I-SWAP Protocol v1

- This protocol has regard for the HRA guidance and order of content

- This study is funded by the NIHR **[NIHR Health Services & Delivery Research Programme: 20/115 Health and Social Care Workforce (NIHR 133813)]**. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.

- The protocol is created by the named authors, under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This project and subsequent publications will be Open Access publications distributed under the terms of the Creative Commons Attribution CC-BY 4.0 licence, which permits unrestricted use, distribution, reproduction and adaption in any medium and for any purpose provided that it is properly attributed. Under this license, the authors agree that anyone can reuse part or all of the protocol and subsequent articles under the Creative Commons Attribution (CC BY) terms (https://creativecommons.org/licenses/by/4.0/). The study has permission to use any third party materials.

FULL/LONG TITLE OF THE STUDY

The determinants of the utilisation of the support and assistant workforce in diagnostic imaging: a multi-methods investigation.

SHORT STUDY TITLE / ACRONYM

I-SWAP Study – Imaging Support Workers and Assistant Practitioners

PROTOCOL VERSION NUMBER AND DATE

I-SWAP study protocol – approved by Study Steering Committee, Sponsor and HRA

Version 1 21/11/22 (renamed v1 to denote full approval of version 0.3 by HRA)

RESEARCH REFERENCE NUMBERS

IRAS Number:	318182
SPONSORS Number:	AA37714491
FUNDERS Number:	NIHR133813

SIGNATURE PAGE

The undersigned confirm that the following protocol has been agreed and accepted and that the Chief Investigator agrees to conduct the study in compliance with the approved protocol and will adhere to the principles outlined in the Declaration of Helsinki, the Sponsor's SOPs, and other regulatory requirement.

I agree to ensure that the confidential information contained in this document will not be used for any other purpose other than the evaluation or conduct of the investigation without the prior written consent of the Sponsor

I also confirm that I will make the findings of the study publically available through publication or other dissemination tools without any unnecessary delay and that an honest accurate and transparent account of the study will be given; and that any discrepancies from the study as planned in this protocol will be explained.

For and on behalf of the Study Sponsor:

Date: 23/08/22

Signature: 

.....

Name (please print):

.....Keith Fildes.....

Position: .....Research Development Manager.....

Chief Investigator:

Date: 31/05/22

Signature: 

.....

Name: (please print): Prof Julie Nightingale

.....

LIST of CONTENTS

KEY STUDY CONTACTS

Insert full details of the key study contacts including the following

Chief Investigator	Prof Julie Nightingale J.Nightingale@shu.ac.uk; 07584 538587
Project Manager	Sarah Etty (Contact details TBC)
Sponsor representative	Dr Keith Fildes – K.Fildes@shu.ac.uk Research Development Manager, Research and Innovation Services, Sheffield Hallam University
Joint-sponsor(s)/co-sponsor(s)	N/A
Funder(s)	NIHR HS&DR: 20/115 Health and Social Care Workforce
Key Protocol Contributors	Prof Julie Nightingale – J.Nightingale@shu.ac.uk Prof Shona Kelly - hwbsk1@exchange.shu.ac.uk Dr Trudy Sevens – t.j.sevens@shu.ac.uk Prof Beverly Snaith – B.Snaith@bradford.ac.uk Associate Prof Hilary Piercy - hwbhp@exchange.shu.ac.uk Dr Robert Appleyard - hscrma@exchange.shu.ac.uk
Committees	*Study Steering Committee:* Chair – A. Prof Karen Knapp – K.M.Knapp@exeter.ac.uk *Stakeholder Advisory Group:* Chair – Prof Bev Snaith – B.Snaith@bradford.ac.uk *Patient and Public Involvement Group* Chair – Prof Bev Snaith – B.Snaith@bradford.ac.uk *Study Management Group:* Chair – Prof Julie Nightingale – J.Nightingale@shu.ac.uk

STUDY SUMMARY

Study Title	The determinants of the utilisation of the support and assistant workforce in diagnostic imaging: a multi-methods investigation.
Internal ref. no. (or short title)	I-SWAP Study – Imaging Support Workers and Assistant Practitioners
Study Design	Mixed Methods
Study Participants	Imaging staff (support workers, their supervisors and service leads) and regional network staff
Planned Size of Sample (if applicable)	N/A
Follow up duration (if applicable)	N/A

Planned Study Period	1st June 2022 – 31st August 2024
Research Question/Aim(s)	Aim: To investigate the development, deployment, and contribution of the S&A workforce to diagnostic imaging activity across England to determine effective models of practice that will support future workforce transformation and re-design. Research question: What models of deployment of the S&A workforce exist within diagnostic imaging departments and what service, hospital, regional and national factors may encourage or inhibit implementation of these models?

FUNDING AND SUPPORT IN KIND

FUNDER(S) (Names and contact details of ALL organisations providing funding and/or support in kind for this study)	**FINANCIAL AND NON FINANCIALSUPPORT GIVEN**
NIHR HS&DR: 20/115 Health and Social Care Workforce	£448,436.93
Sheffield Hallam University	Non financial (environment)
University of Bradford	Non financial (environment)

ROLE OF STUDY SPONSOR AND FUNDER

The role of both funder and sponsor is to provide oversight of the project (via the Study Steering Committee) to ensure that the study progresses on time, within budget and adhering to strictest ethical and governance standards.

ROLES AND RESPONSIBILITIES OF STUDY MANAGEMENT COMMITEES/GROUPS & INDIVIDUALS

Four committees and groups will provide guidance to the study.

I-SWAP Study Steering Committee (SSC)

Provides oversight of study progress (timescales and budgets) and ethics and governance. The SSC includes an Independent Chair and 75% independent membership, including a Public Representative. Meets twice per year and reports to sponsor and funder.

I-SWAP Study Management Group (SMG)

The SMG will be established with membership of the co-investigators and other individuals (project manager; research assistants) who are responsible for the day-to-day running of the study. The SMG will be chaired by the chief investigator (JN) and they will meet at least once per month. They will be responsible for overseeing the progress of the study throughout each of the workstreams and will ensure the overall quality of the study. The SMG will report to the Study Steering Committee (SSC).

I-SWAP Stakeholder Advisory Group (SAG)

The SAG will meet every six months to provide advice and feedback to the study team and the SSC. One of the co-applicants (BS) will chair the SAG which will include core membership from the chief investigator (JN), the PPI group representative, and the other co-investigators as relevant to the stage of the project. Invitations to key external stakeholders will be extended, providing them with an opportunity to inform and shape the research while also keeping the research team updated with any external developments relevant to the project brief. These external SAG members will be vital links to achieving maximum dissemination of project outputs beyond academic publications.

I-SWAP Patient and Public Involvement Advisory Group (PPIAG)

The PPI lead (BS) will chair the PPI Advisory Group which will comprise six independent members who have experienced medical imaging for a range of patient pathways. We will offer invitations to join the group to both of the PPI groups that we currently have established relationships with Mid Yorkshire Hospitals Imaging PPI group and the Sheffield Hallam University Advanced Wellbeing Research Centre Patient Involvement in Research group. We will invite the group to nominate a lead PPI representative who will be invited to join the Stakeholder Advisory group to ensure that the patient voice is strong throughout the project.

