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Critical success factors and risks for PACS implementation across Welsh health boards

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Research Article

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Abstract

Background:

Transitioning Picture Archiving and Communication Systems (PACS) represents a major digital transformation in radiology services, involving complex technical, organisational, and human factors. Despite anticipated improvements in workflow efficiency, diagnostic quality, and interoperability, PACS migrations frequently encounter delays, errors, or suboptimal adoption. This study identifies critical success factors, perceived risks, and stakeholder readiness for PACS migration across Welsh Health Boards, interpreted through a socio-technical lens using the Fit between Individuals, Tasks, and Technology (FITT) framework.

Methods:

A convergent mixed-methods design was applied. A structured literature review examined PACS migration and radiology digital transformation in high-income hospital settings. A national online survey captured perceptions of migration risk, readiness, and anticipated benefits from radiologists, radiographers, PACS managers, modality leads, and digital infrastructure personnel (n = 46). Semi-structured interviews were conducted with 15 stakeholders across clinical and digital leadership roles. Quantitative data were analysed descriptively, while qualitative data underwent reflexive thematic analysis. Findings were synthesised using the FITT framework to assess socio-technical alignment.

Results:

Survey respondents identified data migration errors (79%), training gaps (62%), and insufficient staffing (57%) as the primary risks, with low confidence in timelines (15%) and budgets (18%). Interviews highlighted migration as the most significant risk, variation in workforce capacity across Health Boards, insufficient early clinician engagement, and the importance of comprehensive training and post go-live support. FITT synthesis revealed misalignment between technology deployment and organisational readiness, variable local capacity, and task–technology fit challenges.

Conclusion:

Successful PACS migration requires technical robustness supported by early stakeholder engagement, adequate workforce capacity, context-sensitive training, and realistic planning. Emphasising socio-technical alignment provides actionable guidance for PACS migration in Wales and comparable health systems.

Trial registration

Not applicable.

Introduction

Digital health interventions frequently underperform when implementation is approached primarily as a technical deployment rather than a socio-technical change process. This study examines the adoption and effectiveness of a major health information system transition through an implementation science lens, focusing on how technological capability interacts with staff engagement, workflow demands, and organisational context. While previous studies have explored technological implementation in healthcare, there remains limited applied evidence demonstrating how socio-technical frameworks can be used to guide real-world public sector digital health initiatives and translate findings into actionable implementation insights [1, 2]. This study contributes by examining how implementation science principles can inform the deployment and sustained adoption of health information systems in practice.

Radiology is one of the most data-intensive areas in healthcare, generating high-volume, DICOM-compliant imaging data that must integrate reliably with Radiology Information Systems (RIS), reporting platforms, and electronic health records. At the centre of this infrastructure is the Picture Archiving and Communication System (PACS), which supports image storage and retrieval, hanging protocols, worklist orchestration, and diagnostic reporting. Replacing or migrating a PACS is therefore not a routine technical upgrade but a high-risk intervention with potential consequences for diagnostic continuity, patient safety, and service performance [1, 2].

Figure 1 illustrates the patient pathway through radiology, from referral and scheduling to image acquisition, reporting, and communication of results, alongside the digital systems that support each stage.

Internationally, health systems are transitioning from locally hosted legacy PACS toward consolidated architectures, including cloud-enabled platforms and vendor-neutral archives. These approaches support enterprise imaging, cross-site reporting, disaster recovery, and improved interoperability [3, 4]. In the UK, national digital strategies emphasise integrated imaging records and shared infrastructure to reduce duplication and improve clinical access [5]. However, these transitions introduce complex interdependencies between technical architecture, workforce readiness, and governance arrangements, increasing the potential for implementation risk in multi-organisation settings.

Data integrity represents a critical determinant of PACS migration stability. Errors in accession numbers, study identifiers, modality codes, or patient demographics can disrupt worklists, impair prior image comparison, affect hanging protocols, and compromise audit traceability [6, 7]. Even minor inconsistencies may reduce reporting efficiency or erode clinician trust in the migrated record. Evidence from imaging informatics research highlights that robust data validation and structured migration processes are therefore central to transition safety and adoption [6].

Interoperability further amplifies migration risk, as PACS relies on stable DICOM and HL7 integration with RIS, electronic requesting systems, and downstream clinical platforms. Interface instability or incomplete mapping can fragment workflows and delay reporting [8, 9]. These challenges are particularly pronounced in multi-site or nationally coordinated implementations, where variation in legacy infrastructure, system configuration, and network capacity may affect performance consistency across organisations.

Figure 2 situates PACS within the wider radiology integration landscape, highlighting the surrounding clinical, administrative, and technical systems required to support safe and efficient workflows.

