Utilisation of the support workforce in diagnostic imaging: a mixed-methods investigation

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Synopsis

Utilisation of the support workforce in diagnostic imaging: a mixed-methods investigation

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Abstract

Background: Demand for imaging in England massively outstrips supply in terms of workforce capacity, with well-documented shortages of both radiographers and radiologists. The COVID-19 pandemic exacerbated already stretched services, which have remained 'in crisis'. Three high profile national reports highlighted the urgent need to develop the capacity and capability of the imaging support workforce, yet it is unclear how this vital workforce is utilised.

Aim: To investigate the development, deployment and contribution of the support 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 support workforce exist within diagnostic imaging departments and what service, hospital, regional and national factors may encourage or inhibit implementation of these models?

Design: The study employed a mixed-methods explanatory research design, comprising six consecutive workstreams spanning 27 months: (Workstream 1) scoping review; (Workstream 2) census of imaging workforce; (Workstream 3) engagement with imaging networks; (Workstream 4) deep dive review of selected trusts; (Workstream 5) qualitative case studies; (Workstream 6) determinant framework.

Setting and participants: All National Health Service diagnostic imaging (radiology) services and imaging networks located within England were in scope. Participants included imaging network representatives (n = 18), radiology service managers (n = 24), and Imaging Support Workers and Assistant Practitioners, their supervisors and department managers (WS5, n = 113).

Interventions: This was an exploratory observational study.

Outcome measures: Findings were synthesised to create a determinant framework (Maturity Matrix) for the effective deployment of the imaging support workforce. A Public Summary encapsulated the key findings for imaging services, the wider healthcare community, and for patients and the public.

Data sources: National Health Service Electronic Staff Record database (n = 144 National Health Service Trusts); interviews (n = 38); focus groups (n = 15); documentary analysis (n = 48).

Results: The support workforce (National Health Service pay Bands 2–4) constitutes 23.6% of the non-medical imaging workforce (22.2% median, interquartile range 14.9–29.1). Opposing deployment models were identified, based on grade preference (Band 2 or Band 3) and role flexibility (static or rotational). Wide variations in job titles, roles, grades, competencies and scopes of practice are evident both between National Health Service Trust hospitals and within individual imaging departments. With the exception of breast imaging, assistant practitioners (Band 4) appear underutilised in most imaging services.

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Limitations: Inconsistent and incomplete data in the Electronic Staff Records potentially compromised data quality; however, subsequent participant-supplied data were comparable.
Conclusions: Imaging support workers are 'absolutely pivotal' to smooth patient workflow and the patient experience; however, unwarranted variations in support workforce deployment and utilisation compromise recruitment, retention, career progression and innovation. This workforce appears to be operationally managed rather than strategically planned which potentially limits the impact of the support workforce on the wider imaging workforce crisis.
Future work: The Imaging Support Workforce Maturity Matrix provides a management tool to support review and harmonisation of the imaging support workforce at national, regional, hospital, imaging department and modality levels. A widespread reluctance to fully utilise Assistant Practitioners and enable them to seamlessly progress to registered practice requires further investigation.
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Introduction

Rationale for research and background

This section commences with a brief overview of the development of medical imaging, alongside an introduction to the origins of the current imaging workforce. The significant challenges affecting the contemporary imaging workforce will be outlined, with a more influential role for the unregistered imaging support workforce identified as one potential mitigator for a long-standing workforce crisis.

The development of modern medical imaging

Medical imaging technology has continuously evolved since the discovery of X-rays in 1895, with X-ray examinations, contrast-enhanced procedures and 'real-time' fluoroscopic procedures becoming commonplace in the first half of the 20th century. Significant advances saw new imaging modalities established, including ultrasound, nuclear medicine, computed tomography (CT) and magnetic resonance imaging (MRI). In the last three decades, a 'digital revolution' has transformed X-ray examinations from film-based imaging to digital radiography, with images viewed directly on computer screens. Alongside this digital revolution, new 'minimally invasive' procedures (interventional radiology) enable patients to receive emergency life-saving treatment in the imaging department, replacing traditional high-risk surgery. In the present day, imaging technology continues to evolve, with new Artificial Intelligence opportunities changing the way imaging investigations are both performed and reported.[2] This constantly expanding and evolving technology requires a workforce that is agile and has the capability and capacity to drive forwards the discipline for patient benefit.

The development of the medical imaging workforce

The discovery of X-rays was a pivotal moment for medicine, with some doctors becoming specialists in using imaging techniques for diagnosis, known as radiologists, today. The X-ray images were produced by a wide range of technical staff who did not have medical training. This workforce was to unite in 1920 to form a new professional discipline known as radiography.[3] The professionals became known as radiographers and guided by a professional body and trade union [the Society and College of Radiographers (SCoR)], they adopted an agreed scope of practice, an underpinning education curriculum and a regulatory framework. The radiography profession was shaped by medical dominance, with radiologists positioning their role to perform some complex procedures and be solely responsible for diagnosis[3] (interpreting and reporting on the images). Radiographer roles were restricted to performing imaging procedures under the direction of the radiologist, supporting the radiologist in more complex procedures and providing good patient care as an essential part of their role. Whereas radiologists specialise in a clinical area, for example, musculoskeletal or gastrointestinal, radiographers work predominantly within an imaging modality, for example, CT. The workforce, therefore, has developed within these two complementary foci.

Development of radiographer roles

In the 1980s, radiographers gradually expanded their scope of practice, including performing more complex examinations.[4,5] While still restricted from undertaking 'diagnosis', radiographers built on their experiential knowledge to provide a 'triage' system in A&E departments,

flagging up (usually via a 'red dot' sticker) any fractures to junior doctors. Radiographer image interpretation was introduced in the 1990s following a transition to degree and master's level education, alongside enabling changes to professional guidance and regulatory policy.

In the last two decades, there has been a major shift in the roles, responsibilities, and relationships between radiologists and radiographers.[6] In 2003, a new career structure[7] for the radiography workforce was launched; this 'four tier' career structure recognised radiographers as practitioners, but with opportunities to progress to advanced practice and consultant practice levels. At these higher levels, and with underpinning postgraduate education and governance approvals, radiographers could undertake image interpretation and reporting for specific areas of practice, as well as expanding their impact across four 'domains' of clinical practice, education and training, management and leadership and research and service development.[8,9]

To provide capacity for practitioners to access these new roles, a new Assistant Practitioner (AP) level[10] was introduced to support radiographers by performing non-complex imaging procedures following a clearly defined (restricted) scope of practice. These APs were expected to be drawn from within the imaging support workforce, unregistered staff who provide care to patients and support imaging professionals in a range of duties. Support Workers (SWs) have also seen development of their roles over time, previously occupying 'darkroom' technician and X-ray filing clerk positions in the era of film-based radiography, with some drawn from portering and nursing assistant roles.

Current workforce issues – demand

For many years, the demand for medical imaging services in the UK has outstripped supply in terms of availability of staff and imaging equipment. This demand continues to increase[11] year on year, exacerbated by backlogs resulting from the COVID-19 pandemic; demand is now far above pre-COVID levels. For the first time ever, in October 2024, more than two million diagnostic imaging tests were carried out in a single month, yet the number of patients waiting for more than 6 weeks for their tests remains 'stubbornly immobile'.[12] This 6-week target has not been met since 2013.[13] Notably, this target does not indicate the full extent of imaging delays, as it fails to include the 'report turnaround' time from completing the imaging test to the referring clinician receiving the report.[13] In 2022–3, nearly three-quarters of a million patients' imaging tests were not reported within 4 weeks, increasing by almost 200,000 from the previous year, representing a 31% rise.[14]

From August 2023, a national target requires 100% of scans to be reported within 4 weeks, though it is too early to say whether the presence of a target will have a positive service impact.[14]

Current workforce issues – capacity

Approximately 9 out of 10 NHS patients are supported at some point in their journey by a radiographer and/or a radiologist; imaging is central to addressing wider NHS waiting lists. Radiologists' workload has risen substantially in terms of both quantity and complexity. CT and MRI scanning activity (a significant part of their workload) is rising by over 5% annually, yet the radiologist consultant workforce grew by just 3% in 2022.[14] In 2023, there was a 30% shortfall of consultant radiologists, which is expected to rise to 40% by 2028.[14] This equates to an average vacancy rate of 10% (2023), with 60% of vacancies existing for more than 6 months.[15]

Compounding this issue, there is also a chronic shortage of radiographers; the average UK vacancy rate in 2023 was 13%,[16] and to meet demands approximately one-quarter of UK registered radiographers are now from overseas.[17] Recent increases in pre-registration training are enabling approximately 3% growth in the profession, but this is failing to meet the demand.[16]

Current workforce issues – impact

Persistently high vacancy rates[15,18] impact upon waiting times for scans and reports. They also impact on NHS finances; while there may be pay savings on vacant posts, expensive recruitment rounds (including overseas recruitment) and high costs of temporary staff strongly outweigh the savings. An unsustainable £276 million was spent in 2023 alone by NHS imaging departments on expensive insourcing (overtime), outsourcing (to private companies) and agency and locum staff to fill service shortfalls.[15]

Successive UK governments have recognised the need to increase radiologist and radiographer training capacity, but recruitment alone will not address the workforce deficits. Imaging services are fast-paced and stressful environments, made significantly worse by staff vacancies, contributing to an increasingly fatigued workforce with an increased risk of 'burnout'. A worrying correlation between radiographer burnout, emotional exhaustion, job dissatisfaction and intention to leave exists,[19–22] with several studies[23–31] citing pressure at work, large workloads and long shifts impacting on radiographers' intentions to stay in their profession. A landmark study undertaken by this study team (Nightingale *et al*., 2021 and 2023)[32,33] was the first to focus on radiographer retention in the NHS

and reasons for leaving. The application of Generation Theory revealed how early career radiographers are a more transient workforce leaving for increased career opportunities,[35] with 6% de-registering within 4 years of initial registration.[36] Mid-career radiographers were likely to leave due to the lack of progression and continuing professional development (CPD), often limited when staffing is compromised. Late career radiographers leave due to the inflexibility of working patterns and conditions.

Retention of imaging staff is therefore a particular concern, with leavers moving to the independent sector or agencies, or leaving the NHS altogether. Locum consultant radiologists now make up 10% of the total consultant workforce, with the average (median) age that full-time consultant radiologists left the NHS workforce in 2023 being 45 years.[15] This loss of experienced, older workers (early retirement or pre-retirement) in both radiography and radiology compromises the training of the workforce of the future.

The imaging support workforce – a potential solution?

In response to the imaging workforce crisis, three high-profile national reviews of imaging services in 2019 and 2020[37–39] signalled wide-scale changes, including the establishment of imaging networks across England.[37] All three reports emphasised an urgent need to develop the capacity and capability of the unregistered support workforce, known collectively as the imaging support workforce.[37–39]

At the commencement of the study, a three-tiered model structured the UK imaging support workforce (see *Appendix 1*, *Table 2*),[40] with each tier corresponding to a pay band in 'Agenda for Change' (AfC), the system used by the NHS for staff pay.[41] In order of increasing autonomy, the support workforce includes: (1) Clinical SWs (Band 2); (2) Senior Clinical SWs (Band 3); (3) AP (Band 4).[11,42,43] With appropriate supervision, the imaging support workforce can undertake many patient-facing activities (including image acquisition) that were formerly in the domain of radiographers,[42] providing backfill to enable registered staff to undertake complex imaging procedures and reporting.

Over a decade ago, the Cavendish Review[43] identified the wider NHS support workforce as frequently underutilised, undervalued, inconsistently deployed and often unable to progress their careers. A 2024 report[41] highlighted limited progress across the NHS since the Cavendish review. Similarly, in the 5 years since these imaging reviews were published, it is unclear what progress, if any, has occurred. An initial literature search conducted by the research team in 2020 identified an absence of research, policy and professional guidance related to the imaging support workforce. No data existed on the scale of the imaging support workforce (numbers, grades, roles), or whether there was capacity to develop their roles to effect the workforce transformation envisioned in the three national reports.[35–37] Having the right number of staff with the appropriate skills and qualifications is a critical determinant of the quality and efficiency of health care,[44] yet there is currently a very limited understanding of the capability and capacity of the imaging support workforce. This major research gap was addressed by the 'I-SWAP' research study which was funded by the Health Services and Delivery Research programme.

Research questions, aim and objectives

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

Short title: I-SWAP – Imaging Support Workers and Assistant Practitioners.

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

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

Objectives:

1. To explore where and how the support workforce is deployed within diagnostic imaging services in England.
2. To explore contextual factors including organisational culture which serve to facilitate or inhibit the contribution of the support workforce to imaging services.
3. To understand how investment in the imaging support workforce (training and development) has enabled role expansion and advanced practice within the imaging departments.
4. To identify the current situation and potential for collaboration across imaging networks in disseminating and implementing effective support workforce strategies across regions.

5. To synthesise the findings from (1) to (4) to generate an evidence-based framework for effective implementation and expansion of the support workforce.
6. To identify additional research questions emerging from the investigations.

Research design

This study employs a pragmatic mixed methodology (MM) with a multistage explanatory sequential research design,[45] whereby qualitative workstreams (WSs) are used to explain and enrich the understanding of earlier quantitative data WSs. The six consecutive WSs are illustrated in *Figure 1*, moving progressively from a broad perspective (international level) to a more nuanced view (department level) of the imaging support workforce. As is commonplace in large-scale multistage MM studies, each WS was analysed, interpreted and published separately (a narrative staged approach), enabling findings to be disseminated in a timely manner.

Integration of the findings was considered in the study design (*Figure 2*) following the principles outlined by Fetters *et al.*[46] This included 'building' the design upon the findings of previous WSs. For example, the scoping review (WS1) and census (WS2) findings shaped the

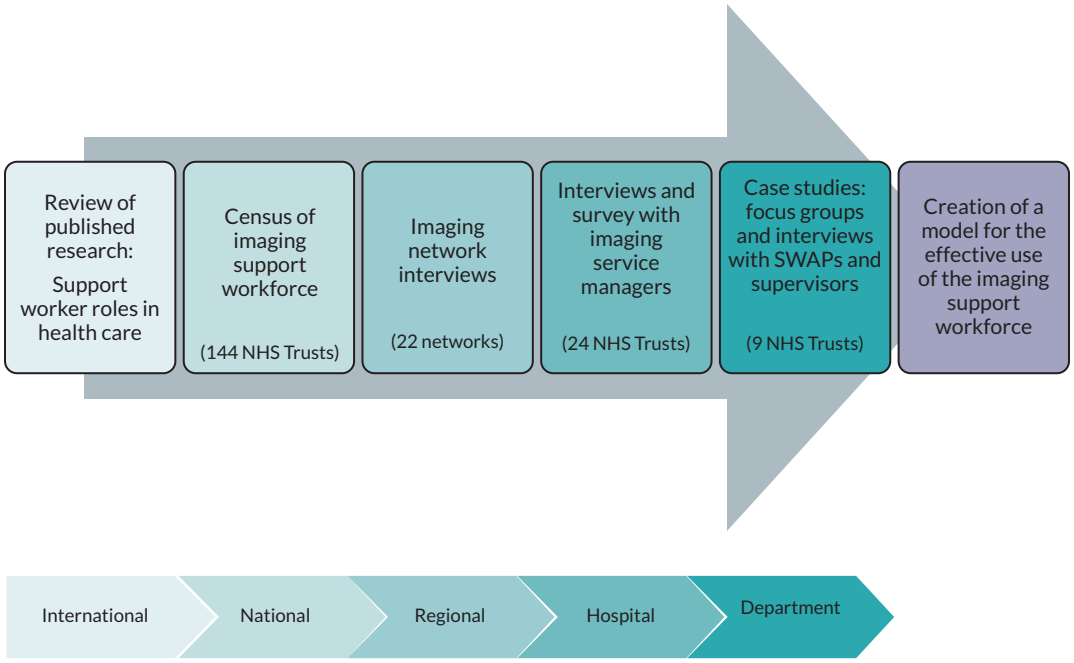

FIGURE 1 I-SWAP research design encompassing an explanatory sequential mixed-methodology approach with six separate WSs.

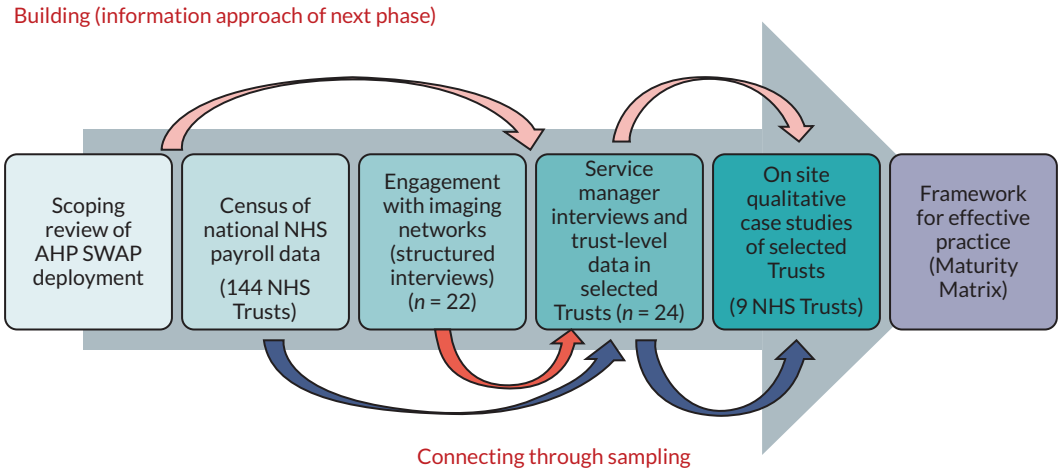

FIGURE 2 Mixed-methodology integration approaches embedded within the research design.

interview questions for WS3 and WS4. Similarly, the findings from WS4 shaped the design of the question schedules for WS5.