PROTOCOL CONTRIBUTORS

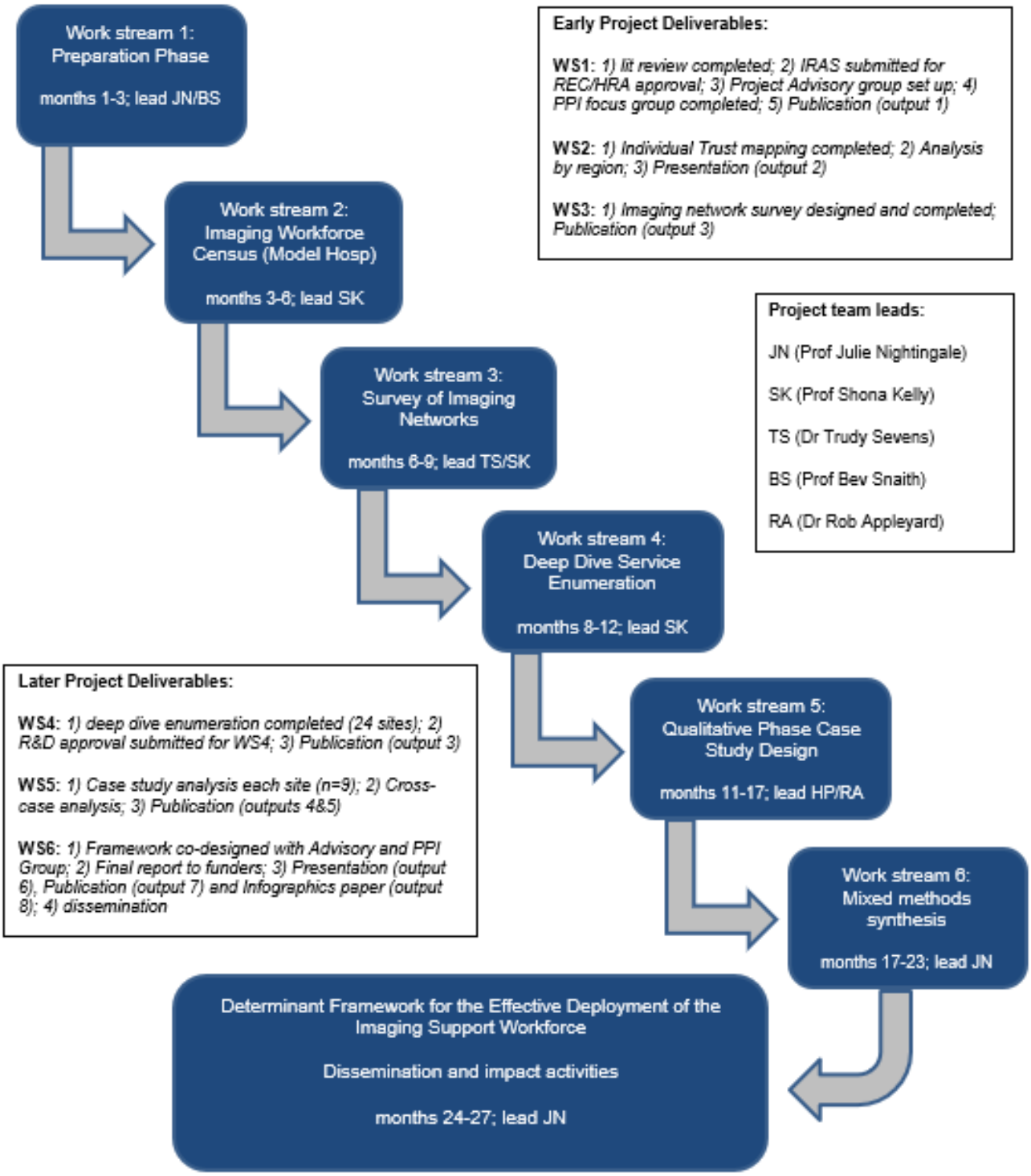
- The primary contributors to the protocol include the Chief Investigator and the co-investigators of the study.
- The sponsor and funders do not have any role in participating in study design, conduct, data analysis and interpretation, manuscript writing, and dissemination of results, and do not have any role in controlling the final decision regarding any of these aspects of the study. However project oversight will be through the Study Steering Committee which will report to the sponsor and funder.
- Members of the public have not been involved in preparing or advising on this draft of the protocol. However this protocol has been reviewed and agreed by the Study Steering Committee which includes a Public Representative. Further aspects of design of each workstream (e.g. interview schedules) will be informed and reviewed by the PPI group and the Stakeholder Advisory Group prior to distribution.

KEY WORDS: Healthcare workforce; support workers; skill mix; mixed methods; medical imaging; radiology; radiography

STUDY FLOW CHART

The determinants of the utilisation of the support and assistant workforce in diagnostic imaging: a multi-methods investigation.

Research Design Flow Chart



STUDY PROTOCOL

The determinants of the utilisation of the support and assistant workforce in diagnostic imaging: a multi-methods investigation.

1 BACKGROUND

Demand for diagnostic imaging is rising year on year, against a backdrop of persistently high vacancy rates in the registered workforce (radiographers and radiologists) [1]. The pandemic has placed increased demands on the workforce and further exacerbated an already stretched service which is now in crisis. In February 2021, 138,385 patients in England were waiting over six weeks for a CT, MRI or ultrasound scan – 12 times as many as in February 2020 [1]. Some imaging departments are reporting backlogs of up to 10,000 imaging referrals with delayed diagnosis impacting on patient outcomes [1]. There is an urgent need for expansion of the imaging department workforce, from support worker to consultant. This requires the team to be deployed using efficient and effective skills mix strategies to ensure that their scope of practice is maximised. However, there is substantial variation in how imaging staff are used across England in terms of skill mix, grades and roles [2].

Three recent high profile national reports [2-4] have highlighted the need for urgent wide-scale changes to imaging infrastructure and pathways, including: 1) establishment of regional imaging networks; 2) sub-division of elective and acute/emergency diagnostics; 3) provision of imaging closer to the patient in community diagnostic centres. All three reports highlight the urgent need to develop the capacity and capability of the imaging S&A workforce in order to address a service in crisis, yet there is an evidence gap in how the S&A workforce can best contribute to imaging delivery to grow the required capacity. Two decades of Government policy have stimulated substantial development of the healthcare support workforce as part of a wider NHS modernisation agenda [5,6], encouraging innovative new roles underpinned by appropriate delegation and the substitution of tasks from registered professional to support worker. The career framework for the radiography profession acknowledges that with appropriate supervision the S&A workforce can undertake many patient-facing activities (including image acquisition) that were formerly in the domain of the registered radiographer [7], thus releasing time for registrants to undertake vital advanced roles such as image reporting. This in turn provides backfill to enable the medical workforce, radiologists, to undertake and report on the most complex imaging procedures. The ideal workforce model is a pyramidal design, with greatest numbers of S&A staff in the lower tiers working alongside radiographers in the upper tiers. However, many Trusts have not embraced, or under-utilise, the S&A workforce.

The S&A workforce is modelled on a three-tiered structure of support workers (entry level), senior support workers (intermediate level), and assistant practitioners, providing support for a wide range of registered professions including radiographers [8-10]. The recently launched Allied Health Professions (AHP) Support Worker Competency, Education and Career Development Framework [10] aims to reduce unwarranted variation in support worker roles, pay band and progression. This will ensure that patients and service users will have access to skilled and consistently well-trained support workers, with these roles “being at the heart of improvements in service delivery and transformation, including new models of care” [10]. Support workers (band 2) carry out well defined routine clinical and administrative duties and essential fundamentals of care, reporting directly to a registered healthcare practitioner. Senior support workers (band 3) undertake a range of clinical and non-clinical activities, under direct or indirect supervision. Assistant Practitioners (band 4) have skills and knowledge beyond that of the healthcare support worker to competently perform duties in areas which have previously been solely within the remit of a registered professional. As such, they work semi-autonomously within a specified care plan, with accountability that comes through working to locally agreed and defined standard operating procedures, protocols or systems of work [7,9]. While current post-holders may possess a range of educational qualifications to prepare them for the role, new apprenticeship standards have recently been created or updated and approved to support all three S&A tiers of practice [10].

Assistant practitioners are well-established in the radiography profession, most notably within breast screening where in 2016 they represented 28% of the total mammographic workforce [11]. Building on this success, the breast screening community has pioneered the development of an additional Associate Practitioner (Level 4) standard for mammography practice. However, within other areas of imaging, the role has been implemented to variable degrees; some imaging centres are yet to employ assistant practitioners or restrict their deployment. An initial review of NHS Model Hospital data [12] indicates substantial variability between units, with analysis of two selected NHS Trusts indicating a ten-fold difference in the number of S&A staff employed as a proportion of total radiography workforce: 28% Mid Yorkshire Hospitals NHS Trust vs 3.1% Barts and the London NHS Trust. The proportion of advanced/consultant appointments was also higher in the former, suggesting a potential correlation between S&A worker deployment and skills mix facilitated in an imaging department.

The apparent reluctance in some centres to utilise assistant practitioners may be due in part to a weak evidence base for their impact and effectiveness. The role of the imaging S&A workforce is not widely covered in the literature and is complicated by their roles using a variety of terminology. We reviewed Medline, CINAHL and Scopus databases using the following search terms: "radiology OR radiography OR x-ray OR radiologic technology OR radiographic imaging" AND "workforce OR workplace OR labor OR employee" AND "assistant" OR "support". This yielded 170 hits which reduced to 163 after removing duplicates. Screening of title and abstract further reduced the peer reviewed literature to fewer than 40 papers; most concerned the advanced practice role (peripheral to the topic of interest) and the historical precedents for the current situation. Only nine articles were identified related to the radiography assistant practitioner. None were found relating to the role of the imaging support worker. These nine articles demonstrate that research related to assistant practitioners in radiography is primarily focussed on education and curricula design [13,14] and individual perceptions of the role [15-18) rather than on evidence of impact. Most studies are now a decade old [15,17,19-22] and deployment practices are likely to have progressed. The most recent work includes a survey of assistant practitioners which highlighted inconsistences in deployment, variation in scope of practice and a lack of opportunities for career progression [18,23].