Organisational readiness and workforce capacity are equally influential in shaping implementation outcomes. Health IT implementation research consistently demonstrates that digital transformation success is determined not only by technological capability but also by contextual factors including staffing levels, leadership engagement, digital maturity, and access to protected implementation time [2, 10]. During PACS migration, activities such as dual-running of systems, validation testing, and workflow reconfiguration increase workload demands. Without sufficient backfill or implementation support, clinicians and radiographers may experience implementation fatigue, increasing the risk of error and limiting effective system use [11].

Human factors and workflow alignment are particularly salient in radiology, where subspecialty reporting pathways, customised hanging protocols, and modality-specific processes are deeply embedded in daily practice. Socio-technical theory and implementation science frameworks emphasise that sustained adoption depends on alignment between individuals, tasks, and technology [1, 12]. Systems perceived as externally imposed or poorly aligned with established workflows frequently generate workarounds and underutilisation, constraining benefit realisation despite technical functionality [10, 12].

Regulatory and governance requirements introduce additional complexity. PACS migration must comply with UK data protection legislation, including GDPR, as well as clinical safety standards, DICOM conformance requirements, cybersecurity controls, and medico-legal record retention obligations [13, 14]. Accountability for migrated data integrity must therefore extend beyond technical configuration to encompass clinical governance, risk management, and transparent validation processes.

Despite published case reports of PACS replacement projects, empirical research examining stakeholder perceptions of readiness, risk, and implementation dynamics at national or multi-organisational scale remains limited. Wales provides a distinctive context in which seven Health Boards operate under a shared national digital strategy while differing in legacy infrastructure, workforce composition, and digital maturity. This combination of central coordination and local heterogeneity offers a valuable opportunity to examine how socio-technical alignment influences PACS migration outcomes.

To ensure comprehensive coverage of prior evidence, this study applied a structured, MeSH-guided literature search alongside keyword-based searches, capturing both indexed and relevant grey literature sources relating to PACS migration, RIS–PACS integration, and radiology digital transformation.

This study addresses four research questions:

1. What critical success factors and risks are identified in the literature on PACS migration and radiology digital transformation?
2. How do radiologists, radiographers, PACS managers, modality leads, and digital infrastructure personnel across Welsh Health Boards perceive migration risks and organisational readiness?
3. How do qualitative stakeholder accounts illuminate real-world implementation barriers and dynamics?
4. How can these findings inform future PACS migration strategies when interpreted through an implementation science lens, specifically the Fit between Individuals, Tasks, and Technology (FITT) framework [12]

By integrating literature synthesis, national survey data, and in-depth stakeholder interviews, this study conceptualises PACS migration as a socio-technical transformation rather than a purely technical replacement. Although grounded in the Welsh health system, the challenges examined, metadata integrity, interoperability dependencies, workforce readiness, and workflow fit, are characteristic of large-scale PACS migrations in other multi-organisation health systems. The findings therefore aim to inform governance, planning, and vendor-independent implementation roles in Wales and comparable healthcare contexts undertaking imaging infrastructure modernisation.

Methods

Study Design

This study employed a convergent mixed-methods design to examine critical success factors, perceived risks, and stakeholder readiness associated with PACS migration across Welsh Health Boards. Mixed-methods approaches are particularly suited to complex health system interventions where quantitative breadth and qualitative depth are both required to understand socio-technical dynamics [15, 16]. By integrating survey data, qualitative interviews, and structured literature synthesis, the study sought to generate complementary insights into implementation processes and contextual variation.

The study was conceptually guided by the Fit between Individuals, Tasks, and Technology (FITT) framework [12], which proposes that successful technology adoption depends on alignment between user characteristics, workflow requirements, and technological capabilities. FITT has been widely applied in health informatics to explain adoption variability and implementation outcomes [12, 17]. In this study, the framework informed survey domain development, interview topic guides, and the final integrative synthesis, providing a structured lens for interpreting socio-technical alignment and misalignment across data sources.

Ethical approval

was obtained from the University of Wales Trinity St David Research Ethics Committee. All participants received written information sheets and provided informed consent prior to participation. Procedures were conducted in accordance with the principles of the Declaration of Helsinki.

Literature Review

A structured literature review was undertaken to identify previously reported critical success factors, risks, and implementation strategies related to PACS migration and radiology digital transformation. The review followed established principles of structured searching and transparent selection but was not designed as a full systematic review with meta-analysis [18].