In addition, integration of findings occurred through 'connecting' WSs via their sampling strategies (*Figure 2*).[46] The census (WS2) enabled the proportion (%) of imaging SWs within each NHS Trust in England to be calculated. The proportions were ranked into three categories (high, medium and low), with a 'high' ranking indicating high utilisation of SWs (high adopter), and vice versa. This ranking system identified 24 potential NHS Trusts for participation in WS4, with 8 drawn from each of the ranking categories. This ensured that selected sites reflected the full range of potential deployment and utilisation approaches. Similarly, the findings from WS4 enabled an impartial selection of nine case study sites for WS5, again ensuring that high, medium and low 'adopters' were equally represented.

BOX 1 Research papers synthesised in this synopsis

Article 1 – Etty S, Snaith B, Hinchcliffe D, Nightingale J. The deployment and utilization of the Allied Health Professions Support Workforce: A scoping review. *J Multidiscip Healthcare* 2024;**17**:2251–69. https://doi.org/10.2147/JMDH.S460543

Article 2 – Snaith B, Etty S, Nightingale J. Has the skills mix promise been broken? A scoping review of the deployment of the support and assistant workforce within diagnostic imaging in the UK. *Radiography* 2024;**30**:1468–73. https://doi.org/10.1016/j.radi.2024.08.006

Article 3 – Nightingale J, Etty S, Snaith B, Sevens T, Appleyard R, Kelly S. Establishing the size and configuration of the *imaging support workforce*: a census of national workforce data in England. *BJR Open* 2024;**6**:tzae026. https://doi.org/10.1093/bjro/tzae026

Article 4 – Nightingale J, Sevens T, Etty S, Appleyard R, Kelly S, Snaith B. The role, scope and utilisation of the imaging support workforce in England: a qualitative framework analysis. *Radiography* 2025;**31**:264–74. https://doi.org/10.1016/j.radi.2024.11.021

Article 5 – Appleyard R, Snaith B, Etty S, Nightingale J. The imaging support workforce: stakeholder perceptions of role, impact and career progression. *Radiography* 2025;**31**:102956. https://doi.org/10.1016/j.radi.2025.102956

Workstream overview

The primary findings from each of the first five WSs have been published in peer-reviewed journals as shown in *Box 1*.

Details of each WS are outlined in *Table 1*. A summary of methods and key findings from each WS are presented in this section, with more detail reported in the five published articles (*Box 1*).

TABLE 1 Focus, scope and methods of the six WSs

Workstream	Focus	Scope	Methods	Objectives	Reporting
1	1. Utilisation of SWs in AHP professions 2. Utilisation of SWs in imaging settings	International National	Scoping reviews with systematic structured search	1, 2, 6	Articles 1 and 2
2	Census of the size and structure of the Imaging Support Workforce across England	National	Secondary analysis (census) of an existing national data set (NHS Electronic Staff Record)	4	Article 3
3	Support workforce planning within imaging networks	Regional	Administered survey (structured interview) with Network representatives	4	Article 4
4	Support workforce utilisation within Imaging Services	National	Semistructured interview with imaging service managers and workforce data review	2, 3	Article 4
5	Stakeholder perceptions of SW roles in imaging services	Local (NHS Trust imaging services)	Case studies: Documentary analysis, semistructured interviews and focus groups (support workforce and supervisors)	2, 3	Article 5, 2 further articles to be published
6	Mixed-methods synthesis of WS1–5	All levels	Synthesis of findings to create a determinant framework and Maturity Matrix	5, 6	NIHR synopsis, I-SWAP public summary, 1 further article

The volume of data acquired through the course of this mixed-methods study was extensive, yielding additional detail that was not anticipated at the commencement of the study and could not be easily accommodated within the five articles in *Box 1*. This additional detail supported the preparation of three additional articles after the end of the study:

Article 6 – Etty S, Snaith B, Appleyard R, Nightingale J. 'What is your job?': A qualitative analysis of the deployment, utilisation and contribution of Support Workers in Diagnostic Imaging Services in England. *Int J Health Plann Manage* 2025;**40**:1220–31. https://doi.org/10.1002/hpm.70005

This article expands on the findings from Article 5 (*Box 1*), drawing out learning that is specific to imaging SWs (Bands 2 and 3). The article provides a greater focus on the perspectives of the SWs on role identity, utilisation and career progression.

Article 7 – Snaith B, Etty S, Appleyard R, Nightingale J. Working title: Effective workforce supply route or road to nowhere: variation in the education of the assistant radiographer role (Under review for *Journal of Vocational Education and Training*).

This article expands on the findings from Article 5 (*Box 1*), drawing out learning that is specific to imaging APs (Band 4). The article provides a greater focus on the perspectives of APs on role identity, utilisation and career progression, and includes review of documentary analysis from WS5. It focuses on the educational opportunities and constraints which enable or disincentivise progression.

Article 8 – Fowler Davis S, Nightingale J, Snaith B, Etty S, Sevens T. A Maturity Matrix and actionable tool for Implementing Best Practices within the Radiography Support Workforce: a mixed methods synthesis. *BMC Health Services Research* 2025;**26**:70. https://doi.org/10.1186/s12913-025-13888-y

This article introduces the Imaging Support Worker Maturity Matrix, which brings together the learning from the final phase (mixed-methods synthesis) and presents this as an actionable tool for imaging managers and leaders. This tool is presented in this report within WS6 findings.

Workstream 1 – support workforce scoping reviews

Methods

The aim of this contemporary scoping review was to explore which models of deployment of the support workforce are utilised by a range of Allied Health Professions (AHPs) across different international contexts. Addressing an exploratory research question, the most appropriate methodology was a scoping review to summarise and synthesise published research.[47] This review was guided by Mak and Thomas[48] and the PEO (population, exposure, outcome) framework was employed to structure the search terms which can be seen alongside eligibility criteria in Article 1 (https://doi.org/10.2147/JMDH.S460543). A literature search was performed using MEDLINE, CINAHL Complete, and Scopus to identify any empirical peer-reviewed articles. The search was repeated using Google Scholar to widen the search to include policy and professional documentation, with the first 100 'hits' being reviewed for each search string. Two researchers independently screened all studies for inclusion using Covidence software,[49] a web-based literature screening and data extraction tool, initially for title and abstract, and subsequently for full text review. Selected studies were assessed for rigour by a single researcher using the Quality Assessment with Diverse Studies (QuADS) appraisal tool,[50] and while this informed the study conclusions, the quality of literature was not used as an exclusion criterion. Following data extraction, data were analysed thematically following the Mak and Thomas approach.[48]

The scoping review protocol was pre-registered with the Open Science Framework registry[51] (https://doi.org/10.17605/OSF.IO/VJBDX) and was reported following PRISMA guidelines.[52] Following completion of this AHP-wide scoping review, the same data were interrogated to identify any support workforce publications with an imaging focus. The search was updated with additional search terms to capture international imaging role titles which were known to vary. Thematic analysis was conducted using a priori themes informed by the prior scoping review (Article 1) exploring role purpose, outcomes, aspirations and capacity building. This updated search formed the basis of Article 2 (https://doi.org/10.1016/j.radi.2024.08.006).

Findings

This review aimed initially to explore how the Support Workforce are utilised internationally within AHP services. Thirty-nine articles met the eligibility criteria, with the majority based in Australia, UK and USA. The PRISMA flow diagram, list of included studies and full exploration of the results can be found in Article 1 (https://doi.org/10.2147/JMDH.S460543).

Highly variable research quality was identified with many low-quality small-scale studies which reported staff perceptions rather than objective evaluations of impact or cost-effectiveness. The AHP support workforce is

largely underutilised due to inconsistencies in role titles, deployment and scope of practice, and limited career progression. The deployment of the support workforce varies by geographical setting, type of service, level of delegation and profession; the variation within individual professions indicates a lack of clear profession-based guidance. There was no evidence of healthcare services making informed deployment decisions based on demand data. Some reluctance to delegate to the support workforce was identified, with concerns regarding 'role creep' into the practitioner role. This review shows that the support workforce is valued but is prevented from reaching its full potential due to inconsistencies in deployment, a lack of clarity in role definition, variation in education and training, and the absence of a clearly defined career pathway.

A discipline-specific review identified 11 publications exploring Imaging Support Workforce roles, with full results in Article 2 (https://doi.org/10.1016/j.radi.2024.08.006). The 11 articles were primarily from England and focused mainly on the lived experiences of APs and the perceptions of their managers. Only one study explicitly included SWs, referred to as imaging assistants. Methodological quality varied although none were excluded on this basis. The lack of imaging support workforce publications suggests there is no obvious advocate for support workforce evaluation.

Themes included opportunities within different modalities, scope of practice, job satisfaction and aspirations, acceptance in practice, and limited evidence of capacity generation and impact. With no professional limits restricting the support workforce area of practice, the literature predominantly places them within X-ray (projection radiography) and/or breast imaging (mammography). Some papers refer to confusion around AP utilisation, scope and supervision requirements with evidence of scope 'creep' where the boundaries of practice expand either through individual's growing experience or deliberate development. While high job satisfaction was recognised, many, but not all SWs wished to progress to registered practice, though barriers to progression were highlighted.

There is limited evidence of the role of APs in generating capacity in the registered workforce to undertake advanced practice that was initially envisioned when the skills mix radiography career strategy was introduced.[7] Any future studies should seek to address impact and cost-effectiveness, and should establish the perspectives of service users, a group omitted from all work so far.

Workstream 2 – census of the imaging support workforce

Methods

The size and structure of the imaging support workforce in England were determined by analysis of an anonymised workforce data set drawn from the Electronic Staff Record (ESR). The ESR is a payroll database system used by 99% of NHS Trusts to manage the payroll for over 1.8 million NHS employees.[53] Data extraction took place in December 2022. A census methodology (complete enumeration)[54] was used to collect and analyse data including whole time equivalents (WTEs) and person counts for the non-medical imaging workforce. The ESR data set included all NHS Trusts with imaging services (n = 137), representing all (100%) of the 124 NHS acute trusts in England, in addition to specialist Trusts with imaging services (n = 13). The anonymised data provided on each employee included region of the country, organisation, job role, occupation code and area of work. Piloting of a single region established comprehensive and reproducible inclusion and exclusion criteria for the wider data set.

Staff WTEs were allocated to individual pay bandings and to one of two groups, the support workforce (Bands 2–4) or the radiographer workforce (Bands 5–8). For each NHS Trust, the proportion of SWs (% utilisation) within their imaging workforce was calculated. Trusts were ranked in ascending order of support workforce proportions, stratified into equal thirds (high/medium/low proportions). As data were non-normally distributed, the median and interquartile range were calculated for each of these categories. Additional correlations explored the relationships between the different work groups and pay bands. This work was reported in Article 3 (https://doi.org/10.1093/bjro/tzae026).

Findings

This census provides the first comprehensive compilation of national imaging workforce data to explore the deployment of the imaging support workforce in England. Analysis of the 137 NHS Trust data identified a combined total of 12842.5 WTE radiographers (Bands 5–8) and 3961.9 WTE SWAPs (Bands 2–4). The support workforce comprised 23.6% of the entire non-medical imaging workforce (median 22.2%, interquartile range 14.9–29.1), a much smaller proportion when compared to the wider NHS clinical workforce (36.1%),[44,55,56] suggesting there may be scope to expand.

Ranking trusts into the 'adopter' categories (proportion of SWs in their imaging establishment), median values ranged from 30.7% (high) to 22.2% (medium) and 10.5%

(low). The wide variability in the support workforce utilisation (proportion) does not appear to be directly influenced by the size of the imaging department (see *Appendix 2*, *Figure 3*), though larger imaging departments are more clustered around the median value than the smaller departments which tend to have a smaller support workforce proportion.

Analysis of combined support workforce numbers (n = 137 NHS Trusts) across different grades are demonstrated in *Appendix 2* (*Figure 4*). The imaging support workforce appears to lack the wide base from which to underpin workforce transformation; Bands 2 and 3 have similar proportions, with a much smaller than expected Band 4 category. Band 4 APs comprise 3.7% of the imaging workforce (n = 625), and 15.9% of the support workforce. This is a much lower utilisation of Band 4 APs than is seen in the wider NHS (7.3% and 20.3%, respectively),[44,55] suggesting that this may be a focus for future imaging workforce development.

Review at the individual NHS Trust level demonstrates that there is significant variation in the grades that the support workforce occupies. *Figure 5* (see *Appendix 2*) depicts the different configurations by workforce 'shape' and WTE occupying each grade, presented in *Figure 5*a as combined data (all trusts), but then recognising significant variation between Trusts. Two opposing deployment models of Band 2 and Band 3 SWs were identified, with imaging services preferring to use either Band 3 (*Figure 5*b), or Band 2 (*Figure 5*c) SWs, but rarely deploying both grades beyond 'in training' roles.

Workstreams 3 and 4 – regional and place-level engagement

Methods

These two WSs were reported together in Article 4 (https://doi.org/10.1016/j.radi.2024.11.021) which presented overarching and overlapping themes. The methods are outlined below.

Workstream 3 – A pragmatic qualitative description research design[57] was used to collect and analyse data which explored the contribution of imaging networks to disseminating and implementing effective support workforce strategies. Representatives of all 22 imaging networks across England were invited to participate in an online structured interview. The interview schedule explored regional approaches to support workforce recruitment and retention, education and training, competency assessment, supervision, and deployment. Interview questions were informed by the self-assessment questions for regions, systems and organisations within the Health Education England (HEE) AHPs support workforce: readiness toolkit.[58] Three pilot interviews were undertaken, two with system-wide lead radiographers and one with a system workforce lead. As no significant changes were made to the interview questions, the pilot interviews were included in the analysis of the wider data set. Imaging network qualitative themes were generated using a descriptive thematic approach,[57] with initial coding undertaken by a researcher seconded to a system-level imaging workforce role. Themes were discussed and refined within the wider team and subsequently combined with the Imaging Services analysis in WS4.

Workstream 4 – This explored contextual factors at imaging service level which serve to facilitate or inhibit the support workforce contribution, addressed through a combined qualitative and quantitative 'nested design'. Purposeful sampling of eight imaging departments within each of the three census 'adopter' categories ensured inclusion of varied levels of support workforce utilisation, department sizes and geographical locations. A radiology services manager (RSM) at each of the 24 NHS Trusts was invited to complete a workforce data questionnaire and participate in an online semistructured interview. The interview guide was informed by findings from WS1–3. Following a pilot interview with a RSM from an unselected medium sized, medium adopter NHS Trust, two additional questions were added to an interview topic guide. An experienced qualitative researcher with a radiography background completed all interviews. During the first two interviews, unexpected but potentially valuable information emerged leading to two additional questions (leadership and diversity) being added to the interview schedule for subsequent participants.

The Gale *et al.* approach of framework analysis[59] was used to organise and compare data from the quantitative and qualitative findings. The analytic framework was generated in Microsoft Excel following the five steps in framework analysis (data familiarisation, framework identification, indexing, charting, and mapping and interpretation).[60,61] The researcher who completed the interviews and was most familiar with the data completed qualitative data extraction into a mixed-methods matrix,[62] with a second researcher extracting quantitative data from the workforce questionnaire. The wider research team debated the emerging framework and confirmed that data saturation had been achieved. An independent policy researcher with extensive expertise in framework analysis subsequently reviewed and validated the framework and supported the generation of the combined WS themes.

Workstreams 3 and 4 findings

Forty-two interviews were completed across the two workstreams (*n* = 48 participants). Eighteen imaging networks participated, representing 81.8% of the networks in England. Interviews with Radiology Service Managers (*n* = 24) represented 17.5% of all eligible NHS Trusts; the majority (*n* = 18) provided support workforce data. Participating imaging services (cases 1–24) were evenly spread across the seven NHS England regions,[63] representing varying workforce sizes drawn equally from the high, medium and low 'adopter' categories.

Analysis yielded three primary themes encompassing seven categories (see *Appendix 3*, *Table 3*). These themes are explored in depth in Article 4 (Nightingale *et al.* 2025;[1]) (https://doi.org/10.1016/j.radi.2024.11.021) and a brief summary is provided below. Exemplar quotations from Article 4[1] can be found in *Appendix 4*, *Tables 4–6*, with accompanying figures[1] in *Appendix 5*. Where appropriate, links are made to participating organisations using the acronym RSM (1–24) for Radiology Service Managers, and INR (1–18) for imaging network representatives.

Theme 1: Deployment rationale and decision-making

Category 1.1: Lack of professional identity

Deployment of SW roles is highly variable, characterised by an extensive range of job titles varying between Trusts, sites within a Trust, and even within a single department, suggesting that the professional identity of SWs is not considered in their deployment. Variations blur grade boundaries, with Band 2 titles (e.g. *Medical Imaging Assistant*) appearing similar to Band 3 titles in other organisations (e.g. *Diagnostic Imaging Assistant*). Three departments used the historical Band 2 term '*Helper*' which lacks acknowledgement of the contemporary skillset required. However, AP titles are uniformly used to denote the Band 4 role. Participants recognised *'huge discrepancies'* (INR6) in titles, competencies, training, job descriptions, AfC banding and scope of practice both within and between Trusts, causing misunderstandings and confusion.

Recognising a lack of professional identity within the support workforce, several RSMs had created SW leadership roles, with responsibility for rosters, appraisals, recording sickness and annual leave and in some cases even disciplinary procedures. In the absence of national guidance, this innovation is accompanied by wide grading discrepancies between AfC Band 3, 4 or 5. Some RSMs recognised the potential for support workforce leadership roles but had not yet implemented them.

Category 1.2: Varied workforce profile

Workforce data provided by 16 RSMs reflected the size and scale of their service (see *Appendix 5*, *Figure 6*). Combined radiographer and support workforce establishments ranged from 78 to 292, with support workforce (Bands 2–4) proportions varying widely between 10% (Trust 18) and 34% (Trust 6). An important finding is that the support workforce proportions are not significantly correlated with department size [r (16) = −0.19, p = 0.478].

Figure 7 in *Appendix 5* displays SW deployment by headcount and grade. Most RSMs deploy either Band 2 or Band 3 SWs, with some indicating dissatisfaction with their grade balance. Band 4 AP staff are utilised poorly, with 29% of departments having none or only one Band 4 (see *Appendix 5*, *Figure 7*). The exception is Trust 4 with 15 Band 4 staff (30% of the support workforce); while Trust 8 has the highest AP number (*n* = 18), they make up only 23% of the support workforce.