2 RATIONALE

Government priorities to build capacity and capability using the modern S&A workforce, supported by innovative work-based learning apprenticeship models, will potentially provide diagnostic imaging departments with a more supportive, equitable and transferable structure for educating and training their S&A workforce. However, the provision of educational opportunities alone will not drive forwards the vital transformational change that is required to address the crisis in Diagnostic Imaging workforce supply and demand. We need to understand the factors which influence how, why and where the S&A imaging workforce is deployed, and identify what constitutes best practice in supporting this staff group to maximise their contribution to service delivery.

Current estimates suggest that effective NHS imaging services require £2 billion per year, with over two thirds of that funding spent on staffing [2]. With on-going issues related to recruitment and retention of imaging staff (particularly radiologists, radiographers and sonographers), approximately £150 million per annum is spent on expensive agency, overtime and bank staff to fill in the service gaps [1,2]. This is unsustainable, both financially and in terms of delivering a viable, quality service.

The demand for imaging services has continued to increase year on year in response to population needs and national policy drivers, particularly around cancer, heart disease and stroke. By providing first line diagnostics across most patient pathways, imaging services impact upon the majority of clinical specialties in both primary and secondary care [4]. The increasing demand for imaging is compounded by a multitude of workforce issues. Ensuring positive patient outcomes and experience whilst reducing unwarranted variation across the NHS requires substantial investment in remodelling the workforce and service delivery. Modernisation is necessary to increase imaging capacity whilst ensuring patient safety, quality, efficiency and productivity. Maximising skill mix through more effective

deployment of the S&A workforce also has the potential to enhance staff recruitment and retention, ultimately leading to more resilient and sustainable services.

However, this service transformation requires the support of influential stakeholders to ensure that research findings are adopted widely. Our research team is linked in to a S&A workforce collaboration between Health Education England and the Society and College of Radiographers. This 'Supporting Success' project is developing guidance on roles and responsibilities for diagnostic radiography (imaging) support workers, underpinned by the recently published AHP framework [10]. This activity has been informed by an expert reference group which includes two members of our research team (JN and TS). In addition to this important bidirectional communication channel, we also have close connections to S&A workforce development activities currently underway within the Integrated Care Systems (ICS) and Imaging Networks. One of our research team (TS) is Lead Radiographer for the first ICS that was established. Another research team member (BS) is currently working with HEE to support regional teams in the implementation of advanced practice, thereby ensuring that we do not see S&A roles in isolation, but as an important enabler in the wider workforce skill mix. These inter-connected workstreams are being underpinned by funding to support S&A workforce audit activities as part of the national roll out of the AHP Support Worker Framework [10]. In 2021/22, NHS trusts across England have been offered one-off assistance to review current deployment and education provision for the S&A tier and to build clear plans locally on how to recruit the future workforce [10].

This work reinforces the criticality, relevance and urgency of our proposed research to understand the most effective ways to utilise the S&A workforce to underpin training pipelines and safe delivery of services. Simply increasing numbers of support staff and radiographers and radiologists in training will not be sufficient to maintain and expand imaging capacity. Investment in S&A staff must be appropriately targeted to ensure that they are effectively and safely utilised. It is essential that we capitalise on the momentum created by these inter-connecting workstreams to develop and share an understanding of what is the optimal deployment of the S&A workforce within diagnostic imaging departments. We need to identify what departmental, hospital, regional and national factors may encourage or inhibit implementation of this workforce model.

Given the central role that this workforce component now holds, there is a serious lack of underpinning research on which to develop effective workforce strategies. A review of research databases including PROSPERO (International Prospective Register of Systematic Reviews) [24] show that no related research is currently underway. The proposed research will make a vital contribution to workforce re-design by investigating the deployment, development and contribution of the support and assistant (S&A) workforce within diagnostic imaging departments across England.

3 THEORETICAL FRAMEWORK

This study employs a Mixed Methods Explanatory research design, whereby a qualitative workstream is used to explain and enrich the understanding of earlier quantitative data workstreams [25]. These multiple approaches strengthen the study compared to using a single method [26]. The Workstreams move progressively from a broad view to a more nuanced view of the S&A workforce and encompass both qualitative and quantitative techniques. The Triangulation Protocol Method will be used to synthesise and triangulate the data from each phase [27]. The integration of the Mixed Methods data will be based on a six-step approach [28] which builds upon the individual analyses by yielding additional findings related to areas of agreement (convergence) and dissonance (divergence) across the data collected. Synthesis of the findings will yield recommendations for a Framework of practice.

The study will commence in WS1 with a mapping literature review to inform the creation of data collection tools in subsequent workstreams, alongside a focus group with PPI representatives. WS2 presents a quantitative analysis of existing organisational, regional and system level data across England (Health Education England workforce data). Aware of its limitations, we will supplement this analysis in WS3 and 4 with structured interview survey data from regional and system level Imaging Network Leads, and from purposefully selected imaging service managers at organisational level.

Both of these Workstreams will provide us with the information needed to select locations for detailed qualitative review in WS5.

Case study design will frame the qualitative data collection phase in WS5 and will enable us to identify and explore in increasing detail issues that arise during the course of data collection. Capitalising on this, we will conduct the case studies sequentially, involving the 'high' category sites first on the basis that S&A roles are likely to be more developed in those units where they comprise a higher proportion of the total workforce. This approach will enable us to identify and examine innovative approaches and aspects of 'good practice' which operate effectively in those units and then to incorporate those into data collection for the subsequent case studies. This will enable us to explore whether comparable practices have been considered or implemented in those units where the role is likely to be less developed, including the degree to which they were successful and any barriers to implementation. Data analysis will involve individual case study analysis followed by a cross case analysis using a thematic analysis approach.

4 RESEARCH QUESTION/AIM(S)

Aim: To investigate the development, deployment, and contribution of the S&A workforce to diagnostic imaging activity across England to determine effective models of practice that will support future workforce transformation and re-design.

Research question: What models of deployment of the S&A workforce exist within diagnostic imaging departments and what service, hospital, regional and national factors may encourage or inhibit implementation of these models?

4.1 Objectives

i) To explore where and how the S&A workforce is deployed within diagnostic imaging services in England [WS2];
ii) To explore contextual factors including organisational culture which serve to facilitate or inhibit the contribution of the S&A workforce to imaging services [WS1, 4 & 5];
iii) To understand how investment in the imaging workforce (training and development) has enabled role expansion and advanced practice within the imaging departments [WS4 & 5];
iv) To identify the current situation and potential for collaboration across Imaging Networks in disseminating and implementing effective S&A workforce strategies across regions [WS2 & 3];
v) To synthesise the findings from i) to iv) to generate an evidence-based framework for effective implementation and expansion of the S&A workforce [WS6];
vi) To identify additional research questions emerging from the investigations [WS1 & 6].

4.2 Outcome

Achievement of objectives i to iv above will result in the development of a Determinant Framework for the effective deployment of the imaging S&A workforce.

5 STUDY DESIGN and METHODS of DATA COLLECTION AND DATA ANALYSIS

5.1 Overview

This study will provide a detailed analysis of development, deployment, and contribution of the S&A workforce to diagnostic imaging activity across England. It will be led by an experienced team with extensive imaging expertise (clinical academic leaders and researchers) working alongside experienced health care research methodologists. The team will be supported by a research assistant and research project manager. The study employs a Mixed Methods Explanatory research design, whereby a qualitative workstream (WS) is used to explain and enrich the understanding of an earlier quantitative data workstream [25,26]. A structured triangulation protocol is used to synthesise and triangulate the data from each phase [27;28], resulting in a Determinant Framework for the effective deployment of the imaging S&A workforce. The six-stage research design is shown in the study flowchart (page vii).

5.2 Workstream 1 - Preparatory phase [JN lead]

The processes for gaining institutional ethics approval, national REC and HRA approval will be initiated on notification of the award. Individual NHS Trust governance approval will be requested at a later stage of the project in preparation for WS4 and 5.

