I can clearly see the implications of a research article	Band 5	106	330.45
	Band 6	296	308.75
	Band 7	178	324.86
	Band 8	50	290.45
	Total	630	
Relevant literature is not easy to find	Band 5	106	317.89
	Band 6	296	312.41
	Band 7	178	320.57
	Band 8	50	310.68
	Total	630	
I do not have access to resources relating to research	Band 5	106	331.87
	Band 6	296	319.92
	Band 7	178	298.48

	Band 8	50	315.18
	Total	630	
Research is not in my scope of practice	Band 5	106	310.72
	Band 6	296	302.76
	Band 7	178	339.02
	Band 8	50	317.32
	Total	630	
Research to my practice must be reviewed by radiologists or physicists	Band 5	106	303.40
	Band 6	296	305.91
	Band 7	178	338.01
	Band 8	50	317.80
	Total	630	
I recognise the need to change my own practice in line with research findings	Band 5	106	344.45
	Band 6	296	300.81
	Band 7	178	322.93
	Band 8	50	314.65
	Total	630	
Research-related matters are a waste of time	Band 5	106	316.33
	Band 6	296	308.19
	Band 7	178	326.50
	Band 8	50	317.88
	Total	630	
Findings can make valuable contributions to practice	Band 5	106	366.01
	Band 6	296	303.56
	Band 7	178	305.92
	Band 8	50	313.21
	Total	630	
There are areas in my practice that need to be researched into	Band 5	106	349.45
	Band 6	296	299.37
	Band 7	178	318.72
	Band 8	50	327.54
	Total	630	
Utilisation improves the quality of patient care	Band 5	106	346.45
	Band 6	296	306.53
	Band 7	178	317.88
	Band 8	50	294.51
	Total	630	
Changing practice is not my responsibility	Band 5	106	327.71
	Band 6	296	298.34

	Band 7	178	334.78
	Band 8	50	322.59
	Total	630	

Kruskal Wallis mean ranks for years qualified

Years Qualified		N	Mean Rank
I do not have time to read research	<5	164	325.19
	5-10	140	327.46
	11-16	88	315.27
	17-22	61	302.39
	>/=23	177	301.70
	Total	630	
We are too busy at work for research matters	<5	164	325.08
	5-10	140	332.95
	11-16	88	325.89
	17-22	61	288.85
	>/=23	177	296.84
	Total	630	
I have access to research articles	<5	164	314.01
	5-10	140	319.92
	11-16	88	317.26
	17-22	61	305.23
	>/=23	177	316.05
	Total	630	
There is no documented need to change practice	<5	164	307.39
	5-10	140	325.11
	11-16	88	294.88
	17-22	61	307.01
	>/=23	177	328.60
	Total	630	
Administration will not allow implementation of new ideas	<5	164	329.40
	5-10	140	322.33
	11-16	88	338.55
	17-22	61	304.30
	>/=23	177	289.62
	Total	630	
Doctors will not co-operate with new ideas	<5	164	321.47
	5-10	140	315.79

	11-16	88	326.73
	17-22	61	308.74
	>/=23	177	306.49
	Total	630	
Other staff are not supportive of new ideas	<5	164	326.51
	5-10	140	298.31
	11-16	88	317.12
	17-22	61	311.50
	>/=23	177	319.47
	Total	630	
I do not have the authority to change practice	<5	164	318.35
	5-10	140	326.63
	11-16	88	330.41
	17-22	61	316.74
	>/=23	177	296.22
	Total	630	
The department makes time for me to think about research and changes in practice	<5	164	318.84
	5-10	140	325.22
	11-16	88	292.74
	17-22	61	306.91
	>/=23	177	318.99
	Total	630	
No knowledgeable person(s) within my department to review research with	<5	164	317.41
	5-10	140	314.90
	11-16	88	322.51
	17-22	61	326.17
	>/=23	177	307.04
	Total	630	
I can critically appraise the literature	<5	164	324.18
	5-10	140	314.26
	11-16	88	336.49
	17-22	61	322.20
	>/=23	177	295.70
	Total	630	
I am uncertain whether to believe the research findings	<5	164	309.31
	5-10	140	309.54
	11-16	88	316.51
	17-22	61	288.11
	>/=23	177	334.88