Searches were conducted in PubMed using Advanced Search and MeSH terms, alongside Web of Science and Google Scholar, to ensure comprehensive coverage. Grey literature sources included NHS Digital publications, Health Board reports, and guidance from professional radiology bodies. Relevant MeSH terms included *Picture Archiving and Communication Systems*, *Health Information Systems*, *Radiology Department, Hospital*, *Medical Informatics Applications*, and *Health Personnel*. These were supplemented with keyword searches including PACS migration, PACS replacement, vendor-neutral archive, RIS–PACS integration, radiology digital transformation, imaging interoperability, and critical success factors.

The search was limited to studies published within the previous 15 years and focused on hospital-based imaging environments in high-income countries. Inclusion criteria comprised empirical studies, case evaluations, or structured reports describing PACS replacement, migration, integration, or enterprise imaging initiatives that reported outcomes, barriers, enablers, or stakeholder perspectives. Purely technical engineering papers without workflow or clinical context were excluded, as were opinion pieces and non-hospital imaging settings.

Two reviewers independently screened titles and abstracts for relevance, with disagreements resolved through discussion. Data extraction captured study design, setting, participants, migration scope, reported risks, enablers, governance considerations, and use of implementation frameworks. Findings were synthesised narratively, consistent with guidance for interpretive synthesis in complex intervention research [18]. Themes identified in the literature informed the design of both the survey instrument and the semi-structured interview schedule.

Survey

A national (Wales-wide) cross-sectional online survey was developed to capture stakeholder perceptions of PACS migration risks, readiness, and anticipated benefits. Survey design followed established healthcare research guidance, including clear item construction, domain structuring, and pilot testing [19].

Target participants included radiologists, radiographers, PACS managers, modality leads, and digital infrastructure personnel across all Welsh Health Boards and Trusts. These groups were selected due to their direct involvement in imaging workflows and system implementation processes.

The survey consisted of six domains:

1. Demographic and professional characteristics (role, years of experience, prior digital project involvement).
2. Perceived migration risks (data migration errors, metadata inconsistencies, RIS interface issues, network capacity, staffing constraints, training gaps).
3. Anticipated benefits (workflow efficiency, reporting turnaround time, national image sharing, patient safety).
4. Organisational readiness and confidence (timeline realism, budget stability, leadership support, local resource adequacy).
5. Training and workforce capacity.
6. Open-text responses for additional insights or concerns.

Most items were structured using fixed-response formats (binary or Likert-type scales), enabling descriptive statistical analysis. The instrument was piloted with three PACS administrators to assess clarity and relevance, resulting in minor wording adjustments prior to distribution.

The survey was disseminated via Health Board professional mailing lists and relevant imaging networks. Participation was voluntary and anonymous. Forty-six complete responses were received over a six-week period. Quantitative data were analysed descriptively using frequencies and percentages. Given the modest sample size, analysis focused on overall distribution patterns rather than inferential statistical testing. Open-text responses were incorporated into the qualitative thematic analysis.

Interviews

Semi-structured interviews were conducted to explore stakeholder experiences, expectations, and perceived implementation dynamics in greater depth. Semi-structured interviewing is well established in health services research for examining complex organisational processes and capturing contextual variation [20].

Purposive sampling was used to ensure representation across professional roles and Health Boards. Fifteen participants were recruited, including senior radiologists, modality leads, PACS administrators, clinical directors, and digital leaders.

The interview guide was informed by literature review findings and survey domains. Key topics included prior experience of digital imaging transitions, perceived migration risks and mitigation strategies, workflow implications and RIS–PACS integration challenges, workforce readiness and training provision,

governance structures and leadership support, and suggested strategies for reducing implementation risk.

Interviews lasted between 40 and 70 minutes and were conducted either remotely via secure video conferencing or in person. All interviews were transcribed verbatim, anonymised, and stored securely in compliance with institutional data protection policies. Recruitment continued until thematic saturation was reached, defined as the point at which no substantively new themes emerged across successive interviews [21].

Data Analysis

The analysis was conducted by GC, who has held senior roles within the Welsh NHS. This insider position informed interpretation by providing contextual understanding of PACS governance and workflows, while reflexive practices, including analytic memoing and academic supervision, were used to critically interrogate assumptions and maintain interpretive transparency

Quantitative survey data were summarised descriptively to identify dominant perceptions of migration risk, anticipated benefits, and organisational readiness indicators.

Qualitative data, including interview transcripts and open-text survey responses, were analysed using Braun and Clarke's six-phase reflexive thematic analysis approach [22]. This involved familiarisation with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the analytic narrative. Coding was conducted iteratively, with ongoing refinement to ensure analytic consistency.