A Stakeholder Advisory Group (SAG) will be established to provide critical feedback to support key stages of the project and intelligence on alignment with related external activity. We will extend invitations to representatives for: the Society and College of Radiographers; the Royal College of Radiologists; Health Education England support worker leads/workforce transformation leads; regional Diagnostic Programme Steering Board; Integrated Care System Imaging Networks; national Radiology Managers group; and S&A worker representatives. One of the key members of the Advisory group will work closely with the Chair of an Imaging PPI group which we will convene to ensure that the patient voice is strong throughout the project. In this early workstream we will undertake a focus group with the PPI members to establish our service users' level of awareness of the existence and role of S&A workers in imaging, and to ascertain their perspectives, needs and values in relation to the provision of imaging services.

A mapping review will provide a characterisation of the overall quantity and quality of the literature [29] related to frameworks for practice for the S&A workforce across a range of health and care professions internationally. This type of review is appropriate in circumstances where the 'lie of the land' needs to be established [29], and will widen the search terms to embrace a wider range of health care professions, so that we can identify any models of practice used in other professions that may help to inform the deployment of S&A workers in imaging services. The search will explore four relevant databases (Medline, CINAHL, Scopus and Google Scholar (the latter to capture a wider range of professional literature). We will capture relevant international frameworks and models where they are available in English language. We will supplement the search of peer reviewed research with a search of 'grey literature' including: 1) websites of governmental and 'Arm's-length bodies' such as Skills for Health and Health Education England; 2) searches of relevant professional organisation websites; 3) document repositories (e.g. The College of Radiographers).

The search terms will be agreed by the team alongside a set of inclusion and exclusion criteria based on relevance developed for any articles identified. Following removal of duplicates, the titles and abstracts will be searched to identify evidence that meets the inclusion criteria. Discrepancies in opinions about the relevance of articles will be resolved through discussion amongst the project team.

A bespoke data extraction form will be developed to encompass criteria based on relevance of content and credibility (methodological rigour). The assessment of rigour and study bias for each article will be informed by use of the appropriate Critical Appraisal Skills Programme (CASP) assessment tool [30].

Data will be extracted and then checked by a second member of the team. The team will undertake a visual synthesis (mapping) and classification of the available studies. A high-level map visualizing the breadth and depth of international S&A workforce literature across the spectrum of health care professions will be created.

5.3 Workstream 2 - Census of Imaging Workforce (using HEE workforce data) [SK lead]

Method

To determine, from HEE data (formerly managed by Model Hospital[12], a free NHS digital information service from NHS Improvement and NHS England data), what roles are in place in NHSE imaging departments. This workforce data was created to allow health systems and trusts to compare their productivity, quality and efficiency with the intention of enabling them to identify opportunities to improve. It has been previously used to inform the comparison of radiographer reporting deployment [4,31].

Data Collection and sampling

The staffing component of the HEE workforce data is taken from the Electronic Service Record (ESR) and is updated annually with an autumn release date. We will use the staff information component to analyse radiographer (including consultant, advanced, sonographer and mammographers), assistant and support roles within NHSE Trust diagnostic imaging departments [n=144]. Information will be analysed on Whole Time Equivalence for: specialism, pay band, bank staff, and vacancies, which will allow us to stratify the Trusts across a range of different measures. As this data is regarded as a complete count of the workforce, it is not relevant to calculate a sample size.

Data Analysis

The first analysis will rank the Trusts by the proportion of S&A posts within the whole radiographic workforce. Additional analysis will explore advanced and consultant posts as a proportion of the total radiographic workforce, and the relative difference between the two. This latter analysis will identify outliers and allow us to look for differences at the regional level or by organisation type (e.g. hospital classification). Using this stratified analysis, we will select 24 Trusts for a 'deep dive' enumeration in WS4. Regional level analysis (at the newly established imaging network level) will be used to inform the development of a survey to gather information related to workforce initiatives from Imaging Networks in WS3. The findings from this workstream will provide a snapshot of the NHSE diagnostic imaging workforce separate from the rest of the allied health professions.

Limitations

NHS workforce analysts have warned us that the HEE workforce data is only moderately accurate as it is only collected once a year and there are no quality criteria monitoring its accuracy. However, this is the only systematic recording of workforce roles in NHSE and a good basis for WS3 and 4.

Additionally the data is not open access. The Principal Analyst for Model Hospital was initially approached and confirmed that the requested data is “likely disclosable if it were requested under FOI, the team would support the request but under ‘business as usual’ request. But to confirm this would be organisational level aggregated data on Radiology/imaging workforce and where there could be a risk of re-identification to individuals any small numbers may need to be suppressed”. This means we will have to request that they distinguish between small numbers (less than 5) and zero in the counts so that we will be able to confirm that there are staff in a particular pay band or not. As part of our Freedom of Information request we will seek to identify whether data exists that will enable us to analyse whether there are differences in the demographic profile of support workers in comparison to the wider radiographic workforce (e.g. age profile, ethnicity and gender).

5.4 Workstream 3 - Survey of Imaging Networks [TS & SK lead]

Method

NHS England committed to establishing imaging networks across England by 2023. The 'Transforming Imaging Services' report [2] directs NHS trusts and foundation trusts to come together to create imaging networks that each have their own identity, operating model, 'brand' and potentially separate legal status. This workstream will engage with these new imaging networks via a questionnaire to showcase examples of innovative practice across regional networks which can be shared with other radiography employers.

Data collection and sampling

All system level lead radiographers or Imaging Network representatives will be invited to participate. The target participants, who may or may not be radiographers, will be identified through established regional and system AHP Councils and Faculties. To mitigate a poor response rate both AHP Council Chairs and their deputies will be contacted, and a Research Assistant (RA) will administer the survey and will make multiple, reasonable, attempts to set up mutually convenient times for telephone meetings.

The survey explores WS2 findings and will identify regional/system-level approaches to recruitment, education and training, competency assessment, supervision and deployment of the S&A workforce. The survey will use a combination of Likert scales and open-ended questions informed by the generic questions for regions, systems and organisations within the HEE AHP support workforce readiness toolkit [32]. The toolkit encompasses the whole of the allied health professions; this workstream will therefore capture more detailed information on, and analysis of, the diagnostic imaging workforce. Probing and exploratory questions will focus on recruitment and retention of the S&A workforce in imaging, and where and how skill mix is facilitating imaging services to operate most effectively. Training of the S&A workforce through the emerging regional imaging and diagnostic training academies will also be explored. One of the co-leads (TS) for this workstream is well placed to inform the development of the survey being actively involved in system, regional and national level workforce groups. Working at the forefront of HEE and AHP Faculty workforce transformation agendas provide a unique insight to contribute to the formulation of the survey content. The second workstream co-lead (SK) has extensive methodological experience to inform the data collection and analysis.

The survey will be supported by a review of publicly available regional workforce strategy and planning documentation relevant to the S&A staff groups. Documentation will be mapped against the HEE Allied Health Professions' Support Worker Competency, Education and Career Framework and the HEE Allied Health Professions support workforce: readiness toolkit 2021 [10,32].

Data Analysis

Basic descriptive statistics will be used to describe the Imaging Networks and Framework analysis begun after the first interview will be used to identify themes. Workstream 5 contains an explanation of this analytic technique.

5.5 Workstream 4 - Deep Dive Enumeration of Imaging Services [SK lead]

Method

Given the limitations of information available via Model Hospital, combined with the rapid implementation of regional and system-level Imaging Networks and the imminent establishment of Community Diagnostic Centres, a deep dive (via telephone interviews) of the imaging workforce is required for WS4.

Data Collection and sampling

Imaging services in the 24 Trusts identified following analysis of HEE workforce data in WS2, will be approached to complete a detailed enumeration of workforce roles. The Trusts will be selected to

represent a spread of S&A staff proportions allowing us to capture a range of perspectives. Where Trusts have fully implemented the Allied Health Professions' Support Worker Competency, Education and Career Framework [10] and Allied Health Professions support workforce: readiness toolkit 2021 [32], this will be capitalised upon through transferable learning. Conversely in Trusts that are yet to fully embrace the framework and toolkit, an exploration as to the barriers and challenges will be undertaken. This will provide an organisational level AHP position which will be interrogated to establish the imaging specific position.

After receiving Trust R&D approval the Radiology Service Managers (likely to be at least one per NHS Trust) will be invited to be interviewed on a prearranged phone/MS Teams call using a structured interview. The interview will start by mapping the image service structure (services and locations) at a finer level than is available from HEE workforce data, confirming the accuracy of the information yielded from Workstream 2 and stating which modalities include S&A roles in their services. The HEE support workforce readiness toolkit [32], if completed, will allow them easy access to this information; if not completed it will expedite and support this process.