Some RSMs struggled to see a role for APs, while others were more positive with many services deploying APs within X-ray and mammography. A recent shift of APs to cross-sectional imaging was noted (INR6). A barrier to deployment was a lack of supervision, requiring 'more flexibility of what is considered supervision and what is not' (INR7), including using technology as an enabler for remote supervision. Many RSMs advocated for a national job description and AP scope of practice extension into operating theatre and mobile work.[1]

Band 2 roles were described as 'flexible' with elements of clerical, portering and chaperoning, whereas Band 3 roles involved clinical elements such as cannulation and sterile trolley preparation. Both roles were often indistinguishable, with a trend towards gradually phasing out Band 2 roles. SWs appear to be vital for improving the flow of patients by liaising with other departments and wards, though no services had involved patient or public groups in the design of SW roles.

Many RSMs were unsure of their support workforce gender, age and ethnic diversity profile, though most suggested a predominantly female, White and older support workforce. There was some recognition of the benefits a diverse support workforce can bring, though support workforce diversity is an area for further consideration to ensure the workforce reflects the local population.

Category 1.3: Workforce flexibility

Bands 2 and 3 SWs are often deployed in CT and ultrasound (see *Appendix 5*, *Figure 8*), mainly for pastoral support, chaperoning and patient flow; Band 4 staff rarely

feature in these modalities (see *Appendix 5*, *Figure 9*). The support workforce may be deployed in rotational posts through two or more modalities, more commonly seen at Bands 2 and 3 than at Band 4. There is no pattern to this deployment, for example Trust 3 commits all SWs (Bands 2–4) to rotational posts, whereas Trust 8 has only modality specific roles.

Imaging network participants confirm that the main deployment decision is shaped by the approach to rotational activity which may extend between hospital sites, though an adverse impact on staff well-being is recognised. Static deployment models were preferred by many SWs enabling them to concentrate on one area as 'natural territory' (RSM23) with better supervision prospects and a chance to become highly skilled; this is particularly the case for APs. Static models potentially reduce workforce flexibility, creating challenges of covering sickness and annual leave, but some embraced both models.

Theme 2: Innovations in support workforce activities

Category 2.1: Evolving scope of practice

Most role innovations related to training innovations alongside a wider scope of practice for APs across different modalities. Support workforce in-patient care coordination and navigation roles were pivotal in improving patient flow. Training demands on imaging networks were associated with management skills, supervision, radiation protection training and for support to undertake non-complex CT/MR scans under supervision. However, innovation was not widespread with reports of limited demand for progression and lack of backfill preventing opportunity, with some stating their departments were 'pretty standard' (RSM2, RSM3).

Category 2.2: Embracing apprenticeships

All participants noted the growing influence of Level 6 Degree Apprenticeships (DAs), an alternative 'grow your own' employer-supported pathway to registered practice. Few services had embraced SW apprenticeships at lower academic levels. While most RSMs were keen to 'watch and wait', services with a commitment to DA described them as a key enabler for recruitment and retention, removing the 'glass ceiling' (RSM21) for SWs.

Barriers to apprenticeships include the 'burden of red tape' (RSM23) with many highlighting 'lack of backfill'; apprentices are not counted as 'in training' and still appear within the establishment budget. Apprentices add to the training burden. To counter a lack of training capability and capacity, several RSMs called for a regional or academy approach to apprenticeship training.

Theme 3: Stability and sustainability of the support workforce

Category 3.1: A stable workforce

Data supplied indicate a high proportion of vacancies in the registered radiographer workforce; conversely, the support workforce confers stability with low vacancy rates. Recruitment was more challenging in more remote geographical locations and/or where Band 2 salaries were unattractive in higher cost locations. Targeted recruitment drives were beneficial, though lengthy Human Resources processes were a barrier, with high volumes of applications in each recruitment round. Support staff are drawn from the local area with homes and family ties, leading to a low turnover in Bands 3 and 4 roles; however, in some services, there is considerable Band 2 turnover.

Network-wide interventions included providing pre-employment experience, and ensuring more robust on-boarding procedures, induction and preceptorship. SWs were seen as the supply pipeline for APs, apprentices and radiographers, with the need for a clear career pathway and succession planning advocated by imaging network representatives. Providing progression opportunities positively affects retention.[1]

Category 3.2: Added value

The support workforce is highly valued by all participants as they add vital stability to the workforce, enabling efficiency and 'flow' of patients, and describing them as 'absolutely the lynchpin' (INR12), and 'absolutely pivotal' (RSM4). While some RSMs suggested a link between SW roles and enabling radiographers to extend their roles (enhanced practice), many refuted the link between SW deployment and advanced practice.[1]

Workstream 5 – qualitative case studies – service-level perspectives

Methods

A collective case study approach[64,65] combined learning from nine individual case studies, providing an operational perspective of support workforce deployment at department level. Purposeful selection of case study sites ensured that the findings are comprehensive and widely applicable to services across the country, with cases sampled equally from the three 'adopter' categories and reflecting different geographical regions, department sizes and settings.

A research team visit to each case study site commenced with a review of support workforce documentation (e.g. job descriptions). Focus groups with SWAPs promoted collective discussion about scope of practice, autonomy in decision-making, team working, and career progression. Semistructured interviews with imaging managers focused on organisational structure, their approach to deployment, considering 'what works well' and operational challenges. Modality lead interviews 'drilled down' to selected modalities (e.g. CT, MRI, digital radiography) to explore the contribution of the support workforce and the processes that support those roles including supervision, delegation, assessment and any implications for safety and quality.

All interviews and focus groups were audio recorded and transcribed. Data analysis consisted of initial within-case analysis followed by a cross-case analysis, applying a framework analytic approach using Quirkos software to organise and manage the process.[66] All data were independently indexed (coded) to ensure validity, with the wider research team offering critical reflections. Detailed field notes taken during the visits, capturing observations and impressions, fed into the analytic process. This analysis is detailed in Article 5 (https://doi.org/10.1016/j.radi.2025.102956)

Findings

Table 7 in *Appendix 6* presents a summary of each of the sites visited. A total of 41 individual interviews and 15 focus groups (n = 108) were undertaken across the nine sites. Four overarching themes were identified (see *Appendix 6*, *Table 8*). Each theme is briefly outlined below and can be seen in full in Article 5. Exemplar quotations can be found in *Appendix 7*, *Table 9*.

Theme 1: Operational efficiency and service impact

The support workforce was universally perceived as integral to optimising workflow and critical to maintaining and enhancing operational efficiency: 'Without them there wouldn't be a service at all' (Site 7). Band 4 APs enhanced service capability through performing more complex tasks under supervision, expanding the scope of services offered. The APs described themselves as 'two thirds of a radiographer' to depict their unique role. The dependency upon the support workforce was challenged where some low utilisation sites experienced high staff turnover which impacted on service efficiency and patient care. High utilisation sites tended to manage these impacts better, often due to more structured team dynamics and role distribution. There was a strong emphasis on the importance of teamwork and enhanced patient interactions.

Theme 2: Roles and responsibilities

Across the sites, roles appeared well-delineated with defined clinical and administrative responsibilities; however, role definitions and role titles varied, with (interchangeable) reference to 'Support Workers', 'Healthcare Assistants', 'Radiology Assistants' and, 'Radiology Department Assistants'. A common grade differentiation was based upon whether SW roles had cannulation skills. Autonomy within roles clearly contributed to job satisfaction; in sites where the support workforce had less autonomy there was a clear desire to introduce initiatives to promote it. However, some sites struggled with blurring of role boundaries and role creep. Unclear role definitions, staffing shortages, banding decisions or operational demands potentially influenced role strain.

Deployment varied with some sites rotating staff through different modalities while others preferred static roles, mirroring radiographer specialisation. While rotation across modalities (and Trust sites) provided some flexibility, it was evident that static deployment enhanced service consistency as well as team dynamics and job satisfaction:

> *… I think having the static people means you get that continuity …*
>
> *Site 3*

Management and supervision of SWAPs varied across sites with the majority providing this within modality areas. There was little evidence of association between utilisation levels and perceptions of roles, responsibilities, job satisfaction and stability of the workforce, although those with high utilisation tended to feature more well-defined roles. Role creep was evident across sites but was more pronounced with lower staffing levels in low utilisation sites.

Theme 3: Career progression, support and training

Training for SWs varied across different sites, with several using established 'in house' competency frameworks. Training approaches ranged from informal supervision to more formalised induction programmes ranging from 6 weeks to 6 months; some sites required completion of the Care Certificate. The support workforce was recruited locally with several sites adopting a 'grow your own' philosophy. There were few opportunities for career progression at a local level, limited by a lack of well-designed, coherent education, training and support packages and largely contingent upon funding availability. Inconsistency in pathways for career progression were noted across different imaging modalities, for example, APs

are predominantly seen within X-ray with SWs focused in ultrasound and cross-sectional imaging. This difference in opportunity warrants further investigation. Nevertheless, there was evidence of initiatives that went some way to promoting progression opportunities, including a 'community of practice' with associated education and training resources for SWs working across multiple sites (Site 7). Lack of progression opportunities appeared to be more pronounced in low utilisation sites, and despite small pockets of good practice, career stagnation across the SWAP workforce remains a frustrating conundrum.

Theme 4: Workforce dynamics and job satisfaction

It was universally clear that the support workforce 'love their job' and especially the impact they had on patient experience and being recognised as part of a non-hierarchical team. Their integration extended to their identity within several sites with the support workforce wearing the same 'scrubs' as radiographers and consultants. Although job satisfaction was high, there was evidence of role strain and perceptions of feeling undervalued in some sites, leading to issues with retention. Contributory factors were the influence of rotational deployment and banding/pay discrepancies: 'They were all down banded, regraded down to 2 [from 3] … It had a massive impact. It was the worst thing we ever did, ever' (Site 8).

There was no association between support workforce utilisation levels and stability of the SWAP workforce; geographical location was the main determinant with rural and coastal regions seeing lower staff turnover.

Workstream 6 – mixed-methods synthesis

Methods

Integration of findings from each previous WS initially followed a Triangulation Protocol Method to synthesise and triangulate the data.[67,68] This approach created additional understanding where findings from each method agree (convergence), offer complementary information (complementarity), or contradict each other (discrepancy or dissonance).[67] The O'Cathain *et al.*[67] Mixed-Methods Matrix approach provided a visual representation of the headline findings which was reviewed by the lead investigator alongside an independent health policy researcher to encourage unbiased reporting.[66] The synthesis was expected to yield a number of critical determinants which are causal factors which control or influence the likelihood of something happening, for example a service being effective. These critical determinants were developed into a determinant framework[69] for the effective deployment of the imaging support workforce, providing 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 support workforce outcomes.

Findings

The determinant framework comprised three themes: evidence-based workforce planning; deployment; development and progression. Each of these themes encompassed five critical determinants for the effective deployment and utilisation of the imaging support workforce (see *Appendix 8*, *Figure 10*).

The determinant framework was developed into a Maturity Matrix which is a model utilised in health care for assessing and improving the maturity of healthcare practices, operations and infrastructure.[69] Empirical benefits of using Maturity Matrices include identifying issues and providing guidance for healthcare improvements, and improving efficiency, effectiveness, performance and productivity.[69] The matrix presents a series of discrete iterative steps that represent a desired or typical evolutionary path towards excellence or effectiveness[70] (see *Appendix 8*, *Figure 11*).

The matrix was designed for use by imaging services and imaging networks to self-assess their support workforce to inform future workforce planning, with an aim to enhance or reduce the influence of relevant determinants. The Imaging Support Workforce Maturity Matrix has been reviewed by the I-SWAP Stakeholder Advisory Group for applicability to imaging services within the wider NHS and was explored further at a national stakeholder event ('I-SWAP – A workforce with untapped potential?'). It was subsequently shared with national leaders from NHS England and the SCoR at a meeting in late January 2025 to support dissemination and adoption. The final version is an online interactive tool available at https://research.shu.ac.uk/i-swap/, and a hard copy version is available in *Appendix 9*.

Discussion and interpretation

This mixed-methods study offers the first comprehensive investigation into the deployment of the support workforce in NHS imaging services in England. Beginning from a broad, international perspective, the study gradually narrowed down the scope within each consecutive WS to explore national, regional, place level and finally individual

imaging department perspectives. This enabled the identification of critical determinants that encourage and inhibit effective support workforce deployment.

Existing research/further research needed

The completion of two scoping reviews facilitated examination of support workforce deployment from both a broad international and multiprofessional perspective, and a national, profession-specific perspective. The international scoping review showed that most research was qualitative and of variable quality, predominantly relying on anecdotal accounts from managers. Most studies were conducted in Australia and the UK, reflecting increased support workforce implementation and advanced research maturity. There was a lack of studies examining the cost-effectiveness of the support workforce – a gap in the research base that was identified over a decade ago in a 2013 systematic review[71] yet remains largely unaddressed. The UK imaging-specific scoping review identified only 11 relevant articles, which contrasts sharply with the volume of literature with a focus on higher-level radiographic practice.[72–75] Ten articles focused on the AP role, with only one article directly examining SW roles; managerial perspectives dominated the findings.

Despite anecdotal evidence suggesting that APs contribute to workforce capacity, there remains a lack of robust research on their impact and cost-effectiveness. The perspectives of the support workforce are almost entirely absent. The mixed-methods approach employed in the I-SWAP study has ensured that a range of stakeholder viewpoints have been explored, including the support workforce voice, but further research is required regarding impact and service user perspectives.

Capacity

The census of ESR data provided the first comprehensive analysis of imaging support workforce data in England, highlighting significant variability in the deployment of the support workforce who comprise approximately 22% of the imaging workforce. This is a small proportion when compared to the 36.1% seen across the wider NHS clinical workforce,[39,44] suggesting scope for expansion. Increasing the proportion of SWs would equip the imaging workforce with the wide base needed to support workforce transformation.[44] Wide variation was noted in the support workforce proportion at individual trust level, with smaller departments showing more variability than larger ones, suggesting that services with larger workforces rely on some form of guiding principle to run effectively.

Workforce planning

The imaging support workforce is operationally managed rather than strategically planned. This workforce has evolved from historical roles often deployed in 'dark rooms', preparing images taken by radiographers and radiologists. As radiology technology advanced, support workforce roles have had to adapt to other patient-facing and administrative work. Isolated operational management has led to significant variations in deployment models, role visibility, and development opportunities as imaging services responded to their individual needs. Some attempts at service redesign are emerging at service level; however, longer-term strategic planning at organisational, regional and national levels is required.

There is an expectation that 'Patient partnerships with the service are used to design and improve future care and service provision' outlined by the Quality Standard for Imaging (QSI), which sets national quality criteria for imaging services (p. 22).[76] Interviews confirmed a lack of engagement with patient and public representatives in support workforce planning. Fortunately, imaging networks present an opportunity to address this and will be well-placed to begin collaborative working between partner NHS Trusts upon reaching the required 'maturity' level by March 2025.[77] The inclusion of patient and public involvement in this network engagement should influence decision-making on future support workforce deployment at regional and place levels.

To aid regional and service-level planning, policy-makers and professional organisations are beginning to release guidance on the support workforce. Radiography was one of the first AHPs to incorporate APs into their career framework;[38] however, the implementation of AP roles remains sporadic. Challenges to their deployment include the professional restriction of their scope of practice (published in 2007 and more recently withdrawn),[78] particularly problematic in settings where supervision can be challenging, such as mobile radiography and operating theatres. SWs have not, until comparatively recently, received similar levels of attention as the AP workforce. The publication of the AHP Support Worker Competency, Education and Career Development Framework[79] aims to reduce variation in roles, grade, and progression opportunities; however, this study highlighted the need for targeted dissemination of the relevant literature to RSMs and imaging networks, as knowledge surrounding these valuable frameworks was low.

Deployment models (grade and rotation)

The most appropriate deployment model (rotational vs. static) was hotly contested, with managers traditionally favouring rotational deployment due to the flexibility in covering staff absence. Here the focus is on addressing operational problems rather than the possible benefits to patient care. SWs often expressed a preference for static

deployment as it allowed specialisation, though some enjoyed the variety offered by rotational deployment. Importantly, there is an absence of strategic planning, nor any consultation with the support workforce on these deployment models. While rotational models allow the 'firefighting' needed to run an imaging department in the NHS of today, they do not offer the same opportunities for progression that static or hybrid models of deployment afford. Some departments are now engaging in some strategic planning through consultation with their staff, which is resulting in positive workforce transformation.

Many imaging departments opted to employ either Band 2 or Band 3 SWs, rather than a balance between the two as seen in the wider NHS clinical workforce.[39,44] This approach is likely to cause challenges with recruitment and retention. Recruiting applicants directly into Band 3 posts with the required clinical skills and experience is likely to be challenging; conversely, career progression will be restricted in the absence of Band 3 posts which may lead to retention issues. Ensuring a balance between Bands 2 and 3 SW roles allows entry-level posts to be utilised to encourage wider recruitment from a range of backgrounds, and smooth career progression through different grades.

Roles and responsibilities

The AHP scoping review highlighted underutilisation of the support workforce, with many AHPs reluctant to delegate tasks and feeling unprepared for supervision. The absence of clear career pathways is likely to contribute to this variation. While frameworks for the support workforce have been published in Australia[80] and the UK,[79] the variation found between AHPs signals a need to move away from a 'one-size-fits-all' approach, and towards profession-specific frameworks that can more accurately address supervision, deployment, scope of practice, and career development. Similarly, variations between SW deployment within individual imaging modalities are stark; case studies showed that when services used rotational deployment, the support workforce faced difficulties in retaining best practice in modalities that they had not worked in for some time. Role guidance is needed for deployment in each modality.

Education and training

Assistant practitioner training and education often varied and was not directly relevant to imaging need, with some education too generic and 'nursing focused' to meet the needs of APs deployed in single modalities such as MRI or breast screening. Engagement with apprenticeships varied considerably between trusts, with some fully embracing them and others avoiding them altogether. Many services are keen to implement AP apprenticeships but are faced with significant barriers such as the costs of having to hold vacancies open until apprentices complete their training, the challenges faced by smaller services in covering out of hours work, and the lack of clarity on scope of practice. Education and training is, therefore, often limited and offered 'in-house', with little to no use of apprenticeships below Degree level. This is likely to have a knock-on effect on career progression.