Following separate quantitative and qualitative analyses, findings were integrated using the FITT framework [12] as an interpretive lens. Data were mapped against three domains of alignment: technology–task, technology–individual, and task–individual. This deductive, framework-based synthesis enabled systematic identification of socio-technical congruence and misalignment influencing perceived migration risk and adoption potential. Framework-based integration is recognised as a robust method for synthesising implementation research across multiple data sources [23].

Results

Survey Findings

The survey captured 46 responses from stakeholders across Welsh Health Boards, including radiologists (35%), radiographers (28%), PACS managers (17%), modality leads (11%), and IT personnel (9%). Respondents reported between 2 and 25 years of professional experience (median 11 years), and 60% indicated prior involvement in digital imaging or PACS-related projects.

When asked to identify the greatest risks associated with PACS migration, respondents most frequently selected data migration errors (79%). Training gaps were the second most commonly reported risk (62%), followed by insufficient staffing or local capacity (57%). Additional concerns included RIS interface instability (43%), equipment delivery delays (39%), and limited time allocated for testing and validation (35%).

Open-text responses expanded on these concerns. Respondents described challenges associated with extracting and standardising historical imaging data, particularly where legacy systems contained inconsistent or incomplete metadata structures. Several highlighted the perceived risk associated with compressed testing windows during cutover periods and the potential downstream impact on reporting workflows and service continuity.

Despite these perceived risks, respondents anticipated substantial benefits from PACS migration. Improved national image sharing was expected by 84% of respondents, reduced duplicate imaging by 77%, and workflow efficiencies or faster reporting by 70%. Importantly, participants demonstrated a nuanced understanding of how these benefits would be realised in practice. One interviewee emphasised that the primary clinical value lay not in altering diagnostic accuracy per se, but in supporting interpretive confidence through improved access to prior imaging and cross-site records:

Enhanced diagnostic certainty is a benefit of the implementation — not diagnostic accuracy.

(Participant 6)

Confidence in implementation parameters, however, was low. Only 15% of respondents expressed strong confidence in project timelines, and 18% expressed strong confidence in budget stability. Open-text responses suggested that uncertainty around legacy data complexity and local resource availability contributed to this lack of confidence.

Interview Findings

Fifteen stakeholders participated in semi-structured interviews, representing a range of professional roles and Health Board contexts. Data were analysed using Braun and Clarke's reflexive six-phase thematic analysis approach [22]. Four major themes were identified.

1. Migration as the most significant risk

Participants consistently identified data migration and metadata integrity as the most critical determinants of PACS migration success. Concerns focused on completeness of historical imaging, preservation of study identifiers, and downstream workflow impacts, including prior image availability and the reliability of reporting worklists where identifiers or mappings were affected.

Stakeholders described the importance of structured pre-cutover validation, staged migration processes, and, where feasible, temporary dual-running arrangements to mitigate risk. Even minor discrepancies in

access to prior imaging were described as having the potential to undermine clinician confidence and reporting efficiency.

Any delay in the project and migration of data could be costly to the Health Boards and create animosity amongst its users who are desperate for a new PACS/RIS system.

(Participant 7)

Migration was therefore framed by participants as a patient safety and governance concern, rather than solely a technical exercise.

Participants also emphasised that the speed of data migration was a critical determinant of overall project timelines. Several interviewees expressed low confidence in supplier-proposed schedules, attributing this to limited understanding of existing local infrastructure capacity, network constraints, and legacy system complexity. Migration timelines were therefore perceived as optimistic and insufficiently grounded in site-specific technical realities.

2. Workforce and capacity variation across Health Boards

Interviewees described substantial variation in local PACS team capacity and digital maturity across Health Boards. Some reported access to dedicated PACS administrators with configuration and testing expertise, while others relied heavily on external vendor support.

Participants noted that limited internal capacity reduced flexibility in responding to local workflow adaptation needs and increased dependence on externally determined timelines. In lower-capacity settings, clinicians and radiographers were often required to balance routine service delivery with migration-related activities, contributing to implementation strain.

Health boards don’t have sufficient resources to implement.

(Interview participant)

Several participants highlighted perceived misalignment between project management capability and the specialist demands of radiology system migration. Interviewees reported that generic digital project management expertise did not readily translate into effective oversight of PACS migration, which requires detailed understanding of radiology workflows, RIS–PACS dependencies, and clinical risk. In some cases, participants suggested that limited domain knowledge increased reliance on clinical staff to compensate for gaps in project coordination [30].

3. Importance of early clinician engagement

Early involvement of end-users in system configuration, interface testing, and workflow mapping was consistently identified as an enabler of smoother transition. Participants reported improved alignment

between system functionality and clinical practice when radiologists, radiographers, and modality leads contributed to hanging protocol design, reporting templates, and worklist configuration.

Engagement is critical to delivering successfully within the specified timeframes.