The radiology managers' data collected in this stage will reveal exemplars of S&A workforce practice and career progression opportunities, as well as detail relating to actual roles and job descriptions, Agenda for Change employment banding and education levels of S&A workers. We will be asking managers in workstreams 4 and 5 about any organisational barriers, capacity constraints or economic challenges that may restrict any further expansion of their support workforce. We will explore with managers what economic factors may have influenced their planning and preparation of business cases for new support worker roles, including any key cost drivers such as grade of staff, time allocated per imaging examination, and different levels of utilisation (workload). Where support staff are allocated 'less complicated' patients than registered practitioners, these key drivers may be influential. In addition, we will explore any solutions or workarounds to these economic barriers that they have successfully implemented. Managers will be asked about PPI engagement which may have influenced the development of the S&A roles. This will allow us to cross reference role requirements and deployment in practice as well as meeting the HEE AHP support Worker competency, education and career framework requirements [10]. The information gathered from this workstream will allow us to identify which trusts to include as detailed case studies in WS5. In preparation for this, the Radiology Service Managers will be asked in this stage of the project to confirm their willingness to participate in the next stage.

Data Analysis

Framework analysis using NVivo qualitative data analysis software [33] to organise and manage the process will be used following the first interview to identify emerging themes. WS5 contains an explanation of this analytic technique.

5.6 Workstream 5 - Qualitative Phase (Case study design) [HP lead]

Method

This workstream will use a collective case study approach [34,35] involving a series of nine individual case studies, in which the case is defined as the imaging service and the support and assistant workers as the unit of analysis. This approach will provide a comprehensive and multi-dimensional examination of each case in turn focusing on their individual complexities. Each case study will then contribute to a collective and expansive understanding of how the S&A workforce is employed in a range of different settings and the contextual factors and circumstances that influence the process. Careful selection of the case study sites means the findings will be comprehensive and widely applicable to radiography services across the country.

Sampling

We will recruit nine imaging services using a purposive sampling approach. Drawing on data from WS4 which categorises services in terms of relative proportions of S&A staff, we will identify and recruit three 'high', three 'medium' and three 'low' category sites. We will endeavour to select services from different geographical regions and settings and from different organisational types.

Data collection

We will conduct the case studies sequentially, starting with the 'high' category sites because we anticipate that their S&A roles will be most developed and offer the richest insights including a longitudinal perspective charting development over time. This approach will enable us to identify and examine innovative approaches and then to incorporate those into data collection for the subsequent case studies. This will sensitise us to the opportunities for development of the S&A role which we will then explore as part of the second set of case studies, enabling us to understand whether similar approaches have been considered or implemented in those units where S&A roles are less developed.

A two-day site visit to each of the case study sites for data collection purposes will involve two researchers, one with and one without a radiography background to provide an emic and etic perspective respectively. This approach offers complementary insights to assist interpretation and challenge assumptions and pre-conceptions, adding to the richness of the data and confidence in the findings [36]. Both researchers will take detailed field notes during the visits, capturing their observations and impressions which will feed into the analytic process. We will collect data from multiple sources:

i) Radiology Manager(s) - a semi-structured interview will build on the enumeration data gathered through structured interviews in WS4. We will focus on the organisational structure of the unit, their strategic approach to deploying the S&A workforce and operational issues associated with realising that approach. The interview will then 'drill down' to explore selected modalities (e.g. CT, MRI, digital radiography) where the S&A workforce are being deployed or might be deployed in future. The interview will explore optimal skills mix and workforce planning decisions and the barriers and facilitators impacting on their realisation. The interviews will include specific questions about their previous recruitment strategies, and whether they recruit from other NHS roles within the same employing organisation, or recruit directly into the NHS from local communities and non-NHS services. We will explore what works well and where there are challenges in advertising, recruiting, training and retaining their support workforce. We will explore whether there are any barriers for managers recruiting directly from the local community, and will enquire whether there are any local employment initiatives to assist in addressing any workforce demographic imbalances (e.g. schemes to recruit from under-represented populations).

ii) Local S&A workforce service documentation - we will undertake a review of workforce profile, service guidelines, job descriptions and scope of practice documents.

iii) Modality lead radiographers - semi-structured interviews with 2-3 lead radiographers involved in S&A workforce recruitment, deployment, training and resource decisions. Interviews will explore the contribution of the S&A workforce to the modality and the processes that support those roles including supervision, delegation and assessment and the use of technologies. Any implications for safety and quality will be explored, including perceived quality issues and training needs, and any concerns raised by patients related to care provided by the support workforce.

iv) Imaging S&A workers - we will host a focus group with 4-5 S&A employees drawn from the selected modalities. They will compare and contrast their roles including their scope of practice and their autonomy in decision making. Their perceptions of their role within the wider imaging team will be explored, including opportunities for career progression, and associated barriers and facilitators.

Data Analysis

All interviews and focus groups will be digitally recorded and transcribed using a commercial transcription service; transcripts will be checked by the research team and anonymised prior to analysis. Data analysis will be a two-stage process consisting of within-case analysis followed by a cross case analysis, applying a framework analytic approach using NVivo software to organise and manage the process [33]. Framework analysis is a pragmatic approach to qualitative data analysis involving a systematic process of sifting, charting and sorting the material into key issues and themes [37]. This allows the integration of a priori issues into the emerging data analysis and provides a clearly defined analytical structure that contributes to the transparency and validity of the results. It follows the five steps for analysis: familiarisation, constructing an initial thematic framework, index and sorting, reviewing data extracts, and data summary and display.

Within case analysis will begin when the dataset for that case study is complete; allowing the unique patterns of each case to emerge before moving on to generalise patterns across cases. Cross case analysis is an iterative process of systematically comparing the emergent framework with the evidence from each case, leading to detailed understandings of emergent relationships within the data, the dynamics underlying the relationship, and the contextual conditions that influence why and how they exist [35]. All data will be independently indexed (coded) to ensure validity. Regular team meetings will provide opportunity to offer critical reflections ensuring that the analytic process and framework development benefits from their theoretical and clinical expertise.

5.7 Workstream 6 - Development of a Framework for Practice [JN lead]

Method

This mixed methods project will yield a large quantity of quantitative and qualitative data. Each workstream will yield specific findings to address different research objectives. These findings need to be compared, contrasted and amalgamated in this final workstream. The Triangulation Protocol Method will be used for integrating the Mixed Methods data [27] and this is combined with a six-step approach by Farmer et al [28] which builds upon the individual analyses by yielding additional findings related to areas of agreement (convergence) and dissonance (divergence) across the data collected.

Synthesis of the findings will enable the creation of a Determinant Framework [38] for the deployment of the S&A imaging workforce. A Determinant Framework provides a mechanism to specify individual determinants which act as barriers and enablers (independent variables) that influence implementation outcomes (dependent variables). The aim is to understand, explain and predict influences on the effective implementation of the S&A workforce outcomes. Determinant frameworks describe general types (also referred to as classes or domains) of determinants that we identify as influencing implementation outcomes; each type typically comprises individual enablers and/or barriers [38]. This Framework will be multilevel, identifying determinants relevant to S&A employees, imaging services and wider imaging networks. The information presented within the framework about what influences S&A workforce implementation outcomes will be highly relevant for designing and executing future implementation strategies; the aim will be to enhance or reduce the influence of relevant determinants.

The Determinant Framework will be reviewed by the Stakeholder Advisory Group and the PPI Group for applicability to imaging services within the wider NHS. The partnerships with HEE, the radiography professional body (SCoR), the Royal College of Radiologists, radiology manager groups and the ICS/ Imaging Networks will assist in driving forwards institutional change and culture.

6 STUDY SETTING

Workstream 2 will involve a 'desk-top' analysis of existing imaging workforce data within the HEE workforce platform to review workforce data from all Imaging Departments within NHS Trusts across England.

Workstream 3 will focus on Imaging Networks, and will send an online questionnaire to imaging leads in each of these networks across England.

Workstream 4 will undertake a 'deep dive' of 24 imaging departments across England, selected from the review of HEE workforce data in Workstream 2. These imaging departments will be selected primarily based upon the percentage of support workers and assistant practitioners as a proportion of the whole radiographic workforce. We anticipate selecting 8 sites in the low, medium and high proportion categories, with selected Trusts also representing variation in geographical regions and hospital sizes and types. Data collection will be via a structured telephone interview with the imaging service lead.