Recruitment, retention and diversity

The support workforce experiences high levels of job satisfaction, and despite a lack of clearly defined career pathways and low levels of pay, the recruitment and retention of this workforce did not seem to be challenging for most departments. This suggests that the roles are rewarding in other ways; SWs often cited high levels of patient interaction. Perhaps influenced by the ease of recruitment, the diversity of the support workforce had not been analysed, though appears to be predominantly White, female and often reflecting an older age group. The NHS Equality, Diversity and Inclusion Improvement Plan[81] outlines how NHS organisations and Integrated Care Boards are expected to implement plans to 'widen recruitment opportunities within local communities' (p. 9). Some imaging networks were beginning to address diversity through grass roots recruitment activities to increase awareness of support roles in local communities, but the impact of this is as yet unknown.

Assistant practitioners/skill mix

Scoping review evidence suggested that in imaging, APs experience job satisfaction and a desire to progress in their careers, although confusion about their scope of practice and supervision requirements continues to impede full utilisation. This may stem from resistance among radiographers toward AP roles; similarly, some APs also appeared reluctant to perform tasks associated with their former SW roles. This could indicate a stronger identification with their new radiographic roles. In this study, imaging APs demonstrate job satisfaction and aspirations for progression, but the confusion over their role limitations persists and potentially stops services being able to maximise their potential. Barriers to career development were reported by APs in modalities such as MRI and breast imaging, as further training often required moving to the 'general' X-ray modality.

Census data identified the proportions of APs were lower than the proportions seen in the wider NHS clinical workforce,[39,44] suggesting that future imaging workforce development could concentrate on this staff group. However, research on the impact and cost-effectiveness of diagnostic imaging APs outside of breast screening

is limited which may be inhibiting their use in other modalities. Limited evidence links the role of APs to increasing radiographer capacity for advanced practice, with the skills mix strategy's[7] promise of workforce expansion largely unfulfilled. The NHS Long Term Workforce Plan[82] more recently outlined the benefits of APs providing backfill for registered staff. A large part of the AP role is non-complex image acquisition that may release radiographers for enhanced and advanced practice;[38,39,79,83] therefore, the relationship between Band 4 and Band 7 deployment was of interest. However, of all the correlations applied to the ESR data set, this correlation was the weakest. This, coupled with the small numbers of APs deployed, suggests that it is unlikely that the utilisation of APs has a direct effect on advanced practice, except perhaps in breast screening modalities. This is surprising in view of the objectives set out in radiography skills mix strategies.[7,84]

Operational efficiency and service impact

Clearly an extremely valuable workforce, SWs were described as key to the smooth running of imaging departments, specifically regarding patient flow and patient experience. The impact on departments when there were low support workforce numbers appeared to be dramatic, with some consultant-led clinics ceasing to run if a SW was not available. The gratitude to the support workforce was overt when interviewing radiographers and managers, and it was clear that this was echoed by patients. The APs were equally valued, with one staff member describing them as 'two-thirds of a radiographer'. While these are important perspectives, their measurable impact on operational efficiency remains unexplored.

Strengths and limitations

This study employed a mixed-methods explanatory research design, enabling the learning from previous WSs to inform later phases of the project. Integration through building and connecting at the methods level was particularly valuable for the recruitment of NHS Trusts, with analysis of ESR data enabling evidence-informed representative selection. Interviews with RSMs (WS4) also supported identification of suitable trusts for the case studies, providing examples of innovation or barriers for further investigation in the case study phase.

Workstreams 3 and 4 used researchers from different professional backgrounds for data collection and analysis. While this could be a limitation, approaches including the use of the standardised framework approach,[59] regular debriefing with the full research team, and the validation of framework themes by an independent, experienced policy researcher were put in place to mitigate this. Completion of a COREQ (COnsolidated criteria for REporting Qualitative research) checklist[85] supported the quality of reporting of the research.

High workloads of RSMs led to reduced responses to the quantitative survey in WS4. Only 75% of RSMs returned the survey, and of those returned much of the data was missing. This hampered the ability of the research team to fully compare imaging departments. However, this phase of the research employed a rigorous framework approach and minimised selection bias by using national ESR data to identify imaging services. This WS achieved meaningful national representation using a large sample drawn from 17.5% of all eligible NHS Trusts and 81.8% of imaging networks in England.

This study enabled a fully comprehensive exploration of stakeholder perspectives of the deployment of the imaging support workforce, though there remains a gap in the research on the cost-effectiveness of this workforce and service user perspectives. However, this study has laid the groundwork for this much-needed research and provided strong qualitative evidence that the imaging support workforce is a highly valued and impactful asset to the NHS.

Reflections on the project and challenges faced

The method of data collection for WS3 changed from administered survey to online structured interviews following stakeholder feedback, enabling more thorough exploration and further clarifications. As imaging networks were in their early development stages, the use of an interview may also have helped with recruitment.

Earlier collaboration with the SCoR and NHS England, either as a co-applicant or funded partner, may have assisted with recruitment which was sometimes challenging because of the current demands and pressures faced by NHS radiology staff. However, this may have compromised independence of the research team. An appropriate compromise was achieved.

The analysis of ESR data was challenging due to the range of different job titles used for what appeared to be the same roles. The team had to use their best judgement in terms of which data to include and exclude in their aggregations and analyses of imaging workforce numbers, as we acknowledge that this data set was not intended as a research tool.

Engagement with partners and stakeholders

Coinvestigators were selected for their unique expertise, perspectives and external collaborations. One team member held a dual role with the host institution and the South Yorkshire & Bassetlaw Integrated Care System as a lead radiographer. Another member held a dual role with a partner Trust (Mid Yorkshire Teaching NHS Trust) and University (University of Bradford) and led both the Stakeholder Advisory Group (SAG) and PPIE Advisory Group. The SAG included a trainee AP and organisational representatives from several NHS Trusts and imaging networks across England, meeting several times to provide feedback on study progress and advise on relevant areas. The I-SWAP team also collaborated with the SCoR who provided a representative on the SAG, and the Study Steering Committee. Since the completion of the Maturity Matrix, the study team met with NHS England, SCoR and the National Imaging Board to support dissemination of the matrix.

Individual training and capacity-strengthening activities

The project manager/research fellow as an early career researcher accessed numerous training schemes during the research study. In the early stages of the project she enrolled in a mentorship scheme, accessing regular mentorship from a senior researcher outside of the research team. She also completed a short course on professional skills for research leadership and engaged in doctoral supervisor training to enable her to sit on PhD supervisory teams. She completed training for several research tools (e.g. Covidence, Quirkos). This additional training and experience enabled her to gain a substantive Research Fellow position at the host institution.

Institutional capacity strengthening

The post-doctoral position of research fellow/project manager was amended from a 0.5FTE, fixed term post, to a 1FTE permanent post, thereby strengthening the host institution's capacity for future research. The post-holder is now committed to working on another successful NIHR funded award. Two co-applicants continued to collaborate and successfully secured a large HSDR-funded workforce partnership award that commenced in Spring 2025. Additionally, a radiographer from Mid Yorkshire Teaching NHS Trust took up their first clinical research post as a part of the I-SWAP project.

Patient and public involvement

Upon the project's inception, a patient and public involvement (PPI) group was formed with four members, all of whom had extensive experience with diagnostic imaging from a patient perspective. The PPI group met several times with the I-SWAP team to review progress, discuss findings, and provide feedback on relevant topics. Influential contributions from the PPI group related to SWAP role identity, training and supervision, patient interaction, and inconsistency across sites. These informed the investigation plan, particularly for WS5. In addition, the PPI group highlighted that they would have wished for investigation of patient views at a site level but recognised that this was beyond the scope of the funded study. This has informed the recommendations for future research.

Maintaining regular communication with our PPI (and SAG) forums was an important aspect of the project. We achieved this through a quarterly newsletter (see *Report Supplementary Material 2*) that provided updates on the progress of the project, preliminary findings and further information about the individual members of the team working on the project. Recipients were encouraged to forward the newsletter on to any potentially interested parties. As a result, the circulation list grew significantly and reached other patient groups, workforce researchers and SCoR who circulated it to their own PPI group.

We maintained a website for the project (https://research.shu.ac.uk/i-swap/) that provides further information on the project activities, the individual team members contributing to the project, and all outputs such as academic articles, conference presentations and social media engagement. In January 2024, two members of the I-SWAP team appeared as guests on a radiography podcast (Imagin' That), where they discussed the I-SWAP project and its importance to the diagnostic imaging community. This podcast is available across the popular platforms Spotify and SoundCloud at these links: https://open.spotify.com/episode/3CdKZMoObz3le04N1cQjN2; https://soundcloud.com/imagin-that/ep-18. A link to the podcast was also posted onto the I-SWAP website and in the newsletter following its distribution. We also upload our quarterly newsletters to the website so that they can be easily found.

In the early stages of the project, the PPI group noted the absence of the patient voice in our interview schedules, which resulted in the inclusion of a question around PPI involvement in workforce planning for imaging managers (WS4). This highlighted that very few imaging services had engaged with public groups in their support workforce redesign. In the most recent PPI group meeting, we invited feedback on our Public Summary (see *Report Supplementary Material 1*) that

we had drafted, and we gained valuable feedback on how best to present the information visually to support optimal engagement by the public.

The Chief Investigator for the project has been invited on two occasions to present information on the I-SWAP project and share findings with the SCoR Patient Advisory Group. This presentation was well received by attendees, who were very positive about the use of the newsletter and Public Summary; the latter will have a link on their public-facing website to ensure it is accessed more widely.

The findings and conclusions of the I-SWAP study were showcased through a full-day Participant and Stakeholder event entitled 'I-SWAP – A workforce with untapped potential?'. This event, held on 6 December 2024, was open to any stakeholders and was free to all delegates, with travel expenses paid for participants and PPI group members. This was an opportunity to share the I-SWAP findings to widen potential impact and to consider the next steps for this work. The event delegates provided feedback to assist in the validation of the project's final determinant framework and the 'Maturity Matrix' for imaging services. Other researchers working on support workforce projects were also invited to present their work at this event to encourage wider sharing of project findings.

Equality, diversity and inclusion

Research team and stakeholder groups

The composition of the research team was convened initially by methodological expertise rather than by considerations of equality, diversity and inclusion (EDI). The initial five co-applicants were White, female researchers, with three having professorial status and four in an older age category (over 50 years). In the early stages of the project, one of the co-applicants retired, enabling us to include a male coinvestigator. We also appointed a full-time Research Fellow who was female but in a younger age category. Participants were selected by their organisational role, rather than by any demographic characteristics; however, our participants included a diverse range of ethnicities, genders and age groups. Our PPI and professional stakeholder groups provided an opportunity to seek greater diversity, with a closer gender split and the inclusion of greater ethnic diversity. Patient Advisory Group members were drawn from different patient pathways (musculoskeletal, cancer, endocrinology) and had wide experience of imaging settings. They were also experienced as PPIE group members from previous research studies, for example, two members were drawn from the SCoR Patient Advisory Group, bringing with them a wealth of knowledge related to patient perspectives in imaging. This was particularly important for this workforce study, which did not include data collection with patients.

Imaging service representation

In WS2 (census), the total population of NHS Trusts with Imaging Services in England was included in data analysis. While focusing on England, stakeholder engagement has indicated that our findings are likely to be transferable to the other devolved nations. WS3 (imaging networks) also embraced the total population, with all 22 imaging networks invited to participate. This mixed-methods study used an integration approach at the methods level known as 'connecting through sampling'.[46] Sampling for WS4 (radiology service managers) and WS5 (case studies) was data driven, based on findings from previous WSs. For example, the team used the census data to stratify imaging services into three 'adopter' categories, based on utilisation of the support workforce (proportion of the imaging establishment). Sampling frames for WS4 and WS5 included equal proportions of services from each of these adopter categories (high, medium and low), enabling exploration not only of services which embraced the support workforce (workforce establishment), but also those who did not. Selection of services within each adopter category was also influenced by a desire to ensure diverse representation of geographical areas, service sizes and types.

Participant representation

Individual participants were selected, based on their role, by the imaging service or network rather than by the research team. For WS5 (case studies), our local collaborators extended invitations to individual managers and the support workforce to participate; inclusion often coincided with their availability on the day of the data collection visit. The research team did not collect demographic data (gender, age, ethnicity) as it did not influence the research question. However, in WS4, the participants were asked to reflect on the diversity of their support workforce; many had not previously undertaken any such review. For this reason, the Maturity Matrix incorporates a critical determinant related to equality, diversity, inclusion and belonging (EDIB) within the support workforce. A 'thriving' workforce in this matrix expects a 'strategic review of the staff workforce profile, informing recruitment strategies to enable the support workforce to reflect a diverse local population'.

Impact and learning

What difference has been made already?

Adopting participatory approaches throughout the delivery of this research programme has led to some unexpected immediate impacts. For example, participants in the interviews and focus groups, triggered by some of our more searching questions, have shown awareness that they 'could do more' and were keen to explore what is happening elsewhere. The data collection clearly prompted discussion around support roles within radiology teams, with several participants contacting the team for further information after their engagement had ended. One example relates to an interview question about the presence or absence of a 'lead' SW role; interviewees appeared very interested in this role and often asked more about it. Similarly, one site in WS5 (case studies) contacted the team following the site visit to request guidance and information on what to include in the job description for a lead SW role. Therefore, a direct and immediate impact following the data collection phase has been to elicit discussion, debate and actions in imaging departments who are now implementing these roles.

The team held a stakeholder and participant event in December 2024 to showcase the results of the study and to introduce and elicit feedback on the determinant framework (Maturity Matrix). During the event, we captured valuable discussion around the Maturity Matrix, including significant interest shown from NHS England and the SCoR. A meeting with representatives from both organisations was subsequently arranged for January 2025 to discuss how best to roll out the Maturity Matrix for maximum impact.

We have also highlighted with a national Support Workforce Expert Group (a parallel SCoR/NHS England project) our concerning findings related to the under-utilisation of APs (Band 4) who are a core element in underpinning the 'four tier' radiography career framework.[7,38] This research-informed evidence has ensured that they will be shifting their emphasis from 2025 to reviewing their guidance on the AP scope of practice, supervision, delegation, education and innovation to encourage greater adoption of this role across England.

Longer-term impact

The Maturity Matrix aims to assist imaging managers and regional imaging networks in workforce planning to maximise their support workforce so that they can be utilised optimally. The Maturity Matrix spans workforce factors including development and progression opportunities, the provision of a clear career pathway and consistency in deployment, encouraging discussion and debate within and across imaging teams. The Maturity Matrix is designed to enable benchmarking and action planning; iterative improvements in these areas will enhance the recruitment and retention in SWAP roles, and improve equity, morale and staff satisfaction. The findings of the I-SWAP project suggest that SWs tend not to be offered as many opportunities to progress and develop as other staff groups; the use of the Maturity Matrix will facilitate exploration of strategies to enhance these areas.

Maximising efficiency in the support workforce requires a clear vision and strategic action planning to work towards the most effective mix of grades (Bands 2–4), deployment model (rotation vs. specialist) and generation and adoption of innovative roles. Adoption of the Maturity Matrix by imaging networks will provide managers with a supportive framework to benchmark, compare practices between partner Trusts, and develop a shared action plan.

Additionally, the Maturity Matrix includes a section on review of the demographics of the support workforce. The project revealed that this was not something that many radiology service managers had considered. Its inclusion in the matrix will encourage active review around this topic, and, as a result, the support workforce will be more representative and inclusive of people from all ethnicities, socioeconomic backgrounds, and age groups.

Lessons learnt for future research

Throughout the study, we have connected with the professional body (SCoR) in two ways. A senior professional officer, responsible for leading support workforce activities, joined the Stakeholder group and the Study Steering Committee (SSC). Two members of the SCoR Patient Advisory Group were members of our PPI group and our SSC respectively. Two of the research team joined the SCoR Support Workforce Expert Group. On reflection, utilising partnership working with SCoR at the research application stage and from the outset of the project would likely have been extremely helpful, in particularly for recruitment of participants through their platforms. However, this has to be outweighed by maintaining the 'independence' of the study, should any of the research aims or findings not be in alignment with professional policy.

The analysis of ESRs showed that the objectives we had for our analysis did not align well with the original purpose of the data set. For future research, we will explore all available sources for relevant data as there are now a wider range of available NHS data sets.

As imaging networks were in their early stages of development at the time of this project, it was a challenge to identify the most appropriate representative. Initial preparatory work suggested that a structured online interview (administered survey) may elicit a better response from these senior leaders than completion of a questionnaire. We therefore had to be flexible in terms of our research design, as it was necessary to interview participants that were not our original intended sample.

The study team has worked with a wide range of stakeholders over a sustained period, including patient groups, imaging managers, SWs, imaging networks, integrated care systems and professional organisations. An initial concern raised by an experienced PPI member was that in previous studies, long periods of time had elapsed between engagement, and they often felt 'used and undervalued', as though PPIE was a 'tick box' exercise. The team therefore introduced a quarterly newsletter (see *Appendix 5*) which regularly updated all stakeholders and participants on study progress. The newsletter has received an exceptionally warm response, with many requests from beyond our participants (including policy-makers and national stakeholders) to be added to our circulation list. Similarly, our colourful and accessible Public Summary (see *Appendix 6*) which provides an overview of the key findings has been warmly received, particularly by our PPIE members to have as a 'keepsake' from the project. We recommend that all longer-term studies adopt a similar engagement approach.

Related work

Two further studies exploring support workforce deployment across AHP services have been initiated and completed by two of the I-SWAP research team in collaboration with local NHS Trusts (Sheffield Children's Hospital and Sheffield Teaching Hospitals). The design and implementation of these projects helped to shape the design of the I-SWAP study and vice versa.