(Participant 2)

Conversely, delayed engagement was associated with misalignment between configured workflows and actual clinical practice. Interviewees described previous digital transitions where limited user consultation led to workaround behaviours and reduced utilisation of advanced system functionality.

4. Training and workflow transformation

Training emerged as a key determinant of adoption quality. Participants emphasised that role-specific, scenario-based training was more effective than generic instruction sessions. Post go-live support mechanisms, including super-user networks and iterative feedback processes, were viewed as particularly valuable.

People will be the barrier to change.

(Interview participant)

Where training was perceived as insufficient, participants described increased reliance on informal peer support and self-directed learning. This variability in training experience was associated with uneven confidence levels and differing approaches to workflow adaptation across sites.

FITT Framework Synthesis

Following separate quantitative and qualitative analyses, findings were mapped against the Fit between Individuals, Tasks, and Technology (FITT) framework [12]. Framework-based synthesis is recognised as a structured method for integrating implementation findings across multiple data sources [23].

Three primary areas of misalignment were identified:

Technology–task misalignment:

Advanced PACS functionality was constrained by metadata inconsistencies, interface instability, or infrastructure limitations, reducing the efficiency of core reporting and retrieval tasks.

Technology–individual misalignment:

Delayed engagement and insufficient training reduced clinician confidence in system reliability and limited effective use of available features.

Task–individual misalignment:

Variation in staffing levels and availability of protected implementation time created uneven readiness across Health Boards, increasing perceived risk in lower-capacity environments.

These misalignments provide a structured description of factors associated with variation in perceived risk and adoption readiness across sites.

Figure 3 illustrates the interface solutions implemented to support interoperability between PACS, RIS, reporting platforms, and downstream clinical systems, reflecting the socio-technical dependencies identified in the FITT synthesis.

Discussion

This study examined stakeholder perceptions, risks, and enablers associated with a national PACS migration across Welsh Health Boards, integrating evidence from the literature with survey and interview findings through the Fit between Individuals, Tasks, and Technology (FITT) framework [12]. The findings demonstrate that PACS migration should be understood not as a routine technical upgrade, but as a complex sociotechnical transformation requiring alignment between system functionality, clinical workflows, workforce capability, and governance arrangements. Technical deployment alone was widely perceived as insufficient to deliver clinical or operational benefit; instead, implementation success depended on how effectively technological change was integrated with organisational readiness and human factors.

Migration risk, data integrity, and downstream consequences

Across both survey and interview data, data migration, particularly the accuracy and completeness of historical imaging metadata, emerged as the most significant perceived risk. Participants consistently emphasised that errors in identifiers, accession numbers, or study mappings can disrupt worklists, hanging protocols, and access to prior imaging, undermining clinician confidence and workflow continuity [5, 6, 24]. These findings reinforce existing evidence that PACS migration failures are more commonly driven by data quality and integration challenges than by core software or hardware limitations [25].

Importantly, participants highlighted that time pressure was not solely a function of data volume or technical complexity, but was shaped by upstream procurement and contractual constraints. Interviewees described situations in which fixed delivery timelines were established in response to legacy contract expiry, limiting flexibility to align migration, testing, and validation activities with infrastructure readiness and local data complexity. This compression of schedules was perceived to transfer risk downstream into implementation and clinical assurance phases [33]. Such findings align with public-sector project literature describing how early commitment to fixed timelines can amplify delivery risk by constraining adaptive planning [33].

Even where migrations were completed on schedule, participants reported that residual data integrity issues could cascade into increased reporting time, reliance on workarounds, and underutilisation of system functionality. Stakeholder emphasis on staged migration, pilot testing, dual-running, and comprehensive pre- and post-cutover validation aligns with professional guidance from the European Society of Radiology and the American College of Radiology [24, 26]. Migration risk was therefore framed not merely as a technical challenge, but as a patient safety and governance concern, extending accountability beyond IT configuration to include medicolegal responsibility, auditability, and clinical assurance [27].

Workforce capacity, capability, and organisational readiness

Workforce readiness emerged as a central determinant of implementation stability. Interviewees described marked variation across Health Boards, with better-resourced sites benefiting from dedicated PACS expertise and local configuration capability, while lower-capacity sites relied more heavily on external vendor support. These findings are consistent with broader health IT literature demonstrating that digital maturity, staffing capacity, and organisational readiness strongly predict adoption outcomes [9–11, 28].