Workstream 5 will deliver a deep qualitative insight into nine imaging departments selected from the 24 hospital sites reviewed in Workstream 4 (3 in each high, medium and low proportions of support worker categories). Each site will form a separate case study and will include interviews with the imaging service leads (n=1), selected imaging modality lead radiographers (n=2-3), and focus groups with support workers and assistant practitioners (n=4-5). Documentary analysis of procedures and policies related to support worker deployment will also inform the case studies.

7 SAMPLE AND RECRUITMENT

7.1 Eligibility Criteria

Imaging Departments in all NHS Trusts in England. Sampling for each workstream is described in Section 5.

7.1.1 Inclusion criteria

There are no inclusion or exclusion criteria related to Gender, Age, Ethnicity etc. The criteria for inclusion are at the Trust level for WS 2-4 and includes:

- Workstream 2 – all NHS Trusts in England included in HEE workforce dataset
- Workstream 3 – all Imaging / Radiography leads for each of the established Imaging networks across England included in survey
- Workstream 4 –Imaging Service leads from 24 selected Trusts (based on proportion of support workers) invited to take part in telephone interviews

Workstream 5 – In the 9 selected case study sites (based on Workstream 2 analysis), the following inclusion criteria will apply:

- Imaging Service Lead (Interview) or Leads if multiple sites
- Modality radiographer lead in 2-3 selected modalities (based on service lead interview)
- 4-5 support workers or Assistant Practitioners who work within the imaging service

7.1.2 Exclusion criteria

Non-imaging sites

7.2 Sampling

Sampling for each workstream is described in Section 5.

7.2.1 Size of sample

The sampling strategy has been designed to drill down from reviewing data for all NHS Trusts in England, to purposively selecting a sample of Trusts for a deep dive interview with imaging service managers (n=24) and subsequent qualitative case studies (n=9 Trusts) which are as representative as possible of the range of imaging departments. The case study sites will include data collection with key personnel, including imaging service managers (n=1/2) and modality leads (n=2-3) and a focus group with support workers and assistant practitioners (n=4-5) to explore their role in more detail. These numbers are flexible depending on the size and configuration of the imaging department (the modality leads will be selected in discussion with the imaging manager to reflect the experiences of leaders in areas which have or have not embraced support workers).

7.2.2 Sampling technique

The aim of sampling in this study is to provide a degree of representativeness across imaging departments in different locations and with different sizes and types (e.g. specialist and acute hospitals). The initial analysis of HEE workforce data in Workstream 2 will stratify imaging departments in terms of the proportion of imaging support workers within their radiographic workforce. We will then select 24 hospitals, including 8 from each category (high, medium and low proportions). Purposive sampling will be applied to select 8 in each category which best represent a spread of locations, hospital sizes and types.

Following a deep dive of these 24 hospitals, the data will again be scrutinised to select a further 9 hospitals for review (3 high, medium and low proportion categories). Purposive sampling will again be applied to ensure representativeness of the sample.

7.3 Recruitment

Participants at each of the selected sites (e.g. imaging service managers) will be approached directly (following ethics and governance guidance) and will be invited to participate. A participant information sheet will explain the study and they will be asked to sign a consent form prior to participation.

7.3.1 Sample identification

Imaging Network lead radiographers and Imaging Service Lead participants will be identified by the project team and approached directly. Within the case study sites, the service leads will support the team in identifying staff who may meet the criteria for inclusion, with following up invitations to participate sent to all eligible staff (e.g. all imaging support workers). Participants will not be recruited by publicity, posters, leaflets, adverts or websites.

7.3.2 Consent

Informed consent will be obtained prior to the participant taking part in any data collection activities. The staff participants will be presented with written material (e.g., information leaflet and consent documents) which has been approved by the University Ethics Committee, HRA and local governance requirements. While this is a low risk project (staff surveys and interviews), all participants will have an opportunity to ask questions of the research team prior to participation. There are likely to be no problems with capacity to consent.

8 ETHICAL AND REGULATORY CONSIDERATIONS

Study participants will include NHS staff (support workers, registered health professionals and imaging service leads) and leaders within Imaging Networks. It is therefore essential that the project complies with best practice in NHS research ethics and governance via compliance with the UK Policy Framework for Health and Social Care Research (2020) [39]. The research team will apply for Institutional ethics approval from the Research Sponsor which is an initial mechanism for assessment of quality of the proposal. We will apply for Health Research Authority (HRA) and Health and Care Research Wales (HCRW) approval for governance purposes. An independent ethical opinion by an external Research Ethics Committee (REC) is not required as the project includes NHS staff participants but not patient participants. The Integrated Research Application System (IRAS) will be used to inform the submission which will include a full research protocol, participant consent forms and participant information leaflets, as well as data collection tools such as interview schedules. Following receipt of HRA approval, we will apply to specific NHS Trusts for Research and Development Department governance approval to host the research at their site for Workstream 5 (capability and capacity check). The individual sites will not be known at the outset; they will be determined following the HEE workforce data analysis in workstream 2. We have already identified the requirements for gatekeeper approval to access HEE workforce data and for Integrated Care System approval to access Imaging Network leads.

8.1 Assessment and management of risk

This study does not include patient participants so it is unlikely that serious risks to individuals will be highlighted. However if in the course of data collection a researcher were to come into information which had safeguarding implications, they will be required to notify the Chief Investigator immediately. A risk assessment and risk management process will be carried out following policies and procedures within the sponsor organisation.

8.2 Research Ethics Committee (REC) and other Regulatory review & reports

Before the start of Workstream 2 (data collection), a favourable opinion will be sought from the sponsor institution (Sheffield Hallam University) to support collection of HEE workforce data and the Imaging Network survey. Prior to Workstream 4 and 5, a favourable opinion will be gained from the HRA. This will include submission through IRAS including review of the study protocol, informed consent forms and participant information sheets.

It is the Chief Investigator's responsibility to submit the HRA application, to produce the annual reports as required and to notify the HRA of the end of the study. Within one year after the end of the study, the Chief Investigator will submit a final report with the results, including any publications/abstracts, to the HRA. Substantial amendments that require review by the HRA will not be implemented until that review is in place and other mechanisms are in place to implement at site. All correspondence with the HRA will be retained in the study file.

Regulatory Review & Compliance

Before any site can enrol staff into the study for Workstream 5, the Chief Investigator will ensure that appropriate approvals from participating organisations are in place, working with R&D departments at NHS sites.

All amendments need to be approved by the Study Steering Committee and it is the responsibility of the Chief Investigator to notify HRA, institutional ethics committees and NHS sites of the amendment request. All amendments will be tracked to identify the most recent protocol version.

8.3 Peer review

The initial grant application was peer reviewed by the local Research Design Service and an inter-disciplinary panel hosted by the study sponsor, and the grant underwent further peer review by the awarding panel. The draft protocol has been reviewed by the Study Management Group and the Study Steering Committee prior to being approved as Version 2; this process complies with the National Institute Health Research (NIHR) Clinical Research Network (CRN) requirements for high quality peer review. The Study Steering Committee has an Independent Chair and 75% Independent Members, including a Public Representative. These reviewers will have knowledge of the discipline to consider the service-based aspects of the protocol, and/or have the expertise to assess the methodological qualitative aspects of the study.

8.4 Patient & Public Involvement

This study is focused on workforce development and service design, with the primary participants of the research being imaging support workers and assistant practitioners, alongside their radiography supervisors, imaging service managers and regional and system-level imaging leaders. However, the beneficiaries of this research in the future will be patients and service users who are accessing imaging departments where S&A workers are effectively deployed. For this reason, we will ensure that the views of service users are embedded throughout the research.

We will have a public member on our Study Steering Committee, in addition to creating in WS1 an Imaging PPI Advisory group (6 participants). We will offer invitations to join the group to both of the PPI groups that we currently have established relationships with (Mid Yorkshire Hospitals Imaging PPI group and the Sheffield Hallam University Advanced Wellbeing Research Centre Patient Involvement in Research group). Inclusion criteria are wide as the imaging service is a key part of many patient pathways but we are requesting that participants are over 18 years of age and we will follow advice from NIHR on engagement of the public [40]. We will ask that patients have experienced imaging procedures in the areas where they are likely to encounter S&A workers (e.g. mammography, CT, general radiography).

Within Workstream 1, we will convene a focus group with the PPI Advisory group members to establish service users' level of awareness of the existence and role of S&A workers in imaging, and will explore their perspectives, needs and values in relation to the provision of imaging services.