Real-world impact/potential impact

This project aimed to investigate the development, deployment and contribution of the support workforce to diagnostic imaging activity across England. The evidence-based findings from the I-SWAP study identified the critical determinants for the delivery of an effective imaging support workforce. The Imaging Support Workforce Maturity Matrix incorporates the critical determinants into a framework to promote assessment, critical review and discussion within imaging workforce teams. We hope that the use of this matrix will enable the furtherance of support workforce roles, with improvements in staff experience and department efficiency. If successful in this, these modifications will have a knock-on effect on patient experience within radiology departments, by providing a stable and thriving workforce within an efficient and effective department.

Collaborations/further funding/future work

Part way through the project the North West Imaging Academy contacted the research team as they had heard about the I-SWAP project in an imaging network meeting. They were in the early stages of developing a regional survey to investigate the deployment of SWs across their network. Due to the similarities of the two projects, the two teams have kept in touch throughout the project, with their colleagues attending the I-SWAP stakeholder event in December to present their findings. We are continuing to collaborate with the North West Imaging Academy in the dissemination of both projects.

The learning achieved through undertaking the I-SWAP study has led to a successful award for the Chief Investigator from the NIHR HSDR funding programme for an AHPs Workforce Research Partnership (NIHR160536). This 5-year award brings together collaborators from across AHP disciplines to work on a range of workforce studies. A support workforce follow-on study undertaken by an Early Career Researcher has been incorporated into this Partnership. The findings of the I-SWAP project have revealed the need for further learning across all four tiers of radiography practice, and three research team members have collaborated to submit a proposal for NIHR funding for a follow-on project.

Aspirational/pre-planned dissemination and discussions

The study team met in January 2025 with senior representatives from NHS England and SCoR to showcase the Public Summary report, highlight the lack of education, training and career opportunities for SWAPs, and to discuss pathways to impact for dissemination and adoption of the Maturity Matrix. Having the support of these influential organisations will be pivotal in ensuring the results of the I-SWAP project are disseminated far and wide, and that the Maturity Matrix can be used effectively by those who can best maximise its impact. Subsequently the Lead Investigator was requested to present key findings and the Maturity Matrix to the NHS England National Imaging Board (September 2025) which provided a vital opportunity to address senior policy-makers and government advisors.

Also in January, the Chief Investigator and PPIE Lead presented the project's findings to the SCoR Patient Advisory Group. Presenting to this audience is particularly

important, as patients were not 'in scope' as the target population for the study. While patient perspectives were sought through our PPI group, ensuring patients and the public are reached when disseminating the results of the study is even more crucial. The findings of the study were warmly received, and the team were commended on both the regular newsletters and the Public Summary, which will be showcased and linked to on their website.

Three of the research team attended the leading international conference, UK Imaging and Oncology (UKIO) Congress, in June 2025 and have presented the most recent findings. UKIO attracts important stakeholders and presenting the findings in this forum means that the impact of this project will be maximised. Radiology managers and imaging network representatives often attend UKIO; it is important to be able to reach this audience for the Maturity Matrix to achieve its aims. The team has also published an article (Article 8) focused to the mixed-methods synthesis and Maturity Matrix for dissemination in a health policy journal.[86]

Climate, health and sustainability

While the study aims and objectives did not directly address climate, health and sustainability, these factors were at the forefront when it came to planning each phase of the research. Meetings for the stakeholder and PPI groups and study steering committee have all been held remotely online, alongside most Study Management Group meetings for the I-SWAP team. Additionally one-to-one interviews for two WSs were also held online to avoid unnecessary travel and expense. Wherever possible consent forms for participation were completed electronically rather than using paper copies. This was also the case for surveys, which were generated using Qualtrics and completed electronically. Our quarterly newsletter was distributed electronically rather than as a hard copy to subscribe to more sustainable practices.

In October 2020, the NHS committed 'To deliver the world's first net zero health service and respond to climate change, improving health now and for future generations' through its Greener NHS programme.[87] Reducing the NHS Carbon Footprint for the emissions they control or can influence is an important goal. By engaging with participants and NHS stakeholder groups through the sustainable means as indicated above, this study has supported this NHS ambition. Similarly, sustainable practices have been employed in publications and outputs which have been submitted and published online using a digital object identifier for online identification. All outputs are Open Access, ensuring that underserved communities can review this research. All research data will be made available to other academics and researchers on request through the Sheffield Hallam University data archive, thus supporting sustainable research practices.

The findings of this study do not directly impact on NHS or global health and environmental initiatives; however, if our findings are acted on by healthcare organisations, this will lead to a more effective utilisation of the support workforce which will increase workforce stability and potentially reduce costs. It will provide more capacity for the registered workforce to innovate and in doing so will reduce patient waiting lists and ultimately improve patient care. Additionally, increased utilisation of a support workforce with clearly defined career progression will provide more opportunities for a diverse group of local people to enter healthcare careers in the NHS.

Implications for decision-makers

The aim of this study was to investigate the development, deployment and contribution of the support workforce to diagnostic imaging activity across England to determine effective models of practice that will support future workforce transformation and re-design. We were keen to identify whether there was the required capability and capacity within the support workforce to support the essential transformational changes outlined in the three 2019–20 reviews of imaging services.[35–37]

Our results suggest that while there is clearly potential for the support workforce to be effectively mobilised, with many pockets of innovative practice, the unwarranted high levels of service variation across all aspects of utilisation (workforce size, titles, grade, role, deployment model) is a significant barrier. The lack of appropriate, accessible, imaging-specific education opportunities restricts many services to 'in-house' training of variable quality which reduces transferability and career progression within and between imaging services. Even where high-quality education provision is available, a lack of 'backfill' funding presents a significant barrier, as managers effectively 'lose' a much-needed post during often lengthy training periods. The AP role appears to be particularly impacted by a lack of appropriate education, with many services choosing to 'de-select' these roles in favour of supporting DA trainees who will occupy these roles while in training. This trend fails to capitalise on role innovations, whereby experienced APs can work with radiographers and radiologists to identify new opportunities to improve patient flow and experience, creating capacity for the registered workforce to develop their roles. A lack of vision in creating educational opportunities to facilitate

'specialist' SWs to transition into 'generalist' registered practice has limited the potential for a local pipeline into registered practice. Our findings provide evidence that the concept of (seamless) career progression through flexible career pathways is some distance away.

The support workforce provides stability for imaging services, identified as the 'bedrock' of imaging services and 'the glue that holds it all together', but if unresolved, the issues outlined above will inevitably impact upon retention, turnover and staff satisfaction. The study identified that the imaging support workforce in England is operationally managed rather than strategically planned, with most services undergoing development in isolation, heavily influenced by local organisational service requirements and efficiency savings. Re-design of the support workforce will require longer-term strategic planning at organisation, regional and national levels. To mobilise the required transformational change, our study has the following implications for decision-makers.

Society and College of Radiographers and NHS England

- Ensure current professional and policy guidance relevant to the imaging support workforce are easily searchable and accessible in one single location, for example in a support workforce section on the SCoR website. Communicate this resource through radiology service manager distribution lists and through imaging networks and academies.
- Review and update current guidance related to the AP role and scope of practice, providing concrete examples of innovative roles across the imaging spectrum and reflecting the potential role of using technology as an enabler to support remote supervision.
- Initiate exploration of current education provision with higher education (HE) and further education (FE) education providers, and co-design (and accredit) a flexible exemplar curriculum for each level of support workforce practice. The curriculum should include modules for each modality ('bite sized') which can be accessed to support CPD, role changes and career progression. Education opportunities should be maximised to enable the workforce to progress seamlessly to registered status. Online or hybrid delivery can ensure the programmes offered are widely accessible and financially viable.

Imaging managers, imaging networks and academies

- Review the size, demographic profile, configuration (grades, roles) and career progression of their support workforce, utilising the Support Workforce Maturity Matrix as a tool to initiate cross-workforce critical reflection at imaging service, site, department and modality levels.
- Imaging networks and regional academies to utilise the Maturity Matrix to facilitate information sharing between partner NHS Trusts, and to inform shared decision-making and workforce planning support at regional levels, under-pinned by regional and national alignment of roles and competencies, including modality-specific guidance.
- Identify opportunities for the support workforce to work across the four pillars of practice, implementing leadership and management roles or role elements, and supporting a community of practice at regional level.
- Imaging networks to support service managers to engage with higher and further education providers, patient and public groups and community leaders to fulfil one of their organisational roles as an 'anchor' institution[40] implementing EDI initiatives in their local community to widen access to healthcare occupations. This is particularly vital for NHS Trusts situated in economically deprived rural, coastal and urban locations, where communities are likely to have the greatest need, yet conversely the hospitals experience more challenges in recruitment and retention.[88] The support workforce is potentially a 'local' workforce, reflective of the local community, with excellent recruitment and retention to continue to be the 'bedrock' of the imaging workforce.

Research recommendations

The I-SWAP project has provided insight into the challenges and opportunities related to the imaging support workforce. This insight has highlighted several further research priorities which are important for improving workforce efficiency both within imaging service delivery as well as wider healthcare settings. These priorities require collaboration between healthcare providers, researchers, professional bodies and policy-makers to ensure these evidence gaps are effectively addressed. While there are further research opportunities that the project has revealed, the following research questions were prioritised for their importance in ensuring the NHS can maximise its output.

Imaging workforce – wider skills mix

Research question: Is imaging 'skills mix' a clinical and cost-effective solution for challenges in service delivery?

Why is this important?

National policies,[82,89] imaging review recommendations[35–37] and professional guidance[38] have exemplified the

expectation that expanding capability and capacity of the support workforce would enable the development of advanced practice. This study found no compelling evidence of this link between support workforce deployment and advanced practice; some of the approaches within current national workforce strategies [NHS Long Term Plan, 2019;[82] HEE Advanced Clinical Practice Framework, 2017[89]] render further exploration, even more crucial given the persistent workforce shortages that show no sign of abating. Given the increasing demands on the imaging workforce, investigation into why certain staff groups from both the registered and unregistered workforce are underutilised is crucial and time sensitive. Identifying the contributing factors in the context of the wider imaging workforce is essential to inform future workforce planning and service design solutions. Importantly, analysis of the clinical efficiency and cost-effectiveness of whole workforce strategies within imaging is required. The examination of how organisational priorities, staffing models and workforce planning within and across modalities affect the imaging workforce may provide new insights into achieving the desired balance across imaging staff groups. Further, the perspective of patients and service users is vital in this research as advocated by the study PPI group.

SWAP determinants

Research question: Do the critical determinants for the effective deployment of SWAPs in diagnostic imaging services have transferability to other AHP services?

Why is this important?

The I-SWAP study identified critical determinants for the delivery of an effective imaging support workforce, subsequently developing a Maturity Matrix to promote assessment, critical review and discussion within imaging workforce teams. There is no 'one size fits all' model for the support workforce, yet some common factors exist that influence deployment in all imaging services. The international scoping review[42] identified a lack of robust research on the support workforce across the AHP professions. Stakeholders with multiprofessional roles, including an NHS England support workforce regional lead, expressed great interest in transferability of the matrix to other AHP services. A valuable avenue for research would be to investigate how applicable the Maturity Matrix would be to support workforce deployment in different healthcare contexts, enabling transferable learning and identification of exemplar practice where it exists elsewhere within the NHS.

If applied to other AHP settings, the I-SWAP Support Workforce Maturity Matrix could reveal cost-saving opportunities and efficiency gains in wider service contexts. Understanding how SWs in these areas can contribute to workload redistribution and enhanced patient care could provide a critical step forward in addressing staff shortages and increasing service sustainability. Moreover, research could highlight how investment in training and development for support roles might increase support workforce morale and retention, while reducing over-reliance on more expensive, highly qualified staff, optimising resource allocation without compromising care quality. Exploring the clinical and cost-effectiveness of SWs within AHPs could provide a better understanding of their impact on patient outcomes, including quality of life and service satisfaction. Evidence in this area could inform future policy decisions on whether developing additional support roles might reduce wait times and improve access to care, particularly in community settings or areas with high demand.

Impact of apprenticeships

Are healthcare apprenticeships delivering the required workforce for the NHS?

Why is this important?

The I-SWAP study found variation in the utilisation of apprenticeships across imaging departments in England. Some provided limited opportunities for Level 6 DAs, while others preferred to 'watch and wait'. Very few were offering apprenticeships at Levels 2–5. The NHS Long Term Workforce Plan identifies apprenticeships as central to addressing the workforce crisis;[83] a dramatic rise in DAs is required (by 2031, they will constitute over 80% of all training places for therapeutic radiography and 50% for diagnostic radiography). Achieving these targets, alongside adoption of the apprenticeships at lower academic levels, presents enormous challenges for universities, systems and employers. It is important to explore the factors that contribute to the decision-making related to which apprenticeships to engage with and indeed whether to engage with apprenticeships at all.

Variation was also found in the design of apprenticeship courses. Some support workforce apprenticeships were more generic in nature and geared towards nursing, whereas others had been tailored specifically for working in an imaging setting. It is not clear whether the more generic apprenticeships are delivering the training required for effective clinical workforce development. There is also uncertainty regarding how well the more tailored apprenticeships align with the rapidly evolving demands of services. Further research is needed to identify how to balance standardisation with specialisation in apprenticeship design to ensure relevance across diverse

healthcare contexts. Investigation is required into the efficacy of apprenticeship education in producing the workforce needed to staff the NHS, including whether there are missed opportunities to integrate enhanced practical skills into these training programmes.

Conclusions

The NHS has overlooked the opportunity to shape the healthcare support workforce through policy implementation. It is troubling that more than 10 years have passed since the Cavendish review,[43] in which inconsistencies, underutilisation, underdeployment and wasted resources associated with a lack of mandated policy for the support workforce were outlined, yet in 2024, a report by Griffin *et al.*[41] showed that little has changed. Specifically, within diagnostic imaging, this absence of national policy has limited the potential for any significant impact to be made on the workforce crisis and has resulted in the highly varied deployment models that can be seen in this study. This variation is evident not only between organisations but also within individual services, with stark differences in workforce size and proportion, grades, role titles, areas of work, scopes of practice and deployment models. The result of these variations is a reduced visibility and de-valuing of this 'absolutely pivotal' workforce within and between services, organisations and with patients. The Imaging Support Workforce Maturity Matrix, incorporating the critical determinants for effective deployment identified in this study, will support critical review and reflection at region, service, site and modality levels.

As this research has shown, the focus on the imaging support workforce presents a valuable opportunity to increase the capacity and capability that is required to tackle the increasing demands on the imaging workforce. The AP role is increasingly underutilised with a trend to replace the role in favour of DA trainees, yet if deployed effectively AP roles may be an enabler to release the registered workforce for more advanced roles. The professional body is urged to develop contemporary guidance to support AP deployment across all modalities; engagement with education providers is required to support co-design of an imaging-specific support workforce curriculum to enable seamless career progression. Increased attention on SW strategies could enable NHS Trusts to fulfil one of their roles as an 'anchor' institution,[87] and widen access to healthcare roles by implementing EDI initiatives in local communities. This is particularly important for NHS Trusts in deprived rural, coastal and urban areas, where communities are likely to have the greatest need, but where the hospitals experience more recruitment and retention challenges.

Additional information

CRediT contribution statement

Julie Nightingale (https://orcid.org/0000-0001-7006-0242): Conceptualisation (equal), Formal analysis (equal), Funding acquisition (lead), Investigation (equal), Methodology (equal), Project administration (lead), Validation (equal), Visualisation (supporting), Writing – original draft (equal), Writing – editing and reviewing (lead).

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Sally Fowler-Davis (https://orcid.org/0000-0002-3870-9272): Formal analysis (supporting), Methodology (supporting), Validation (equal).

Data-sharing statement

All data requests should be submitted to the corresponding author for consideration. Access to anonymised data may be granted following review.

Ethics statement

National and institutional ethical approval was obtained to support WS3–5 (Health Research Authority 22/HRA/4272 21/11/2022; Sheffield Hallam University Research Ethics Committee ER50766713, 20/01/2023; ER53139410, 27/03/2023). Workstream 5 additionally required NHS Trust

Capability and Capacity approvals, with all field researchers either having an approved Research Passport or an NHS contract. For WS2, HEE gatekeeper permission was gained to access anonymised data from the national NHS workforce payroll data set, the ESR.

Information governance statement

Sheffield Hallam University as the study sponsor is committed to handling all personal information in line with the UK Data Protection Act (2018) and the General Data Protection Regulation (EU GDPR) 2016/679.

Under the Data Protection legislation, the Data Protection Officer (DPO@shu.ac.uk) is the Data Controller, and you can find out more about how we handle personal data, including how to exercise your individual rights here: www.shu.ac.uk/about-this-website/privacy-policy/information-governance-policy

This study did not handle any personal information other than names and contact e-mail addresses of participants.

Disclosure of interests

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This synopsis was published based on current knowledge at the time and date of publication. NIHR is committed to being inclusive and will continually monitor best practice and guidance in relation to terminology and language to ensure that we remain relevant to our stakeholders.

Study registration

(1) Research registry (full study), ID researchregistry 7945 www.researchregistry.com/browsethe-registry#home/.

(2) Open Science Foundation Registry (Scoping Review): Etty S, Snaith B, Hinchcliffe D, Kelly S, Nightingale J. (2023, December 7). The Deployment and Utilisation of the AHP Support Workforce: A scoping review. https://doi.org/10.17605/OSF.IO/VJBDX

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Award publications

This synopsis provided an overview of the research award *The determinants of the utilisation of the support and assistant workforce in diagnostic imaging: a multi-methods investigation*. Other articles published as part of this thread are:

Etty S, Snaith B, Hinchcliffe D, Nightingale J. The deployment and utilization of the Allied Health Professions support workforce: a scoping review. *J Multidiscip Healthc* 2024;**17**:2251–69. https://doi.org/10.2147/JMDH.S460543

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For more information about this research, please view the award page (www.fundingawards.nihr.ac.uk/award/NIHR133813).

Additional outputs

Nightingale J, Etty S, Kelly S, Snaith B *et al.*Establishing the Size and Scope of the Imaging Support Workforce: A First Stage Analysis of National Workforce Data in England. In *Presentation B4.5 p6. United Kingdom Imaging and Oncology, Liverpool*, 5–7 June 2023. URL: www.bir.org.uk/media/541504/2023-proceedings-of-uk-imaging-and-oncology-congress-2023.pdf

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List of supplementary materials

Report Supplementary Material 1
I-SWAP Public Summary

Report Supplementary Material 2
Example of a quarterly newsletter

Supplementary material can be found on the NIHR Journals Library report page (https://doi.org/10.3310/GJJN0626).