	Total	630	
Available research articles I find are not relevant to my practice	<5	164	303.43
	5-10	140	299.30
	11-16	88	332.73
	17-22	61	305.39
	>/=23	177	334.42
	Total	630	
I can develop my own research questions	<5	164	312.38
	5-10	140	317.42
	11-16	88	338.67
	17-22	61	335.45
	>/=23	177	298.48
	Total	630	
I have difficulty in applying research findings to my practice	<5	164	301.23
	5-10	140	303.13
	11-16	88	315.77
	17-22	61	321.65
	>/=23	177	336.25
	Total	630	
I can interpret statistics in research	<5	164	334.94
	5-10	140	317.80
	11-16	88	306.45
	17-22	61	311.57
	>/=23	177	301.52
	Total	630	
I can judge the quality of a research article	<5	164	334.19
	5-10	140	319.02
	11-16	88	310.20
	17-22	61	317.58
	>/=23	177	297.32
	Total	630	
When I read articles I can clearly see the implications of a research article	<5	164	331.62
	5-10	140	319.21
	11-16	88	337.05
	17-22	61	300.90
	>/=23	177	291.94
	Total	630	
Relevant literature is not easy to find	<5	164	318.90
	5-10	140	285.34

	11-16	88	325.54
	17-22	61	296.04
	>/=23	177	337.92
	Total	630	
I do not have access to resources relating to research	<5	164	331.59
	5-10	140	301.30
	11-16	88	301.19
	17-22	61	302.23
	>/=23	177	323.51
	Total	630	
Research is not in my scope of practice	<5	164	312.46
	5-10	140	317.09
	11-16	88	333.31
	17-22	61	349.06
	>/=23	177	296.64
	Total	630	
Research to my practice must be reviewed by radiologists or physicists	<5	164	308.66
	5-10	140	327.93
	11-16	88	336.77
	17-22	61	296.21
	>/=23	177	308.08
	Total	630	
I recognise the need to change my own practice in line with research findings	<5	164	326.18
	5-10	140	321.81
	11-16	88	326.95
	17-22	61	329.98
	>/=23	177	289.93
	Total	630	
Research-related matters are a waste of time	<5	164	319.43
	5-10	140	328.01
	11-16	88	340.80
	17-22	61	320.06
	>/=23	177	287.81
	Total	630	
Findings can make valuable contributions to practice	<5	164	338.65
	5-10	140	319.75
	11-16	88	331.59
	17-22	61	312.45
	>/=23	177	283.74

	Total	630	
There are areas in my practice that need to be researched into	<5	164	334.59
	5-10	140	332.64
	11-16	88	334.69
	17-22	61	297.42
	>/=23	177	280.95
	Total	630	
Utilisation improves the quality of patient care	<5	164	337.13
	5-10	140	325.06
	11-16	88	345.93
	17-22	61	309.47
	>/=23	177	274.84
	Total	630	
Changing practice is not my responsibility	<5	164	312.29
	5-10	140	325.45
	11-16	88	336.14
	17-22	61	330.00
	>/=23	177	295.35
	Total	630	

Kruskal Wallis mean score for area of practice

Major Area of Practice		N	Mean Rank
I do not have time to read research	GR	209	308.63
	Fluoro	61	287.80
	CSI	154	329.32
	Rep	39	273.81
	BI	49	344.90
	Res	4	230.25
	US	61	357.13
	NI	23	311.07
	Others	30	285.02
	Total	630	
We are too busy at work for research matters	GR	209	309.18
	Fluoro	61	290.06
	CSI	154	343.54
	Rep	39	308.63
	BI	49	311.67
	Res	4	221.88

	US	61	335.61
	NI	23	280.74
	Others	30	280.75
	Total	630	
I have access to research articles	GR	209	307.48
	Fluoro	61	286.97
	CSI	154	296.79
	Rep	39	344.10
	BI	49	343.28
	Res	4	315.63
	US	61	357.11
	NI	23	306.98
	Others	30	364.82
	Total	630	
There is no documented need to change practice	GR	209	325.21
	Fluoro	61	299.93
	CSI	154	330.79
	Rep	39	266.92
	BI	49	317.00
	Res	4	285.50
	US	61	274.58
	NI	23	272.87
	Others	30	381.65
	Total	630	
Administration will not allow implementation of new ideas	GR	209	324.36
	Fluoro	61	338.01
	CSI	154	315.49
	Rep	39	250.67
	BI	49	267.96
	Res	4	246.00
	US	61	325.89
	NI	23	362.37
	Others	30	322.23
	Total	630	
Doctors will not co-operate with new ideas	GR	209	342.35
	Fluoro	61	281.66
	CSI	154	311.56
	Rep	39	268.14
	BI	49	285.86