Crucially, participants distinguished workforce misalignment in terms of both capacity and capability. PACS and RIS were consistently characterised as niche domains requiring specialist technical and clinical knowledge, including detailed understanding of radiology workflows, imaging standards, system interdependencies, and clinical risk. Where individuals responsible for implementation, coordination, or oversight lacked sufficient imaging informatics expertise, participants perceived increased inefficiency, heightened implementation risk, and greater reliance on informal clinical workarounds [34]. In such contexts, radiologists and radiographers were often required to compensate for gaps in technical understanding or project coordination, increasing workload pressure during migration and constraining effective local adaptation. These findings suggest that workforce readiness for PACS migration depends not only on staffing volume but on access to appropriately skilled personnel with domain-specific expertise, which participants noted was difficult to recruit and retain within existing organisational structures.

Early engagement, training, and sociotechnical alignment

Early clinician engagement was consistently identified as a key enabler of sociotechnical alignment. Survey and interview findings showed that involving radiologists, radiographers, and modality leads in workflow mapping, interface testing, and configuration decisions improved alignment between system functionality and clinical practice. These findings align with implementation science principles emphasising co-design, ownership, and early stakeholder involvement as mechanisms for improving adoption and reducing resistance [14, 23, 29].

Conversely, delayed or limited engagement was associated with Technology–Individual misalignment, with systems perceived as imposed rather than integrated. Participants linked such misalignment to workaround behaviour and underutilisation of advanced system functionality. Engagement was therefore viewed as extending beyond technical configuration to encompass workflow redesign, reporting templates, and contingency planning. Structured collaboration mechanisms, such as multidisciplinary design workshops, iterative feedback loops, and formal user acceptance testing, were perceived as supporting adaptive implementation and sustained uptake [15, 30].

Training quality and scope were similarly central to adoption outcomes. Participants consistently favoured longitudinal, role-specific, scenario-based training models supported by superuser networks and post-go-live reinforcement. Where training was perceived as insufficient, respondents described increased reliance on informal peer support and self-directed learning, contributing to uneven confidence and variable system use [16, 17, 31]. Within the FITT framework, training directly influenced both Technology–Individual and Task–Individual alignment, shaping confidence, efficiency, and resilience during transition.

Confidence in timelines, budgets, and governance

Low confidence in project timelines and budgets reflected concerns about optimistic planning assumptions and limited contingency. Large-scale digital health programmes frequently underestimate the interdependencies between infrastructure readiness, workflow redesign, governance, and workforce capacity [18, 19, 32]. In the context of PACS migration, compressed schedules were perceived to curtail testing and validation, increasing exposure to clinical and operational risk.

Participants identified transparent milestone reporting, phased delivery, and visible risk management as mechanisms for improving organisational trust. In the Welsh context, externally imposed contractual deadlines and limited flexibility to extend legacy systems were described as compressing implementation schedules and reducing local discretion to adapt timelines to infrastructure readiness and data complexity, amplifying implementation risk [33].

FITT framework interpretation and implications

Application of the FITT framework clarified how sociotechnical misalignment contributed to perceived risk and adoption challenges [12, 23]. Technology–Task misalignment arose where PACS functionality was constrained by metadata issues, interface limitations, or infrastructure capacity. Technology–Individual misalignment emerged when training was insufficient or engagement delayed, reducing confidence and uptake. Task–Individual misalignment was evident where operational demands exceeded available staffing capacity, producing uneven readiness across Health Boards.

Together, these findings explain why technically successful migrations may fail to deliver anticipated clinical or workflow benefits. Sustained value depends on deliberate alignment across all three domains; technology, tasks, and individuals, rather than technical performance alone.

Policy and practice implications

The findings point to several prioritised implications for national and regional PACS programmes:

- Structured data validation and staged migration to manage metadata risk and clinical assurance [24, 26].
- Formal readiness assessment and workforce capacity planning to address variation in digital maturity [9, 10].
- Early and continuous clinician engagement in configuration, workflow design, and testing [12–15, 29].
- Role-specific, longitudinal training models supported by superuser networks [16, 17, 31].
- Realistic timelines, budgets, and contingency planning informed by sociotechnical complexity [18, 19, 32].

Equitable adoption requires that standardisation strategies explicitly account for local workforce and infrastructure variability. Governance structures must bridge IT and clinical leadership, ensuring shared accountability, clear escalation pathways, and integrated risk management across organisational boundaries.

Strengths and limitations

Key strengths include triangulation of literature, survey, and interview data across multiple professional roles and Health Boards, providing a comprehensive view of PACS migration challenges and enablers. Use of the FITT framework offers analytical coherence and practical relevance for implementation planning.

Limitations include a modest survey sample size and potential response bias, with stakeholders holding stronger views more likely to participate. The study is situated within the Welsh context; however, the identified themes; data integrity, interoperability, workforce readiness, and socio-technical alignment, are consistent with international evidence on large-scale radiology digital transformation. The findings are therefore transferable to other multi-organisation health systems, particularly for vendor-independent implementer roles responsible for balancing commercial solutions with system-level clinical and organisational fit.