Supplementary material has been provided by the authors to support the report and any files

provided at submission will have been seen by peer reviewers, but not extensively reviewed. Any supplementary material provided at a later stage in the process may not have been peer reviewed.

The supplementary materials (which include but are not limited to related publications, patient information leaflets and questionnaires) are provided to support and contextualise the publication. Every effort has been made to obtain the necessary permissions for reproduction, to credit original sources appropriately, and to respect copyright requirements. However, despite our diligence, we acknowledge the possibility of unintentional omissions or errors and we welcome notifications of any concerns regarding copyright or permissions.

List of abbreviations

AHPS	Allied Health Professions
AP	assistant practitioner
CPD	continuing professional development
CT	computed tomography
EDI	equality, diversity and inclusion
EDIB	equality, diversity, inclusion and belonging
ESR	Electronic Staff Record
FE	further education
HE	higher education
HEE	Health Education England
I-SWAP	Imaging Support Worker and Assistant Practitioner
MRI	magnetic resonance imaging
RSM	radiology services manager
SCoR	Society and College of Radiographers
SW	support worker
SWAP	support worker and assistant practitioner
WS	workstream
WTE	whole time equivalent

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90. Nightingale J, Etty S, Snaith B, Sevens T, Appleyard R, Kelly S. Establishing the size and configuration of the Imaging Support Workforce: a census of national workforce data in England. *BJR Open* 2024;**6**:tzae026. https://doi.org/10.1093/bjro/tzae026

Appendix 1 UK imaging workforce structure

TABLE 2 UK imaging support workforce structure

Tier	Clinical SW (CSW)	Senior clinical SW	AP
Level	Entry level	Intermediate	Advanced
Typical qualifications/ apprenticeship levels	FHEQ[b] Level 2 (secondary school level e.g. GCSEs), Care Certificate	FHEQ Level 3 (college level e.g. A levels); profession-appropriate qualification	FHEQ Level 5 (higher education level, equivalent to a Dip HE[c] or Foundation Degree)
Typical grade (agenda for change[a])	Pay Band 2	Pay Band 3	Pay Band 4/5

continued

TABLE 2 UK imaging support workforce structure (*continued*)

Tier	Clinical SW (CSW)	Senior clinical SW	AP
Supervision	Close supervision. Report directly to a registered practitioner	Direct or indirect supervision when required	Work semi-autonomously within a specified care plan, under supervision of registered staff. Supervision model varies depending on area of work, experience and scope of practice.
Role	Enables effective patient care. Important clerical, adminis-trative, housekeeping tasks to support delivery of imaging services	As CSW, but also clinical support and care before, during and after imaging examinations. Range of delegated duties, including clinical tasks	Competently performs non-complex examinations in areas previously within the remit of a registered professional, working to locally agreed standard operating procedures, protocols, or systems of work. Work is protocol-driven within defined scope of practice
Example imaging tasks	Supporting patients to change clothing; assist infection control process; managing stock and supplies; reception duties	Intravenous cannulation; patient positioning; support preparation of contrast agents and procedure trolleys	Primarily patient-facing. General radiography or mammography exams within imaging department setting or breast screening service. Support patients during invasive procedures/complex pathways or provide aseptic scrub support.

a Agenda for change: www.healthcareers.nhs.uk/working-health/working-nhs/nhs-pay-and-benefits/agenda-change-pay-rates.
b FHEQ – Framework for Higher Education Qualifications (www.qaa.ac.uk/the-quality-code/qualifications-frameworks).
c DipHE – Diploma of Higher Education.

Appendix 2 Workstream 2: figures

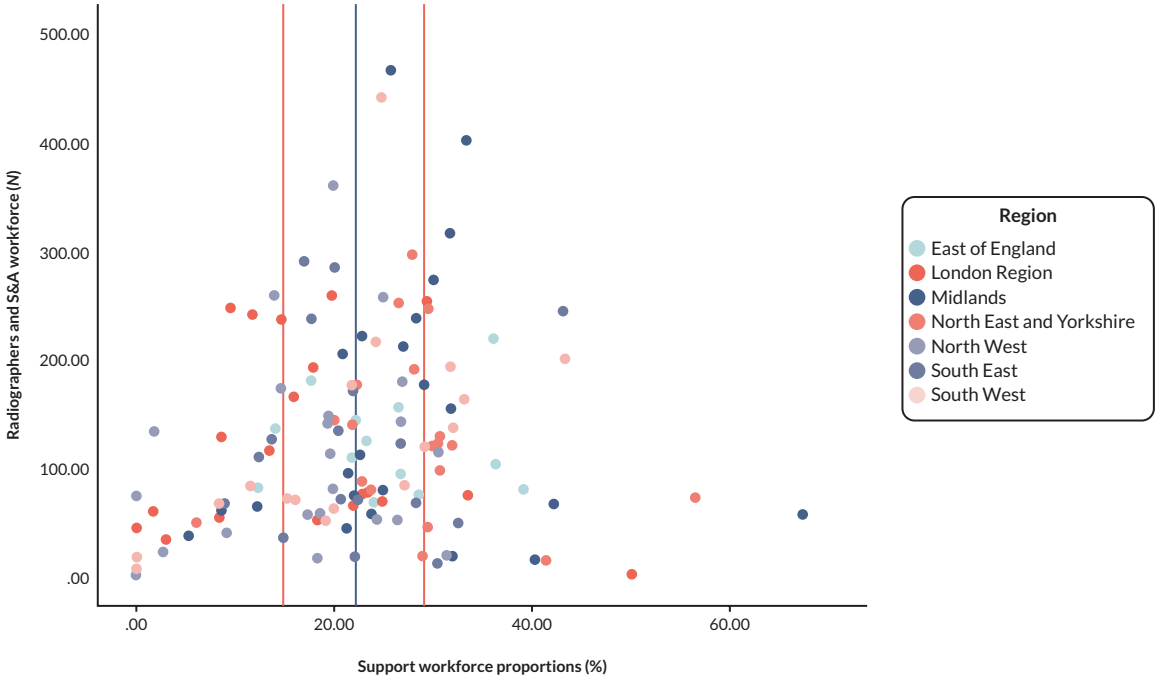

FIGURE 3 Scatter plot charting the support workforce proportion (*x*-axis) against imaging workforce size (*y*-axis) for each NHS Trust in England. Individual Trusts (dots) are colour coded for the region in which they reside. The median value is displayed (blue-grey) and the interquartile range indicated (red lines).

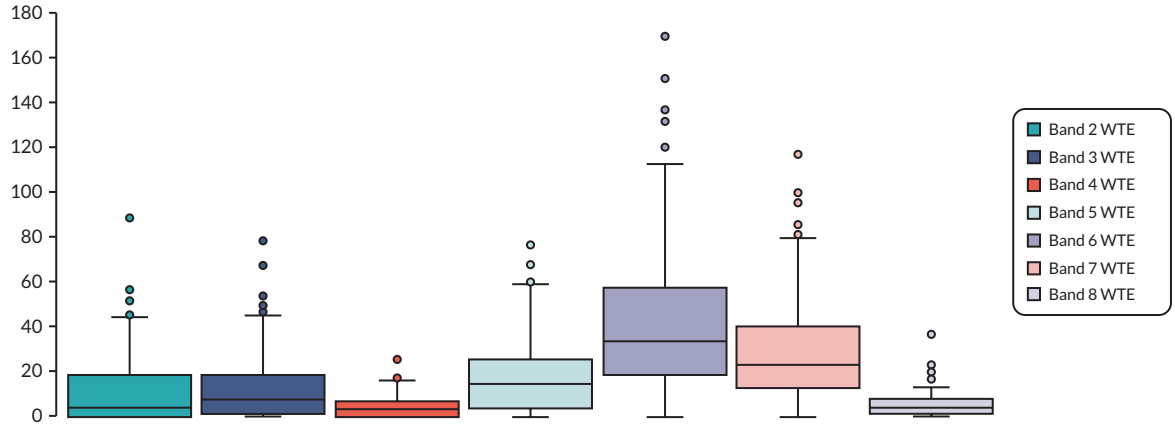

FIGURE 4 Box and whisker plot to illustrate median values and interquartile ranges of WTE staff within each pay band for a typical imaging department (*n* = 137 NHS Trusts), data extracted from ESR December 2022.

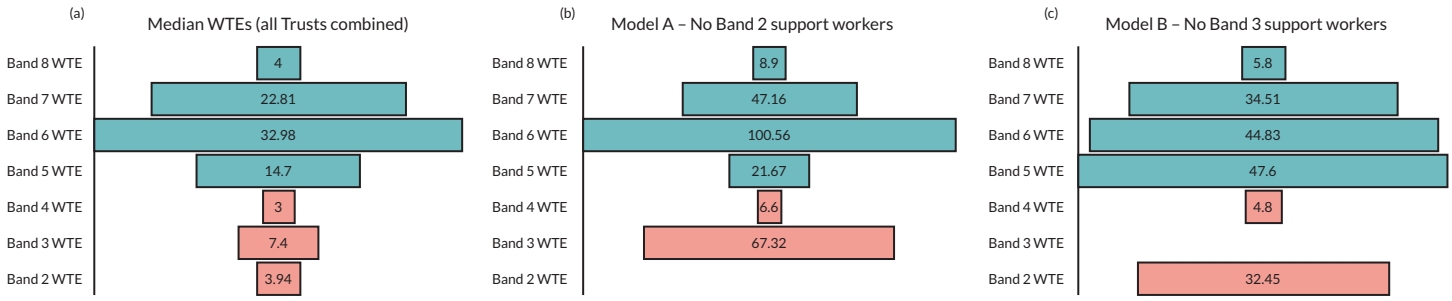

FIGURE 5 Workforce configurations based on WTE numbers within each band. (a) Represents median combined values (*n* = 137 NHS Trusts) to demonstrate a 'typical' imaging department configuration. The support workforce is represented in Bands 2–4 (orange). (b) Displays WTE counts for a selected NHS Trust imaging department which does not utilise Band 2 SWs (Model A). (c) Displays a selected NHS Trust with no deployment of Band 3 SWs (Model B). Data extracted from ESRs December 2022.

Appendix 3 Workstreams 3 and 4: theme overview

TABLE 3 Framework themes and categories

Theme	Category	Description
1. Deployment rationale and decision-making	1.1. Lack of professional identity	Extensive variation in job titles, job descriptions, pay banding and scope of practice blurs role boundaries and causes confusion both within and between imaging departments. Poor professional identity and visibility, particularly at Bands 2 and 3, are mitigated by a trend towards placing SWs in leadership roles.
	1.2. Varied workforce profile	The size of the support workforce as a proportion of the wider imaging establishment varies widely between services, but this is not significantly correlated with department size. Managers prefer deployment of either Band 2 or Band 3 SWs, with few deploying APs. Few sites had reviewed their support workforce demographics.
	1.3. Workforce flexibility	The main deployment decision is shaped by the approach to rotational activity, either rotating SWs through several imaging modalities, or utilising a static specialist model. Different grades of SWs tend to be deployed in different imaging modalities; Bands 2 and 3 often deployed in CT and ultrasound, Band 4 in X-ray (projection imaging) and mammography.
2. Innovations in support workforce activities	2.1. Evolving scope of practice	There was limited innovation in many services; however, clinical skills innovations resulted in a wider scope of practice for APs in departments that embraced them. SW 'in-patient' care coordination and navigation roles were pivotal in improving patient flow, and leadership roles encouraged cohesion in the support workforce teams.
	2.2. Embracing apprenticeships	Some services had embraced degree apprenticeships (DAs), an alternative employer-supported pathway to registered practice, though few had embraced apprenticeships below degree level. Early DA adopters described them as a key enabler for recruitment and retention, others highlighted lack of funding and training capacity as a barrier to innovation.
3. Stability and sustainability of the support workforce	3.1. A stable workforce	SWs are the local supply pipeline for APs, apprentices and radiographers with low vacancy levels reported. Recruitment is positive except in more remote or expensive locations. Retention at Band 2 can be challenging with high turnover in some services.
	3.2. Added value	A pivotal workforce adding vital stability to imaging services, although opinions are divided on whether they enable radiographer advanced practice.

Appendix 4 Workstreams 3 and 4: findings and quotations

TABLE 4 Theme 1: Deployment rationale and decision-making

Category	Description	Exemplar quotations
1.1. Lack of professional identity	Extensive variation in job titles, job descriptions, pay banding and scope of practice blurs role boundaries and causes confusion both within and between imaging departments. Poor professional identity and visibility, particularly at Bands 2 and 3, is mitigated by a trend towards placing SWs in leadership roles.	**Variation:** *'Too much disparity in job titles in the trust'* (RSM23); *'… a lot of variation across the trusts'* (INR7); *'They're using that support workforce differently in each trust, there's no consistency'.* (INR12) **Visibility/identity:** *'[They] were a team that felt that they weren't included, that they didn't have the support, that people didn't understand, and actually all of the support workers are so instrumental to our workflow, to our patient care … that we felt that they did need somebody that was managing them and also that they had a voice'.* (RSM5) *'I'd really like to have two band 4 support workers that would be able to line manage … they don't need a band 7 [professional] to be able to do this'.* (RSM16) *'It would give them ownership over their work … that could be the tie in that we need, the cohesion that sort of fits them together. I think maybe this would help them to feel like a team'.* (RSM17)

TABLE 3 Framework themes and categories (*continued*)

Category	Description	Exemplar quotations
1.2. Varied workforce profile	The size of the support workforce as a proportion of the wider imaging establishment varies widely between services, but this is not significantly correlated with department size. Managers prefer deployment of either Band 2 or Band 3 SWs, with few deploying APs. Few sites reviewed their support workforce demographics.	**Grade balance:** *'[when] it went to digital, all the band threes were disbanded. Now I feel that there is a gap in the service, we are saturated with Band 2s'.* (RSM9) *'I'd like us to have more … to release some of the registered staff from some of the tasks that perhaps you don't have to be a registered radiographer to do'.* (RSM7) **Diversity:** *'Support workers help break down cultural and language barriers as they have a broad range of ethnicities and cultural backgrounds'.* (RSM10)
1.3. Workforce flexibility	The main deployment decision is shaped by the approach to rotational activity, either rotating SWs through several imaging modalities, or utilising a static specialist model. Different grades of SWs tend to be deployed in different imaging modalities; Bands 2 and 3 often deployed in CT and ultrasound, Band 4 in X-ray (projection imaging) and mammography.	**Rotational models:** *'I think there are a couple of places which have started to look at APs being on a rotation, but they've realised there might be pitfalls with that because it's hard for them to get to the top of where they want to be'.* (INR6) *'There's pros and cons on both sides, but without that rotation you just don't have that flexibility of staff … it's worked so much better when the static posts have been filled by people that know what they like because they're more likely to stay because they've got that passion for the area'.* (RSM22)

TABLE 5 Theme 2: Innovations in support workforce activities

Category	Description	Exemplar quotations
2.1. Evolving scope of practice	Limited innovation in many services, clinical skills innovations resulted in a wider scope of practice for APs in departments that embraced them. SW 'in-patient' care coordination and navigation roles were pivotal in improving patient flow, and leadership roles encouraged cohesion in the support workforce teams.	**Autonomy:** *'I think they've definitely got more autonomy now'.* (RSM6)
2.2. Embracing apprenticeships	Some services had embraced DA, an alternative employer-supported pathway to registered practice, though few had embraced apprenticeships below degree level. Early DA adopters described them as a key enabler for recruitment and retention, others highlighted lack of funding and training capacity as a barrier to innovation.	**Apprenticeships as an enabler:** *'[We have] challenges recruiting [and retaining] … it means more emphasis on "grow your own" and international recruitment, with its own challenges'.* (RSM9) *'Phenomenally successful … It's been absolutely brilliant. The best thing that has happened to radiography in my opinion for a lot of years is the apprenticeship route'.* (RSM4) **Removing the glass ceiling:** *'… the first imaging care assistant to qualify, so will go from band 2 to band 6 in six years via apprenticeships'*. (RSM14) **Adverse impacts:** *'Too much training causes issues: You have too many people in this department. It's trying to balance it all'.* (RSM18)

TABLE 6 Theme 3: Stability and sustainability of the support workforce

Category	Description	Exemplar quotations
3.1. A stable workforce	SWs are the local supply pipeline for APs, apprentices and radiographers with low vacancy levels. Recruitment is positive except more remote or expensive locations. Retention at Band 2 can be challenging with some high turnover seen.	**Band 2 turnover:** *'They use it as a stepping stone to other things. No one wants to stay as a band 2 support worker forever, do they?'* (RSM9) *'It's an ongoing battle … A lot of the support workers are ambitious young people who want to move on. It's no longer seen as a role that you stay in and don't progress'.* (INR15)
3.2. Added value	A pivotal workforce adding vital stability to imaging services, although opinions are divided on whether they enable radiographer advanced practice.	**Perceived value:** *'absolutely the lynchpin … the glue that kind of holds it all together'* (INR12) *'Absolutely pivotal, [we] need to understand their diverse needs and interests and work with them to keep them happy'* (RSM4)

Source
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Appendix 5 Workstream 4: data questionnaire figures

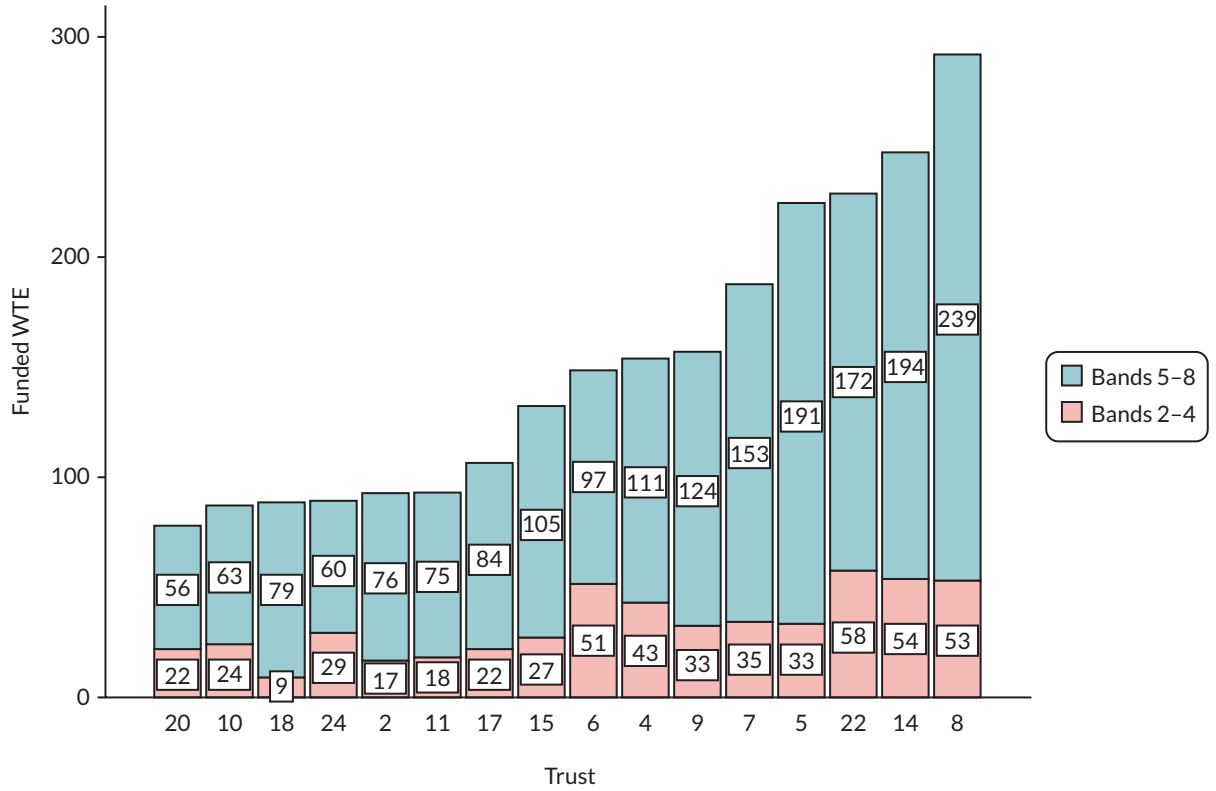

FIGURE 6 Funded radiographic establishment in WTE for Bands 5–8 (radiographers), and Bands 2–4 (support workforce), for 16 NHS Trusts supplying data. Reproduced from Nightingale *et al.*[1] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) licence, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: https://creativecommons.org/licenses/by/4.0/. The figure above includes minor additions and formatting changes to the original text.