We will invite the group to nominate a lead PPI representative who will work closely with our PPI lead (BS) who will chair the PPI Advisory Group. The PPI lead representative will be invited to join the Stakeholder Advisory Group to ensure that the patient voice is strong throughout the project. They will liaise with the wider PPI group at various points in the project to assist the project team in creating and reviewing subsequent data collection tools and participant information. In Workstream 6 we will also ask for their advice on the creation of a 'highlights' infographics booklet and other appropriate messaging of relevant results to patients, service users and the wider public.

PPI costs and expenses are calculated in line with advice from the Sheffield Hallam University Reward and Recognition Policy for Patient and Public Involvement in Research at the Advanced Wellbeing Research Centre (Dec 2020). This document incorporates advice from the NIHR [40] for rewarding, recognising and supporting the contribution of members of the public who are involved in our research.

8.5 Protocol compliance

Protocol deviations, non-compliances, or breaches are departures from the approved protocol. Accidental protocol deviations must be adequately documented on the relevant forms and reported to the Chief Investigator and Sponsor immediately. Deviations from the protocol which are found to frequently recur will require immediate action and will be reported through the Study Steering Committee to the sponsor and funder.

8.6 Data protection and patient confidentiality

All study investigators must comply with the requirements of the study sponsor and the Data Protection Act 1998 with regards to the collection, storage, processing and disclosure of personal information and will uphold the Act's core principles. No patient data will be collected, but staff personal data (e.g. email addresses, consent forms) will be stored securely on a bespoke project drive (Sheffield Hallam University J Drive) that is backed up automatically to several locations on a daily basis. Only the project team (chief investigator, co-applicants and study researchers) will have access to this data during the study, alongside the data custodian. The named data custodian / Caldicott Guardian for the College of Health, Wellbeing and Life Sciences at Sheffield Hallam University is Prof Shona Kelly (hwbsk1@exchange.shu.ac.uk).

Following initial data collection activity (e.g. questionnaire completion or interview), any participant names will be anonymised via the creation of coded, depersonalised data where the participant's identifying information is replaced by an unrelated sequence of characters. The team will ensure secure maintenance of the data and the linking code in separate locations using encrypted digital files within password protected folders and storage media.

Following completion of the study, the data will be archived in the Sheffield Hallam University Research Archive for 10 years.

8.7 Indemnity

The sponsor will meet insurance and/or indemnity to meet the potential legal liability of the sponsor(s) for harm to participants arising from management or design or conduct of the research.

8.8 Access to the final study dataset

Only the Study Steering Committee and the research team will have access to the full dataset. If the dataset is used for secondary analysis this can only be undertaken with the consent of the participants. All patient documentation will reflect the future use of these data in research.

9 DISSEMINATION POLICY

9.1 Dissemination policy

This project is designed as a 27-months investment and while the Final Report will be the ultimate output, the mixed methods research design will facilitate the launch of interim outputs at different time periods. We believe this is a vital element of this project as the launch of the new HEE AHP Support Worker Framework [10] necessitates early dissemination of resources that could inform and support the on-going drive to develop the imaging support workforce.

Academic Outputs

A number of journal articles and conference presentations will be specifically targeting journals and conferences that are most likely to reach imaging service managers and network leaders; these individuals are in the primary position to influence local and regional implementation of effective S&A

deployment strategies. For example, we will submit abstracts to the United Kingdom Imaging and Oncology conference which is the primary imaging-focused event attended annually by imaging leaders. In addition we will prepare a publication directly addressing perspectives of the imaging S&A workforce; this will be published in the international Radiography journal which the support workers and their radiographer supervisors are most likely to have access to. At the request of the Society and College of Radiographers on a regular basis we will prepare brief information updates on the project for their professional magazine (Synergy News) for imaging professionals. This will enable us to signpost any new developments or publications in peer reviewed journals to service managers, radiographers and imaging S&A workers.

Synthesis of the findings in WS6 will result in a 'Framework for Practice' for the effective deployment of the imaging S&A workforce. This framework document will be reviewed by the membership of the Study Steering Committee, Stakeholder Advisory Group and the PPI Advisory group for applicability to imaging services within the wider NHS. The Stakeholder Advisory Group includes representatives of influential external organisations including Health Education England, the radiography professional body the Society and College of Radiographers (SCoR), radiology manager groups and the ICS/ Imaging Networks, and these will be key to ensuring ample opportunities to assist in disseminating our research findings and driving forwards institutional change and culture. Co-applicant TS holds a lead radiographer role at system level and is well-placed to tap into recently and yet to be established Imaging Networks to support initiatives to create impact across and beyond regions.

With the guidance of our PPI Advisory Group representatives, at the conclusion of the project we will develop an accessible 'highlights' paper which incorporates inclusive language and effective infographics to address the key messages from the project; this will be shared with social media and conventional media via press releases, and with patient groups with an interest in the delivery of imaging services.

Anticipated outputs include, in order of delivery:

1. Journal article (WS1) – Published evidence and grey literature related to the imaging support workforce, Radiography journal (Imaging professionals, imaging managers)

2. Conference presentation (WS2) – Analysis of the imaging support workforce at organisational, regional and system level via Model Hospital data, United Kingdom Imaging and Oncology (UKIO) (Imaging service managers; Imaging professionals; Radiologists; Imaging Network leads)

3. Journal article (WS2-4) – Analysis of the imaging support workforce via Model Hospital data and a review of data accuracy via structured interviews, British Journal of Radiology (Multi-disciplinary audience; Imaging managers; Radiologists; Imaging professionals)

4. Journal article (WS5) – Facilitators and barriers to the successful deployment of imaging support workers, Journal of Health Services Research and Policy (Wider professional base of healthcare leaders

Regional NHSE&I/HEE Workforce transformation leads)

5. Journal article (WS5) – Support worker perceptions of role, impact and career progression, Radiography (Imaging professionals, S&A workers & their supervisors, radiography educators)

6. Conference presentation (WS6) – Determinant Framework for Practice for effective deployment of support workers, UKIO; SCoR Manager Forums; HEE AHP forums (Imaging service leaders and imaging network leads, but also wider AHP HEE delegates)

7. Guidance document (WS6) – Frameworks for Practice for the Effective Deployment of Imaging Support Workers, HEE; SCoR (Document discussed, endorsed and disseminated via prof body and HEE networks)

8. Highlights document (WS6) – Key project outcomes and recommendations, SCoR; social media; PPI organisations (Patient, public, service users; S&A & imaging professionals; AHPs)

Feedback to Participants

The primary participants for this study are the imaging service managers who participate in workstreams 4 (deep dive) and 5 (case studies), alongside other members of the imaging teams who are participants in the case studies. Leads for regional and system-level imaging networks will also be key participants in workstream 3. There are unlikely to be any ethical or rigour issues that we foresee regarding sharing information with our participants in a staged manner throughout the project.

While our academic outputs are intended to target imaging leaders through selection of appropriate journals and conferences, we will also provide a brief report back to the service leads of each of the nine case study sites at an earlier stage (prior to publication). This will enable any learning from the case and its comparisons to other sites to be considered by the imaging department to enable earlier implementation of any potential changes to the deployment of S&A workers. At the conclusion of Workstream 5 (qualitative case studies), we will invite our research participants to attend an Imaging S&A Workforce workshop where we will present the findings from the case studies and the earlier workstreams alongside our emerging Determinant Framework. This will be a catalyst for discussion and debate and will enable us to support managers in beginning to understand and address the challenges of implementation of new ways of working. We will invite participants from all participating organisations to comment on the extent to which they recognise the findings as being applicable to their own service (supporting the notion of generalisability), which will inform the refinement of the Determinant Framework. In tandem, we will develop with our PPI group an accessible 'highlights' paper which incorporates effective infographics to address the key messages from the project; this will be shared with all participants including our S&A workers.

Where possible, the study protocol, full study report and anonymised participant level dataset will be made publicly available.

9.2 Authorship eligibility guidelines and any intended use of professional writers

The protocol should detail: The Final Report will include all authors within the study team, with criteria for individually named authors following guidance by The International Committee of Medical Journal Editors. Professional writers will not be utilised.