Conclusion

PACS migration should be understood and managed as a complex sociotechnical transformation rather than a discrete technical procurement or software replacement. This study demonstrates that successful adoption depends on deliberate alignment between technology, tasks, and individuals, rather than on technical robustness alone. While system performance and infrastructure reliability are necessary conditions, they are insufficient without parallel attention to workforce capability and capacity, workflow redesign, stakeholder engagement, and governance arrangements.

Across both survey and interview data, data migration integrity emerged as the most critical perceived risk. Stakeholders consistently emphasised that metadata accuracy, preservation of historical imaging, and comprehensive pre- and post-cutover validation are central to maintaining reporting continuity, clinician confidence, and patient safety. Even minor inconsistencies in migrated data were viewed as capable of disrupting workflows, increasing reporting time, and prompting reliance on informal workarounds. These findings reinforce the need for structured, staged migration approaches that treat data quality as a clinical and governance priority rather than a purely technical task [24–26].

Workforce readiness and organisational context were equally influential determinants of adoption. Health Boards with dedicated PACS expertise and higher levels of digital maturity reported greater confidence and implementation stability, whereas under-resourced sites experienced disproportionate operational strain and uneven readiness [9–11,28]. Importantly, participants highlighted that workforce misalignment reflected not only staffing volume but capability. PACS and RIS were consistently described as niche domains requiring specialist imaging informatics expertise, and where such expertise was lacking, risk, inefficiency, and reliance on clinical compensation increased [34]. These findings underscore the importance of formal readiness assessment, minimum capability benchmarks, and capacity-equalisation mechanisms within national PACS strategies to avoid inequitable implementation outcomes.

Early clinician engagement and tailored, longitudinal training were central to sustained adoption. Stakeholders emphasised that workflow configuration must reflect real-world clinical practice rather than theoretical process models. Role-specific training, superuser networks, iterative feedback loops, and post-go-live support enhanced confidence, reduced workaround behaviour, and increased effective system use [12–17,29–31]. Training therefore functions not as a one-off implementation activity but as a continuous mechanism for maintaining sociotechnical alignment over time.

Low confidence in project timelines and budgets further highlighted the importance of realistic planning and contingency provision. PACS migration involves multiple interdependent components, including software replacement, infrastructure readiness, interoperability, workflow redesign, and clinical governance [18,19,32]. Where timelines are compressed—particularly due to upstream contractual constraints rather than local readiness—testing and validation are often curtailed, transferring risk downstream into implementation and assurance phases [33]. Transparent milestone reporting, adaptive scheduling, and visible risk management were identified as mechanisms for improving organisational trust and reducing uncertainty.

Application of the FITT framework clarified how misalignment across domains constrains benefit realisation. Technology–Task misalignment limited workflow optimisation, Technology–Individual misalignment reduced confidence and uptake, and Task–Individual misalignment amplified workload pressure during transition [12,23]. Alignment across all three domains emerged as a prerequisite for achieving sustainable benefits and equitable outcomes from large-scale PACS migration.

Taken together, these findings highlight the need for a holistic, implementation-science-informed approach to digital radiology transformation. National PACS programmes should integrate robust data validation protocols, structured readiness assessment, explicit workforce capability planning, early and continuous clinician engagement, and longitudinal training models within governance arrangements that bridge IT and clinical leadership. Although situated within the Welsh health system, the challenges identified; metadata integrity, interoperability dependencies, workforce readiness, and sociotechnical alignment, are characteristic of large-scale PACS migrations internationally. The findings are therefore applicable to other health systems undertaking regional consolidation, vendor-neutral archive adoption, or cloud-enabled PACS transformation.

Future research should focus on longitudinal post-migration evaluation, including impacts on reporting turnaround times, duplicate imaging, user experience, and patient safety outcomes. Comparative studies across health systems with differing governance models and workforce capacity would further strengthen understanding of contextual influences on PACS adoption success [28,30]. When technology, tasks, and individuals are deliberately aligned, PACS migration has the potential to deliver substantial gains in interoperability, workflow efficiency, and patient care. When misaligned, even technically successful deployments risk underperformance and inequitable outcomes. Integrating sociotechnical and implementation science perspectives provides a structured pathway for anticipating risk, guiding delivery, and maximising the value of digital radiology investment [23].