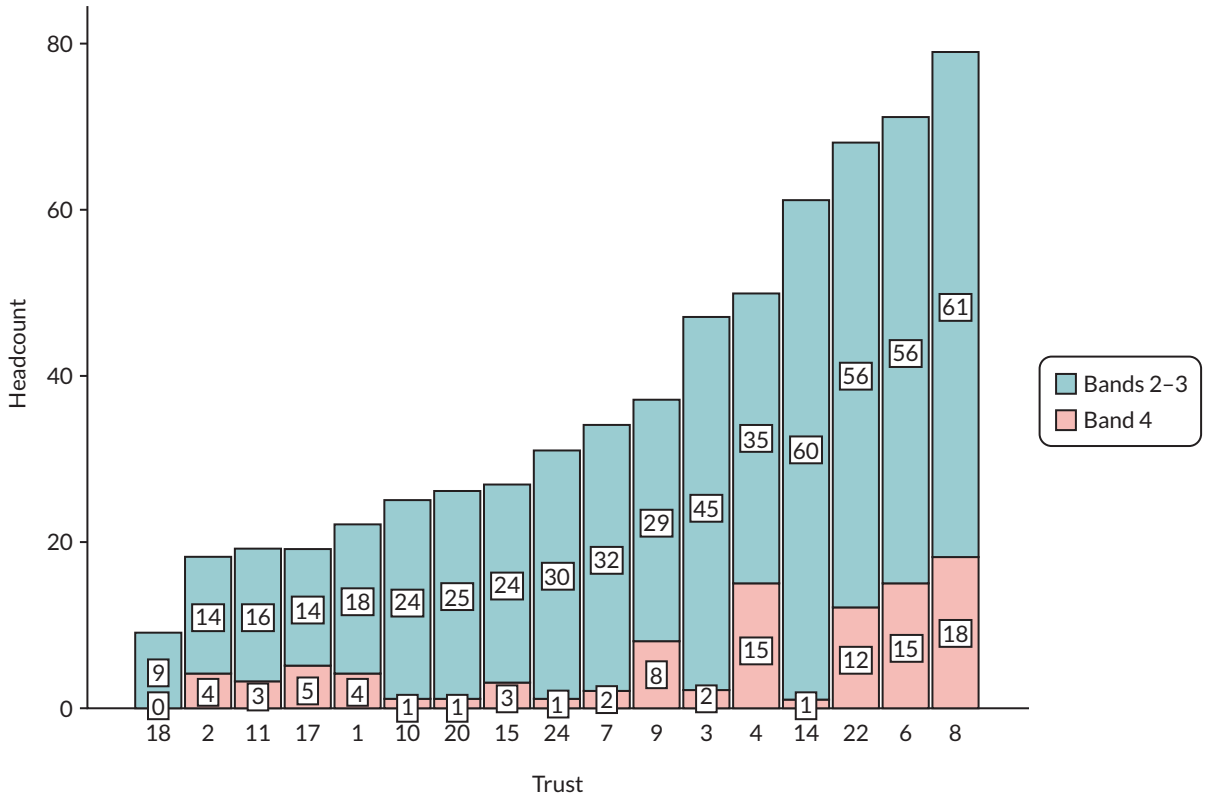

FIGURE 7 Headcounts for Bands 2–3 (SWs and senior SWs), and Band 4 (APs), for 17 NHS Trusts supplying data. Reproduced from Nightingale *et al.*[1] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) licence, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: https://creativecommons.org/licenses/by/4.0/. The figure above includes minor additions and formatting changes to the original text.

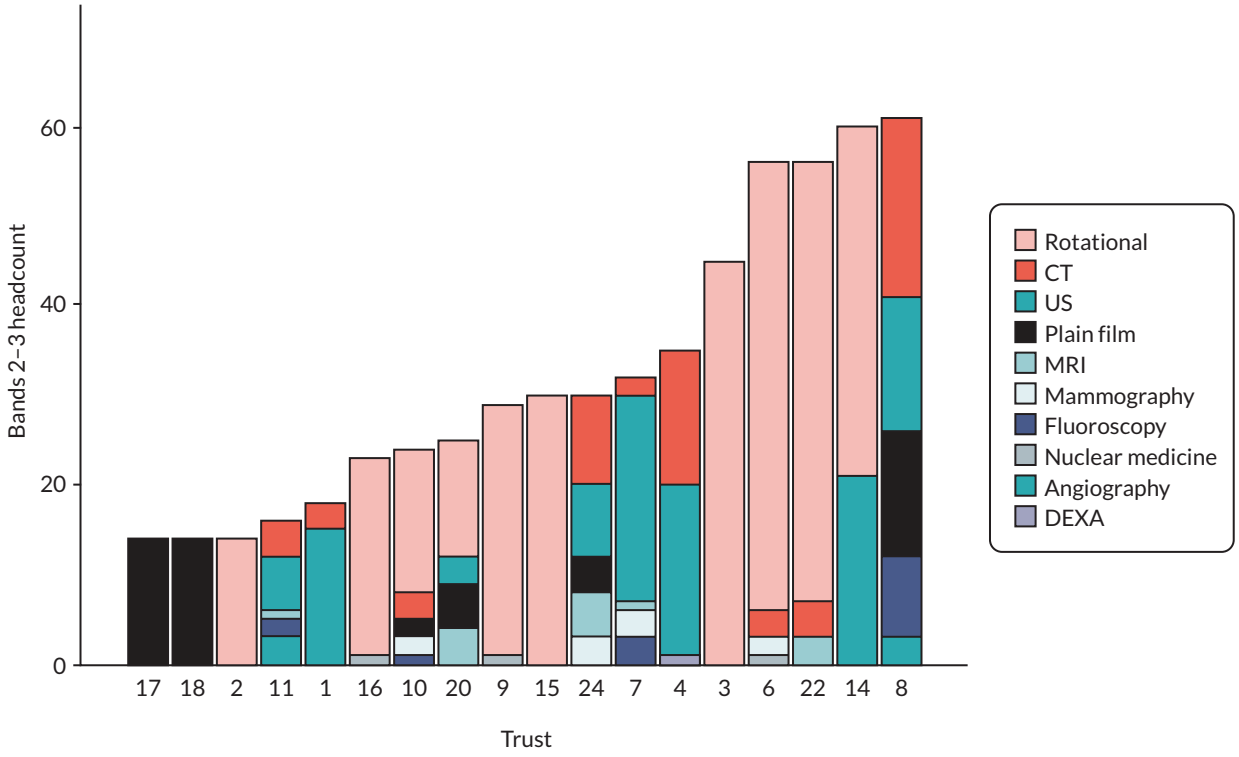

FIGURE 8 Bands 2 and 3 SWs headcount by specialty area and rotational posts for 18 NHS Trusts who supplied data. Reproduced from Nightingale *et al.*[1] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) licence, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: https://creativecommons.org/licenses/by/4.0/. The figure above includes minor additions and formatting changes to the original text.

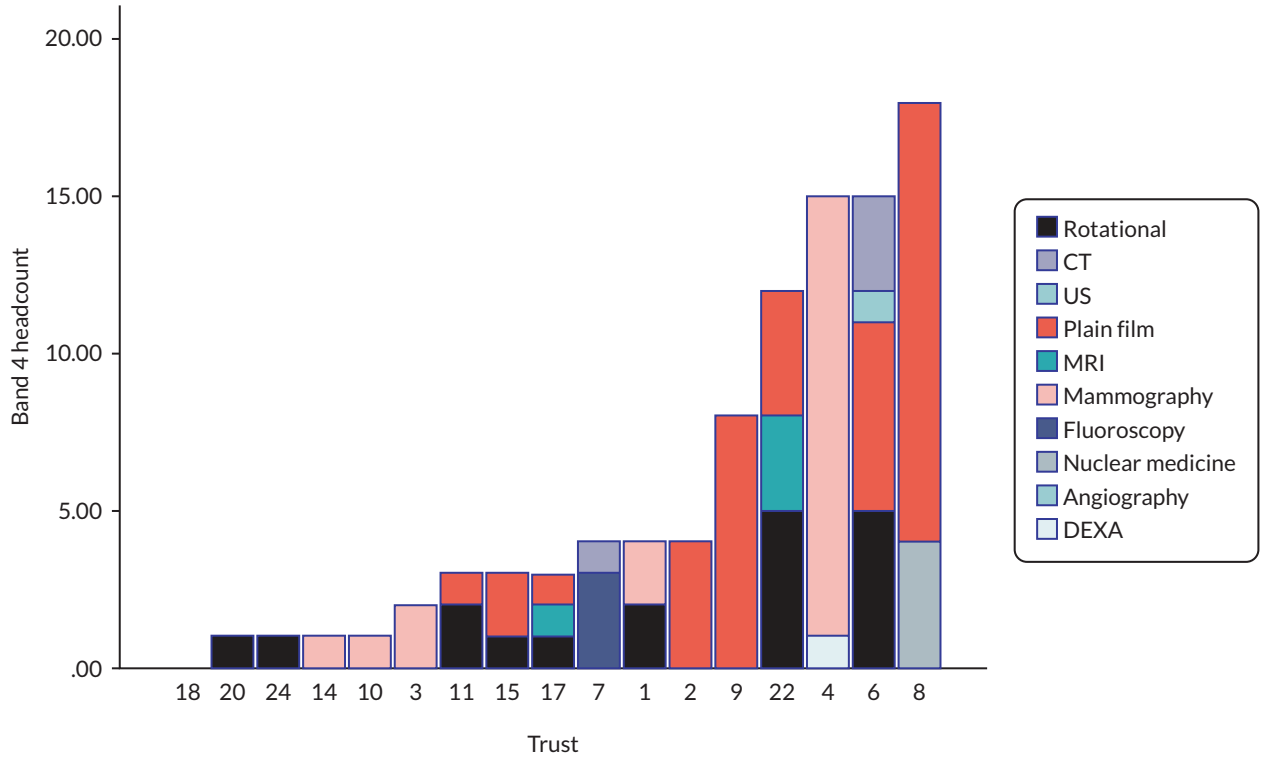

FIGURE 9 Band 4 SW headcount by speciality area and rotational posts for 17 NHS Trusts who supplied data. Reproduced from Nightingale *et al.*[1] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) licence, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: https://creativecommons.org/licenses/by/4.0/. The figure above includes minor additions and formatting changes to the original text.

Appendix 6 Workstream 5: participating organisations, themes and codes

TABLE 7 Summary of sites visited

Site	Setting	Participants
1 (H)	Medium-sized service, coastal. 1 main site and further community sites	4 interviews 2 focus groups (SWs, *n* = 4, Trainee APs, *n* = 5)
2 (H)	Large-sized service, coastal. 1 main site and a further satellite site	7 interviews 3 focus groups (SWs, *n* = 8, APs/apprentice radiographers, *n* = 2)
3 (H)	Medium-sized service, city/rural. 1 main site and further community sites	5 interviews 2 focus groups (SWs, *n* = 7, APs, *n* = 5)
4 (M)	Small-sized service, city. 1 main site and further community sites	4 interviews 1 focus group (SWs, *n* = 7)
5 (M)	Large-sized service, city. 2 main sites and 2 community sites	7 interviews including 2 with an individual AP and SW
6 (M)	Large-sized service, city. 2 main sites and a further community site	2 interviews 2 focus groups (SWs, *n* = 5, APs/trainee APs, *n* = 7)
7 (L)	Large-sized service, city. 1 main site and 4 satellite sites	5 interviews 2 focus groups (SWs, *n* = 10, APs, *n* = 6)
8 (L)	Medium-sized service, coastal. 1 main site and 3 satellite sites	3 interviews 2 focus groups (SWs, *n* = 2, APs, *n* = 2)
9 (L)	Medium-sized service, coastal/rural. 1 main site	4 interviews 1 focus group (SWs, *n* = 3)

H, high SWAP utilisation; M, medium SWAP utilisation; L, low SWAP utilisation.

TABLE 8 Main themes and associated codes

Themes	Operational efficiency and service impact	Roles and responsibilities	Career progression, support and training	Workforce dynamics and job satisfaction
Codes	Workflow optimisation Operational dependency Enhanced patient care and interaction Teamwork and collaboration Challenges and constraints	Role clarity Role creep/role ambiguity Role adaptability and flexibility Role autonomy Rotational vs. static deployment Supervision and management issues	Career aspirations Career stagnation and lack of progression Lack of training opportunities Organisational and support challenges Positive experiences and value Grow your own	Love my job Feeling undervalued Positive cultural dynamics Impact of static vs. rotational deployment SWAP retention and stability Role strain

Appendix 7 Workstream 5: findings and quotations

TABLE 9 Workstream 5 themes, codes and quotations

Category	Exemplar quotations
Operational efficiency and service impact	**Critical to service delivery:** *'There's an awful lot of panic … when a support worker has gone off sick … they are the engine room of the department'.* (Site 9) *'… when they're not here … if we're not fully staffed with them you can tell the difference of the flow, the team just doesn't work'.* (Site 1) *'If it's CT or MRI and they don't have support workers [available], they will actually cancel lists … it does have an impact'.* (Site 9) **Recruitment issues:** *'We did have a massive issue with recruitment and retention, we had quite a big turnover and this was to do with the fact that they were working in all areas'.* (Site 1) *'The support worker is … quite hard to recruit into and it's quite hard to retain'.* (Site 7) **Teamwork and patient interactions:** *'They are very much a part of the team and very much relied on, particularly when we're short staffed'.* (Site 5) *'They're really valued members of the team, they do so much great work. And they're amazing with the patients …'* (Site 7) *'They're so experienced, they're very good with patient care, it does make things a lot more efficient … they're very experienced, very helpful, they speed things up'.* (Site 2)
Roles and responsibilities	**Grade differentiation:** *'The support workers are all band 3s and they're band 3s because they're required to be able to do cannulation …'* (Site 3) **Autonomy:** *'So I actually enjoy this job role, because of all the things that you learn about, and the people you work with. I also feel like there's a lot of autonomy as well in this job role, because it's down to you what you're meant to be doing, and you should know what's going to go on throughout the day'.* (Site 7) *'I can run a room on my own. I can use my own initiative to go and check the day list, get the patient in, get the patient changed'.* (Site 5) *'I think there are a lot of very skilled people in the team and it would be nice to be able to use those skills and be able to give them a little bit more autonomy around how they manage things themselves on a day-to-day basis'.* (Site 3) *'So there are initiatives going on at the moment … [for] APs, to give them a bit more autonomy in their position, and that's something that I think we will have to move towards in the future'.* (Site 6) **Role creep:** *'… when we [band 2] look at our job description, we do a lot of clinical stuff, and clinical stuff is not band 2 support worker role. Clinical stuff is a band 3 and it's not even on our job description'.* (Site 1) *'I'm getting sick of getting paid band 2 and doing a band 5 job …'* (Site 6) *'I do feel they consider me more than they should as a radiographer. I'm not, I'm a band 3 AP … I don't mind being treated like that, in fact I embrace it … but it's definitely not what I'm paid to do'.* (Site 8) **Rotation vs. static deployment:** *'Yeah, [they're] working with the anaesthetists or a consultant. They're quite specialised, so a rotational [support worker] wouldn't be able to come in and just cover that'.* (Site 3) *'I think it would be good to have support workers that worked in a dedicated modality, at the moment they rotate round … if they were dedicated into a modality then they would be more invested in that modality, and supportive and build up relationships with the team, and then we could really formalise their training better'.* (Site 4) **Support workforce management:** *'We don't actually directly line-manage them; they're managed by somebody else in the department. That's a problem'.* (Site 3) *'I'd like to see that the support workers that are working in a modality and managed by modality, simple as that'.* (Site 4)

continued

TABLE 9 Workstream 5 themes, codes and quotations (*continued*)