10 REFERENCES

1. The Royal College of Radiologists. Clinical Radiology UK workforce census 2020 report. London: The Royal College of Radiologists. Ref no:BFCR(21)3, April 2021. https://www.rcr.ac.uk/publication/clinical-radiology-uk-workforce-census-2020-report
2. NHS England and NHS Improvement. Transforming imaging services in England: a national strategy for imaging networks. November 2019. NHS Improvement publication code: CG 51/19 https://www.england.nhs.uk/transforming-imaging-services-in-england/
3. Richards M. NHS England. Diagnostics: Recovery and Renewal, October 2020. Independent Review of Diagnostic Services for NHS England . Prof Sir Mike Richards. https://www.england.nhs.uk/publication/diagnostics-recovery-and-renewal-report-of-the-independent-review-of-diagnostic-services-for-nhs-england/
4. Halliday K, Maskell G, Beeley L, Quick E. NHS. Radiology GIRFT Programme National Specialty Report. November 2020. https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2020/11/GIRFT-radiology-report.pdf
5. NHS Modernisation Agency (2004) Changing workforce programme. Role redesign: review of activities 2003/4, NHS Modernisation Agency, London https://www.researchgate.net/publication/241881079_Role_redesign_New_ways_of_working_in_the_NHS

6. Nancarrow SA, Shuttleworth P, Tongue A and Brown L. Support workers in intermediate care. Health & Social Care in the Community 2005;13:338-344. https://doi.org/10.1111/j.1365-2524.2005.00563.x
7. Education and Career Framework for the Radiography Workforce. Version 3 2013. Society and College of Radiographers. https://www.sor.org/learning-advice/professional-body-guidance-and-publications/documents-and-publications/policy-guidance-document-library/education-and-career-framework-for-the-radiography
8. Skills for Health. Key Elements of the Career Framework. 2010. Available at https://www.skillsforhealth.org.uk Accessed December 2020
9. Skills for Care. Core Standards for Assistant Practitioners. 2009. Available at https://www.skillsforhealth.org.uk Accessed December 2019
10. Health Education England. AHP Support Worker Competency, Education and Career Development Framework. Oct 2021. https://www.hee.nhs.uk/our-work/allied-health-professions/enable-workforce/developing-role-ahp-support-workers/ahp-support-worker-competency-education-career-development
11. Public Health England. NHS Breast Screening Programme National radiographic workforce survey 2016. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/564515/Final_radiographic_workforce_report_25-10-16_colinbabb_gateway_number_2016416.pdf
12. NHS Improvement and NHS England. Model Hospital. https://www.england.nhs.uk/insights-platform/model-hospital/
13. Baker D. Designing a curriculum for the assistant practitioner of the future: Ensuring interprofessional care aspects and other stakeholder requirements are met. Radiography 2016; 22(2):161-165. https://www.radiographyonline.com/article/S1078-8174(15)00124-8/fulltext
14. Stewart-Lord A. Training and development of the Assistant Practitioners (APs) in radiography. Radiography 2014;20(1):36-41. https://doi.org/10.1016/j.radi.2013.08.003.
15. Stewart-Lord A, McLaren SM, Ballinger C. Assistant practitioners (APs) perceptions of their developing role and practice in radiography: Results from a national survey. Radiography 2011;17(3):193-200 https://www.radiographyonline.com/article/S1078-8174(11)00025-3/fulltext
16. Stewart-Lord A, Ballinger C, McLaren SM. Assistant Practitioners (APs) in radiography: An exploration of perceptions and experiences related to role development. Radiography 2014;20(2):137-142 https://doi.org/10.1016/j.radi.2013.11.001. https://www.radiographyonline.com/article/S1078-8174(13)00126-0/fulltext
17. Adams C. The assistant practitioner: A professional project. International Journal of Therapy and Rehabilitation 2008;15(11):509-517 https://www.magonlinelibrary.com/doi/abs/10.12968/ijtr.2008.15.11.31547
18. Palmer D, Snaith B, Harris MA. Assistant radiographer practitioners: Creating capacity or challenging professional boundaries? Radiography 2018; 24(3):247-251. https://www.radiographyonline.com/article/S1078-8174(18)30016-6/fulltext
19. Bennion CM, Irvine F. Embedding the assistant practitioner role within the clinical department: A qualitative study, Radiography 2011; 17(4):292-296 https://doi.org/10.1016/j.radi.2011.02.007.
20. Colthart I, McBride M, Murray M. On your wavelength: Radiography assistant practitioner training in Scotland. British Journal of Healthcare Assistants 2010; 4(1): 29-33 https://www.magonlinelibrary.com/doi/abs/10.12968/bjha.2010.4.1.46069
21. Winnard Y, Kittle S. Assistant practitioners in radiography. British Journal of Healthcare Assistants 2008;2(1):42-44 https://www.magonlinelibrary.com/doi/abs/10.12968/bjha.2008.2.1.28017
22. Smith T, Fisher K. Self-reported competency and continuing education needs of limited licence remote X-ray operators in New South Wales, Australia. Rural and remote health 2011; 11(2): 1560 https://www.rrh.org.au/journal/article/1560
23. Snaith B, Harris MA, Palmer D. A UK survey exploring the assistant practitioner role across diagnostic imaging: current practice, relationships and challenges to progression. The British Journal of Radiology 2018; 91:1091 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6475955/
24. National Institute for Health Research. PROSPERO. PROSPERO - International prospective register of systematic reviews. Accessed 26.11.21. https://www.crd.york.ac.uk/prospero/
25. Creswell JW. Research design: qualitative, quantitative, and mixed methods approaches. 3rd Edition ed. USA: Thousand Oaks : Sage Publications, 2009.
26. Creswell JW, Plano Clark VL. Designing and Conducting Mixed Methods Research. 2nd Edition. ed. USA: Sage; 2011.
27. O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. BMJ 2010;341:c4587 https://pubmed.ncbi.nlm.nih.gov/20851841/

28. Farmer T, Robinson K, Elliott SJ, Eyles J. Developing and implementing a triangulation protocol for qualitative health research. Qualitative Health Research 2006;16(3):377-94 https://pubmed.ncbi.nlm.nih.gov/16449687/
29. Booth A. EVIDENT Guidance for Reviewing the Evidence: a compendium of methodological literature and websites. 2016. DOI:10.13140/RG.2.1.1562.9842
30. Critical Appraisal Skills Programme. https://casp-uk.net/casp-tools-checklists/
31. Woznitza N, Steele R, Groombridge H, Compton E, Gower S, Hussain A, Norman H, O'Brien A, Robertson K. Clinical reporting of radiographs by radiographers: Policy and practice guidance for regional imaging networks. Radiography 2021;27(2):645-649 https://pubmed.ncbi.nlm.nih.gov/32814647/
32. Health Education England, October 2021. Allied Health Professions Support Workforce: Readiness Toolkit 2021. https://www.hee.nhs.uk/sites/default/files/documents/AHP_SupportWorker_Toolkit_Acc_Form.pdf
33. NVivo qualitative data analysis software. https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home
34. Stake, R. The art of case study research. 1995 Sage Publications Thousand Oaks.
35. Crowe S, Cresswell K, Robertson A et al. The case study approach. BMC Med Res Methodol 2011;11:100 https://doi.org/10.1186/1471-2288-11-100
36. Eisenhardt, K. Building Theories from Case Study Research. Academy of Management Review 1989; 14(4) https://journals.aom.org/doi/10.5465/amr.1989.4308385
37. Gale NK, Heath G, Cameron E. et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol 2013; 13:117. https://doi.org/10.1186/1471-2288-13-117
38. Nilsen P. Making sense of implementation theories, models and frameworks. Implement Sci. 2015;10:53. https://implementationscience.biomedcentral.com/articles/10.1186/s13012-015-0242-0
39. UK Policy Framework for Health and Social Care Research, 2020. https://www.hra.nhs.uk/planning-and-improving-research/policies-standards-legislation/uk-policy-framework-health-social-care-research/
40. PPI (Patient and Public Involvement) resources for applicants to NIHR research programmes. https://www.nihr.ac.uk/documents/ppi-patient-and-public-involvement-resources-for-applicants-to-nihr-research-programmes/23437

11. APPENDICES

11.1 Appendix 1- Required documentation

None for initiating a study site.

11.2 Appendix 2 – Schedule of Procedures

N/A

13.3 Appendix 3 – Amendment History

Amendment No.	Protocol version no.	Date issued	Author(s) of changes	Details of changes made
Initial Draft	0.1	01.06.22	N/A	N/A, 1st draft
1	0.2			No change other than NIHR statement added to first page, approved by NIHR team
2	0.3	23.08.22	JN	Sponsor signature added (page ii) and sponsor name amended (page iv) Ethics sections amended to reflect advice to require HRA approval, but not REC (no patient participants) Update flow chart (page vii) to include staff changes and site numbers References to 'Model Hospital' amended throughout to 'HEE workforce data' as Model Hospital no longer responsible for this data set.
3	1	21.11.22	JN	Approved by HRA 21.11.22, listed now as v1 as it is the first approved version.

Protocol amendments must be submitted to the Sponsor for approval prior to submission to the HRA.