	Res	4	251.63
	US	61	318.16
	NI	23	346.61
	Others	30	306.72
	Total	630	
Other staff are not supportive of new ideas	GR	209	324.82
	Fluoro	61	298.92
	CSI	154	320.93
	Rep	39	273.76
	BI	49	290.38
	Res	4	350.25
	US	61	316.99
	NI	23	347.09
	Others	30	319.82
	Total	630	
I do not have the authority to change practice	GR	209	318.71
	Fluoro	61	298.84
	CSI	154	322.98
	Rep	39	269.82
	BI	49	323.26
	Res	4	188.00
	US	61	342.28
	NI	23	328.61
	Others	30	287.85
	Total	630	
The department makes time for me to think about research and changes in practice	GR	209	317.05
	Fluoro	61	299.07
	CSI	154	310.42
	Rep	39	330.47
	BI	49	319.26
	Res	4	305.88
	US	61	295.81
	NI	23	329.24
	Others	30	369.35
	Total	630	
No knowledgeable person(s) within my department to review research with	GR	209	328.25
	Fluoro	61	296.93
	CSI	154	330.43
	Rep	39	274.27

	BI	49	273.95
	Res	4	304.38
	US	61	320.75
	NI	23	319.11
	Others	30	297.30
	Total	630	
I can critically appraise the literature	GR	209	303.55
	Fluoro	61	339.58
	CSI	154	290.04
	Rep	39	335.73
	BI	49	358.89
	Res	4	268.75
	US	61	366.39
	NI	23	348.11
	Others	30	261.07
	Total	630	
I am uncertain whether to believe the research findings	GR	209	319.45
	Fluoro	61	298.71
	CSI	154	322.10
	Rep	39	325.88
	BI	49	303.87
	Res	4	456.13
	US	61	312.11
	NI	23	286.59
	Others	30	303.98
	Total	630	
Available research articles I find are not relevant to my practice	GR	209	317.72
	Fluoro	61	354.47
	CSI	154	330.54
	Rep	39	324.79
	BI	49	263.67
	Res	4	270.63
	US	61	266.34
	NI	23	319.13
	Others	30	319.33
	Total	630	
I can develop my own research questions	GR	209	329.60
	Fluoro	61	305.14
	CSI	154	289.15

	Rep	39	343.82
	BI	49	327.53
	Res	4	296.38
	US	61	314.64
	NI	23	347.28
	Others	30	297.10
	Total	630	
I have difficulty in applying research findings to my practice	GR	209	313.39
	Fluoro	61	340.00
	CSI	154	322.47
	Rep	39	309.38
	BI	49	266.57
	Res	4	332.63
	US	61	307.45
	NI	23	360.48
	Others	30	312.07
	Total	630	
I can interpret statistics in research	GR	209	334.50
	Fluoro	61	331.35
	CSI	154	306.82
	Rep	39	310.96
	BI	49	316.23
	Res	4	254.00
	US	61	274.13
	NI	23	321.63
	Others	30	287.77
	Total	630	
I can judge the quality of a research article	GR	209	315.06
	Fluoro	61	345.02
	CSI	154	303.69
	Rep	39	322.64
	BI	49	314.05
	Res	4	263.75
	US	61	324.66
	NI	23	327.22
	Others	30	291.48
	Total	630	
When I read articles, I can see the implications of a research article	GR	209	313.19
	Fluoro	61	315.78

	CSI	154	319.06
	Rep	39	333.27
	BI	49	305.97
	Res	4	273.75
	US	61	314.14
	NI	23	388.02
	Others	30	257.93
	Total	630	
Relevant literature is not easy to find	GR	209	327.90
	Fluoro	61	321.11
	CSI	154	312.79
	Rep	39	311.26
	BI	49	296.03
	Res	4	243.13
	US	61	305.52
	NI	23	294.57
	Others	30	314.93
	Total	630	
I do not have access to resources relating to research	GR	209	340.52
	Fluoro	61	310.65
	CSI	154	331.23
	Rep	39	281.68
	BI	49	298.86
	Res	4	305.63
	US	61	263.15
	NI	23	290.17
	Others	30	268.68
	Total	630	
Research is not in my scope of practice	GR	209	298.13
	Fluoro	61	293.11
	CSI	154	315.95
	Rep	39	369.09
	BI	49	317.33
	Res	4	335.50
	US	61	339.61
	NI	23	370.57
	Others	30	313.15
	Total	630	
	GR	209	292.80