Category	Exemplar quotations
Career progression, support and training	**Grow your own:** *'We only recruit from support worker roles. it's very much because we know them, we know who they are, we know what their work ethic is like'* (Site 1) *'… my dream scenario here is, I've got fantastic staff and none of them ever leave … So we start people at band 2 and we've got competencies that they work towards and once they achieve those competencies, we re-band them to 3'.* (Site 2) *'The APs … are always thanking me for giving them the opportunity to do the job and they are loving it. They still have moments where they have a bit of a wobble about their confidence and their level of ability, but the team are really good at supporting them through and yeah they do enjoy it which is why they want to progress to a band 5 at some point'.* (Site 3) **Barriers to career progression:** *'A few years ago this department promised that there would be two positions available [per year] for apprenticeship, in the last couple of years there's just been one, I think. So, it's just that little frustration … what's stopping them? We're all eager to do this …'* (Site 7) *'The issue I have as a manager is that if there's an apprenticeship programme, I've got to keep a post open for the time that they're doing that apprenticeship. And say that apprenticeship is … two years, that's a long time to have a vacancy and not fill it with somebody training …'* (Site 3) *'What's frustrating is I've got a lack of education, and the only way to progress … is that you have to have those qualifications to become a band 4. I've been trying to prove myself over the last few years … it would be nice if there was a senior or a lead support worker [role] … there just doesn't seem to be scope for that, and that I find a little bit disappointing'.* (Site 9) *'I think historically … because there's no progression, the particularly competent [SWs] have nowhere to go other than to leave and go to a new role, unfortunately'.* (Site 4)
Workforce dynamics and job satisfaction	**Job satisfaction:** *'Oh, do you know what, I do [enjoy my job] and I'm not just saying that I really love it, I get up every morning and it doesn't bother me coming to work'.* (Site 5) *'Everyone's as important as each other … This has been my home for the last 24 years, this hospital. But we're all equal and there's no "you're only an assistant". Everyone works together'.* (Site 2) **Feeling undervalued:** *'I think there has been a period where they felt undervalued, not from a department perspective but from a trust [employer] perspective … they haven't been rewarded [for cannulation] and … they've probably become a little bit demoralised'.* (Site 4) *'They were all down banded, regraded down to 2 [from 3], which was awful, because it gave them absolutely nowhere to go. So the ones that were really keen and wanted to progress, they just got stuck at the top of band 2 or they left and went somewhere else … It had a massive impact. It was the worst thing we ever did, ever. It was awful. And that's led to a demoralised and quite cross group of people that don't feel supported'.* (Site 8)

Appendix 8 Workstream 6: critical determinants

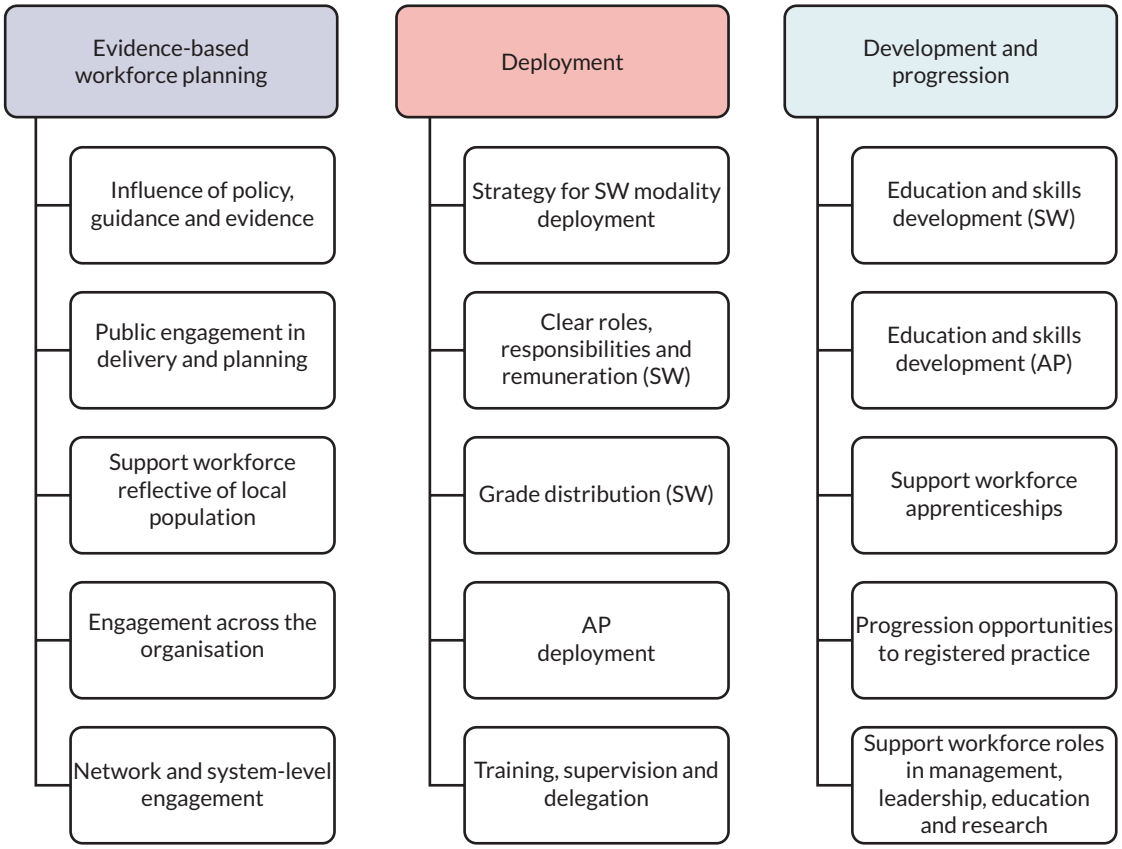

FIGURE 10 Determinant framework for the deployment and utilisation of the imaging support workforce. Critical determinants (clear boxes) are grouped under three primary workforce themes. AP, Assistant Practitioner; SW, Support Worker.

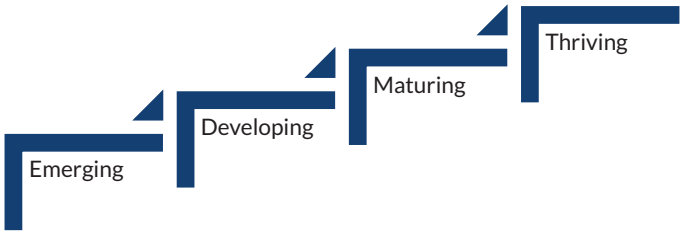

FIGURE 11 The four iterative steps used in the I-SWAP Maturity Matrix.

Appendix 9 I-SWAP Imaging Support Workforce Maturity Matrix

Imaging Support Workforce Maturity Matrix

Introduction

Critical determinants are causal factors which control or influence the likelihood of something happening, for example a service being effective. The NIHR-funded I-SWAP project was a mixed-methods study designed to investigate the development, deployment and contribution of the support workforce to diagnostic imaging activity across England. The evidence-based findings from the I-SWAP study identified the critical determinants for the delivery of an effective imaging support workforce. This Maturity Matrix incorporates the critical determinants into a framework to promote assessment, critical review and discussion within imaging workforce teams. The matrix has been coproduced by the research team working alongside research participants and public and professional stakeholders.

Maturity Matrix Framework Design

The critical determinants (column 1) identified within the I-SWAP project have been grouped into three workforce themes: (1) deployment; (2) development and progression and (3) evidence-based workforce planning. Column 2 outlines the importance of each determinant in influencing the development of an effective imaging support workforce. Columns 3–6 provide examples of different levels of adoption or engagement with each of the determinants, working through increasing levels of engagement: emerging; developing; maturing; thriving. These engagement levels are captured as RAG-B (red, amber, green, blue) colours.

Using the Maturity Matrix

This matrix has been designed as a self-assessment tool to stimulate evidence-based discussions relevant to the imaging support workforce at place, organisation, site, department and modality levels. The I-SWAP research has demonstrated that there is no 'one size fits all' model for this workforce; however, the challenges facing imaging services means that many services have not had the opportunity to undertake evidence-based strategic workforce planning.

It is not expected that any service will be 'thriving' in all areas, this matrix may identify where additional reflection and action planning may be beneficial. An imaging service may be thriving in one of the determinant areas yet review at individual modality or imaging sites may highlight areas for development. With wide adoption of this tool, the matrix will support sharing of best practice within and between organisations and promote adoption of system and network wide working. The Maturity Matrix will be presented in a downloadable Excel Spreadsheet with an opportunity for noting barriers, enablers, short-/medium-/long-term action plans and progress against objectives.

This synopsis should be referenced as follows:
Nightingale J, Snaith B, Etty S, Sevens T, Appleyard R, Kelly S, Fowler-Davis S. Utilisation of the support workforce in diagnostic imaging: a mixed-methods investigation. *Health Soc Care Deliv Res* 2026;**14**(4). https://doi.org/10.3310/GJJN0626

Workforce theme 1: Evidence-based workforce planning

Determinant	Importance	Emerging (E)	Developing (D)	Maturing (M)	Thriving (T)
1.1 Support workforce plans underpinned by national policy, guidance and research evidence	Engagement with published research, guidance and frameworks supports best practice and reduces unwarranted variation, providing evidence for business planning and improving support workforce morale and transferability between Trusts	No/limited awareness of current professional or policy publications related to the support workforce	Working knowledge of professional support workforce resources, for example SCoR/HEE guidance on roles and responsibilities and supervision	Understanding of professional support workforce guidance and cross-discipline workforce resources, for example HEE AHP Support Worker Competency Framework	Benchmarking against relevant policy and tools (e.g. Model Hospital). Guidance has informed workforce planning and scope of practice review
1.2 Public engagement in support workforce service delivery and planning	Engagement with Patient and Public Involvement (PPI) groups (e.g. Patient Advice and Liaison Services – PALS) can offer a different perspective on support workforce priorities and patient engagement across pathways which may be useful in business planning	No public or PALS engagement or mechanism for public awareness of support workforce in imaging service delivery	The role and contribution of support workforce to imaging service delivery promoted (alongside the registered staff) to patients and the public. Initial engagement with PALS	Understanding of local context and population (informed by PALS) included in support workforce planning, for example opportunity for roles focused on specific population needs	Population demographics/context is known (data) and used in planning with regular mechanisms for PPI/PALS engagement (e.g. patient advisory panel, Experts by Experience)
1.3 SWAP workforce reflective of local population	SWAP workforce reflects local population and supports diversity in the wider imaging workforce. Creates role models in service and wider community, improving recruitment, retention, opportunity and staff morale	Limited or no understanding of workforce drivers related to EDIB	Initial engagement with community or cultural leaders. Some understanding of significant local EDIB challenges but no action planning	Review of service SWAP workforce profile (age, gender, ethnicity) to include EDIB review of recruitment and progression	Strategic review of staff workforce profile informing recruitment strategies to enable the SWAP workforce to reflect diverse local population
1.4 Engagement across the organisation	Engaging in support workforce developments across the organisation increases visibility, enabling inclusion of imaging support workforce in relevant multidisciplinary networks, training and progression	No strategic involvement or awareness of Trust support workforce networks	Representation on relevant Trust groups relevant to the support workforce including education and planning	Discussions in Trust networks and groups inclusive of imaging support workforce with relevant resources identified	Influence at Trust level including support workforce training, apprenticeships, workforce planning and progression. Engagement at network or system level is evident
1.5 Network and system level engagement	Network/system level engagement highlights innovative support workforce practices and provides opportunities to reduce variance and capitalise on new ways of working, while improving clarity of roles and the potential for sharing training and other resources	Support workforce is not included in any regional network or system imaging or AHP discussions	Regional networks focusing on the AHP or imaging-specific support workforce but no review of variations in imaging scope of practice or deployment	Regional scoping of the imaging support workforce deployment, roles, scope of practice and agreement to share learning	Imaging managers engaging with support workforce strategic planning activities in imaging networks or AHP faculties

Workforce theme 2: Deployment

Critical determinant	Importance	Emerging (E)	Developing (D)	Maturing (M)	Thriving (T)
2.1 Strategy for SW modality deployment (Bands 2 and 3)	Balance of flexibility (rotation) and skills development (modality deployment) to enhance SW satisfaction, promote team building, and enhance patient pathways and experience	Custom and practice (static/ rotational) not questioned	SW deployment models reviewed; action plan developed. Support workforce largely rotational with emerging static posts, enabling skills development, team working and contribution	SW deployment models responsive to imaging service need. Where appropriate flexible rotational posts to enable cross-modality 'cover'	SW deployment strategy embedded – rotation used within induction for familiarisation, specialist deployment used for SW skills enhancement
2.2 Clear roles, responsibilities and remuneration (Bands 2 and 3)	Consistent SW identity across services, organisations and networks increases visibility and improves recruitment, retention and progression opportunities while offering opportunities for cross system working	No consistency in SW role titles and grades across the imaging service(s)	Some role titles are consistent, but grades and role responsibilities vary across the imaging service(s)	Clearly visible SW roles via consistent job titles aligned to grade and wider organisational appointments	SW identity, roles, titles, grades consistent across services and imaging networks. Opportunities for system working explored and/or implemented
2.3 SW grade distribution (Bands 2 and 3)	Grade balance is strategically planned and related to SW responsibilities rather than relying on custom and practice, enabling support workforce training and educational opportunities, progression and improved morale. Aligned to employing organisation policies and procedures	No current or recent strategic focus or review of grade distribution (Bands 2 and 3) across the service	Localised decisions about grading with reference to context and local pressures for staffing recruitment and retention	Local review of workforce structures to clearly distinguish Band 2 from Band 3 within and across services with reference to career progression and recruitment pressures	Clear accountability in service/across networks for role delivery and balance of SW staffing to enable recruitment, retention, skills mix and progression
2.4 AP (Band 4)	Effective deployment of APs supports innovations in patient care and delivery. It supports radiography skills mix and SW progression and retention. APs may offer an additional employment pool for pathway to registered practice (local workforce with improved retention)	Not utilising APs	Band 4 AP roles used in limited modalities or deployed as training roles within apprenticeships. Governance and scope of practice review required	Review of potential deployment opportunities with plan for engagement of wider AP roles. Opportunities explored for radiographer/AP skill mix review across modalities	AP roles embedded and potential fully realised. Governance in place aligned to defined scope of practice. Providing or considering progression opportunities (e.g. Band 5 Associate Practitioner)
2.5 Training, supervision and delegation	Support workforce roles can only take place in the presence of clear supervisory and delegation policies. Both registered and support staff require a clear understanding, with training offered to new employees	Lack of clarity in roles and responsibilities, no training specific to supervision or delegation provided	Active engagement with support workforce and registered staff to review role supervision and delegation requirements	Clear supervision policy with associated training offer for current and new support workforce and registered staff	Clear understanding of scope of practice and supervision requirements enables support workforce innovations

Workforce theme 3: Development and progression

Critical determinant	Importance	Emerging	Developing	Maturing	Thriving
3.1 Education and skills development for SWs (Bands 2 and 3)	Rolling education and training programme ensures a competent support workforce and a clear career trajectory into senior support workforce roles. Improves staff morale, recruitment and retention. Training of registered staff ensures safe and effective delegation and supervision	Requirement for role-specific education and training recognised. Training needs analysis considered against role requirements	Competency frameworks in place for support staff across modalities but no underpinning resources or training plans	Training packages for initial education to meet competency frameworks. Ongoing provision of CPD for SWs in place, guided by SCoR Education and Career Framework	Service changes consider support staff education. New skill acquisition underpins progression. Peer mentor and education roles embedded. Liaison with FE Colleges evident
3.2 Education and skills development for APs (Band 4)	An education and training offer designed for the AP workforce supports a fully utilised scope of practice guided by SCoR Education and Career Framework and provides clear career opportunities improving recruitment, retention and staff morale	Department-based training reflects the scope of practice for the role, but academic underpinning is limited or does not enable progression	AP roles supported by formal recognised education programmes, but not enabling progression	CPD opportunities include APs either alongside registered staff or with specific role focused training. Organisational level engagement with education provider(s)	Education supports skills maintenance/expansion, enabling progression. Academic provider(s) engaged at service level, influencing content and future provision
3.3 Support workforce apprenticeships	Rolling programme of support workforce apprenticeships (Academic Level 2/3/5) provides regular progression opportunities to support recruitment and retention and improve workforce morale. Developments underpinned by SCoR Education and Career Framework	No opportunities for apprenticeships (Level 2/3/5) and no opportunities for access to training beyond mandatory courses	No access to Level 2/3/5 apprenticeships, other formal training available. Access to functional skills (maths/English) through organisation	Opportunity for apprenticeships at one or more academic levels, though number of places limited restricting progression opportunities	Apprenticeships across academic levels available on a rolling programme across support workforce levels. Clear succession planning
3.4 Progression opportunities to registered practice	A rolling programme of AP 'top up' courses and/or DAs to support recruitment into radiography posts increases retention and widens diversity (local workforce)	Not planning to offer DA or top up opportunities or other progression to registered practice	Not yet offering DA/top up options, exploring options with apprenticeship leads and HEIs and preparing business case	Small annual DA or top up intakes and/or supporting SWAPs to progress to traditional routes (e.g. top up degrees)	DA or top up on a rolling programme, functional skills offers to ensure wide and inclusive learning opportunities
3.5 Engagement across four 'pillars': clinical, research, education, leadership	Support workforce engagement in innovative roles may release managers and radiographers from time-consuming duties, providing a non-clinical progression alternative. Improves support workforce ownership, visibility and belonging	No engagement evident beyond clinical practice. Management and Leadership solely from registered workforce	Limited engagement in peer education. Some opportunities for enhancing SWAP voice or participation	Support Workforce engages in peer mentorship, training and management roles (e.g. rostering), with tasks appropriately delegated	Engagement across four pillars with leadership roles and representation in imaging service decision-making forums