Research to my practice must be reviewed by radiologists or physicists	Fluoro	61	330.51
	CSI	154	299.34
	Rep	39	373.92
	BI	49	319.91
	Res	4	256.63
	US	61	369.97
	NI	23	337.78
	Others	30	322.93
	Total	630	
I recognise the need to change my own practice in line with research findings	GR	209	309.41
	Fluoro	61	313.59
	CSI	154	301.92
	Rep	39	360.71
	BI	49	314.58
	Res	4	259.38
	US	61	357.19
	NI	23	339.15
	Others	30	278.87
	Total	630	
Research-related matters are a waste of time	GR	209	307.68
	Fluoro	61	310.37
	CSI	154	300.80
	Rep	39	344.87
	BI	49	334.87
	Res	4	292.75
	US	61	382.89
	NI	23	311.41
	Others	30	255.22
	Total	630	
Findings can make valuable contributions to practice	GR	209	317.44
	Fluoro	61	307.70
	CSI	154	304.79
	Rep	39	336.59
	BI	49	321.64
	Res	4	283.63
	US	61	336.55
	NI	23	335.22
	Others	30	281.67
	Total	630	

There are areas in my practice that need to be researched into	GR	209	311.35
	Fluoro	61	294.77
	CSI	154	300.96
	Rep	39	322.01
	BI	49	343.24
	Res	4	256.88
	US	61	373.46
	NI	23	355.59
	Others	30	266.60
	Total	630	
Utilisation improves the quality of patient care	GR	209	311.64
	Fluoro	61	301.63
	CSI	154	304.07
	Rep	39	344.26
	BI	49	324.21
	Res	4	236.63
	US	61	358.26
	NI	23	330.11
	Others	30	290.05
	Total	630	
Changing practice is not my responsibility	GR	209	309.80
	Fluoro	61	321.93
	CSI	154	296.83
	Rep	39	368.87
	BI	49	304.48
	Res	4	303.38
	US	61	355.09
	NI	23	329.00
	Others	30	297.35
	Total	630	

Appendix VI: Mann-Whitney U test for subgroups with p<0.05

Perceived knowledge of research skills

	Subgroups	N	n(%) of agreement	Mean Rank	Response	*p-value*
I can critically appraise the literature	Diploma	65	28(431%)	147.01	A/SA	*0.018*
	BSc	280	178(63.6%)	179.03		
	Diploma	65	28(43.1%)	53.25	A/SA	*0.005*
	MSc	59	44(74.6%)	72.69		
	Diploma	65	28(43.1%)	108.05	A/SA	*0.000*
	Pg C/D	218	161(73.9%)	152.15		
	BSc	280	178(636%)	236.44	A/SA	*0.019*
	Pg C/D	218	161(73.9)	266.28		
I can interpret statistics	Female	489	234(47.9%)	303.83	A/SA	*0.009*
	Male	141	85(60.3%)	355.98		
	Pg C/D	218	100(45.9%)	134.33	A/SA	*0.024*
	MSc	59	36(61.0%)	156.26		
I can develop my own research questions	Diploma	65	21(32.3%)	54.16	A/SA	*0.006*
	MSc	59	38(64.4%)	71.69		
	Pg C/D	218	92(42.2%)	131.75	A/SA	*0.090*
	MSc	59	38(64.4%)	165.79		
	BSc	280	119(42.5%)	162.28	A/SA	*0.007*
	MSc	59	38(64.4%)	206.66		

A=Agree; SA=Strongly Agree; D=Disagree; SD=Strongly Disagree;

Barriers in the organisation

	Subgroups	N	n(%) of agreement	Mean Rank	Response	*p-value*
We are too busy for research matters	CSI	154	88(57.1)	89.64	A/SA	*0.028*
	NI	23	7(30.4)	84.74		
	US	61	36(59.0)	44.57	A/SA	*0.048*
	NI	23	7(30.4)	37.02		
No documented need to change practice	GR	209	113(54.1)	140.25	D/SD	*0.030*
	US	61	44(72.1)	119.22		
	CSI	154	79(51.3)	113.78	D/SD	*0.030*
	US	61	44(72.1)	93.41		
Administration will not allow implementation of new ideas	Band 5	106	38(35.8)	155.58	D/SD	0.016
	Band 7	178	100(56.2)	134.71		
	Fluoro	61	25(41.0)	55.93	D/SD	*0.019*
	Reporting	39	25(64.1)	42.00		
	BI	49	30(61.2)	33.31	D/SD	*0.040*
	NI	23	9(39.1)	43.30		
	GR	209	95(45.5)	133.88	D/SD	*0.049*
	BI	49	30(61.2)	110.82		
	Reporting	39	25(64.1)	27.59	D/SD	*0.024*
	NI	23	9(39.1)	38.13		
Doctors will not cooperate with new ideas	GR	209	76(36.4)	141.47	D/SD	*0.013*
	Fluoro	61	35(57.4)	140.07		
	GR	209	76(36.4)	129.04	D/SD	*0.029*
	Reporting	39	23(59.0)	100.18		
	GR	209	76(36.4)	133.99	D/SD	*0.033*
	BI	49	27(55.1)	110.34		
Other staff not supportive of new ideas	Diploma	65	40(61.5)	127.98	D/SD	*0.035*
	Pg C/D	218	102(46.8)	146.18		
	Diploma	65	40(61.5)	56.48	D/SD	*0.018*
	MSc	59	25(42.4)	69.13		
	Diploma	65	40(61.5)	35.25	D/SD	*0.022*
	Doctorate	8	2(25.0)	51.25		
I do not have the authority to change practice	Band 6	296	101(34.1)	246.66	D/SD	*0.042*
	Band 7	178	80(44.9)	222.27		
	Band 6	296	101(34.1)	178.04	D/SD	*0.024*
	Band 8	50	29(58.0)	146.62		
	Reporting	39	12(30.8)	43.59	A/SA	*0.038*
	US	61	35(57.4)	54.92		

A=Agree; SA=Strongly Agree; D=Disagree; SD=Strongly Disagree;

Attitude to Research Utilisation

	Subgroup	N	n(%) of agreement	Mean Rank	*p-value*	Response
Research is not in my scope of practice	Diploma	65	31(47.4)	53.62	*0.008*	D/SD
	MSc	59	44(74.5)	72.28		
	BSc	280	152(54.2)	162.95	*0.010*	D/SD
	MSc	59	44(74.5)	203.47		
Research to my practice must be reviewed by radiologists and physicists	Diploma	65	36(55.4)	120.17	*0.027*	D/SD
	PgC/D	218	159(72.9)	148.51		
	Diploma	65	55(.4)	54.26	*0.049*	D/SD
	MSc	59	45(76.3)	72.28		
I recognise the need to change practice	Diploma	65	38(58.5)	123.03	*0.043*	A/SA
	PgC/D	218	164(75.3)	147.66		
	CSI	154	102(68.1)	102.32	*0.007*	A/SA
	US	61	53(86.9)	122.33		
	GR	209	146(67.9)	130.98	*0.008*	A/SA
	US	61	53(86.9)	150.99		
Research-related matters is a waste of time	GR	209	160(76.6)	128.36	*0.017*	D/SD
	US	61	55(90.1)	159.96		
	CSI	154	119(77.3)	99.82	*0.027*	D/SD
	US	61	55(90.1)	128.66		
	Fluro		47(77.1)	54.24	*0.047*	D/SD
	US	61	55(90.1)	68.76		
Research findings can make valuable contributions to practice	CSI	154	120(77.9)	104.76	*0.048*	A/SA
	US	64	55(90.2)	116.17		
There are some areas in my practice that need researching into	Band 5	106	78(73.6)	225.22	*0.025*	A/SA
	Band 6	296	181(61.2)	193.01		
	CSI	154	93(60.4)	101.01	*0.016*	A/SA
	US	61	48(78.7)	125.65		
	Fluoro	61	36(59.0)	53.56	*0.031*	A/SA
	US	61	78.7)	69.44		
Research utilisation improves practice	Fluoro	61	42(68.9)	55.88	*0.041*	A/SA
	US	61	52(85.2)	64.53		
	CSI	145	111(72.1)	102.68	*0.045*	A/SA
	US	61	52(85.2)	121.43		
I am not responsible for changing practice	GR	209	149(71.3)	161.18	*0.037*	D/SD
	US	61	52(85.2)	150.29		
	CSI	154	109(70.8)	102.06	*0.040*	D/SD
	US	61	52(85.2)	122.98		
	Fluoro	61	52(85.2)	58.47	*0.045*	D/SD
	US	61	41(67.2)	64.53		

A=Agree; SA=Strongly Agree; D=Disagree; SD=Strongly Disagree