Abbreviations

ABUHB
Aneurin Bevan University Health Board
AI
Artificial Intelligence
DHCW
Digital Health and Care Wales
DICOM
Digital Imaging and Communications in Medicine
EHR
Electronic Health Record
FITT
Fit between Individuals, Tasks, and Technology
GDPR
General Data Protection Regulation
HL7
Health Level Seven (standards framework)
IT
Information Technology
NHS

National Health Service
PACS
Picture Archiving and Communication System
RIS
Radiology Information System
VNA
Vendor Neutral Archive
WAN
Wide Area Network

Declarations

Ethics approval

This study received ethical approval through the Course Lead/Module approval process at the University of Wales Trinity Saint David as part of a postgraduate taught programme. The research was conducted in accordance with the University's Research Ethics and Integrity Code of Practice and Research Data Management Policy.

Consent to participate

Informed consent was obtained from all individual participants included in the study. Participants were provided with an information sheet and gave written consent prior to participation. Participation was voluntary and participants were able to withdraw at any time without consequence.

Consent for publication

Not applicable. No identifiable personal data are included in this manuscript.

Competing interests

The authors declare no competing interests.

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Author Contribution

Author 1 designed the study, collected and analysed the data, and wrote the manuscript. Author 2 reviewed the manuscript, and contributed to refinement of the analysis and interpretation.

Data Availability

The dataset(s) supporting the conclusions of this article is(are) available from the corresponding author on reasonable request.

Trial registration

Not applicable.

The survey instrument developed specifically for this study is in Appendix 1.

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Figures

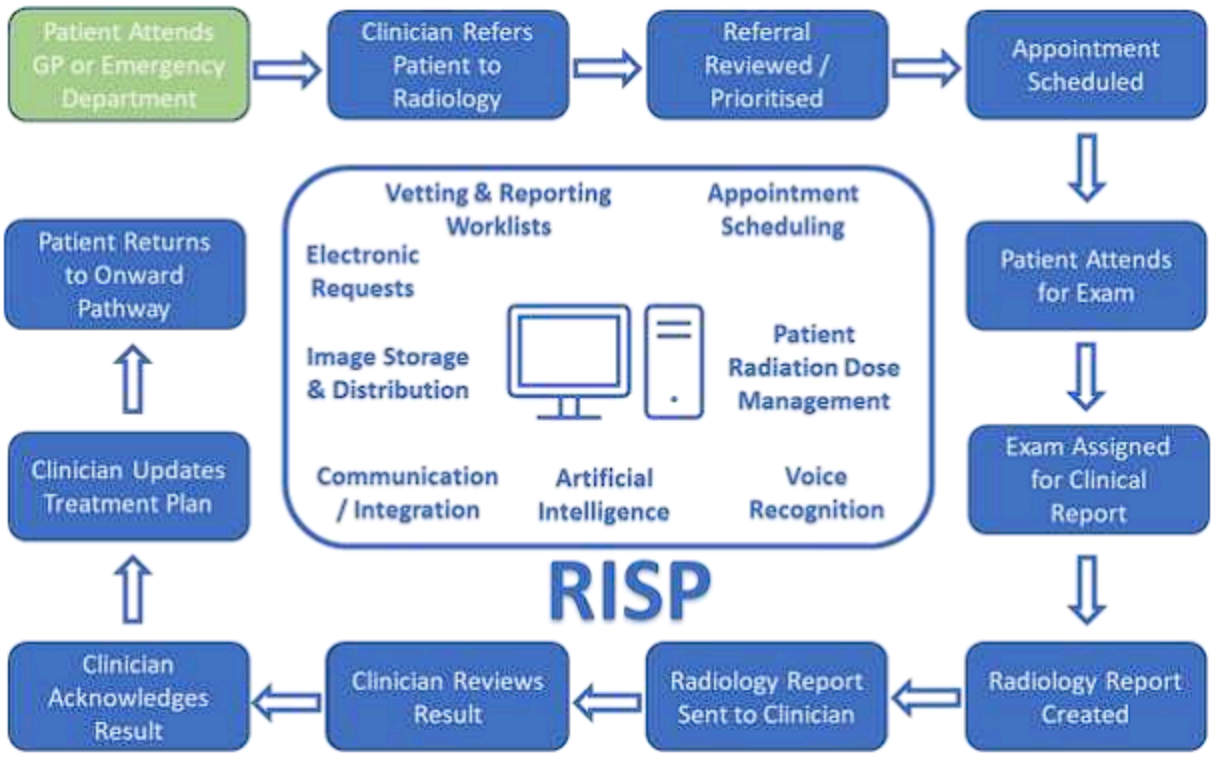


Figure 1

Typical clinical pathway to and through radiology in Wales, Adapted from the Radiology Informatics System Procurement (RISP) business case [Internal organisational document]

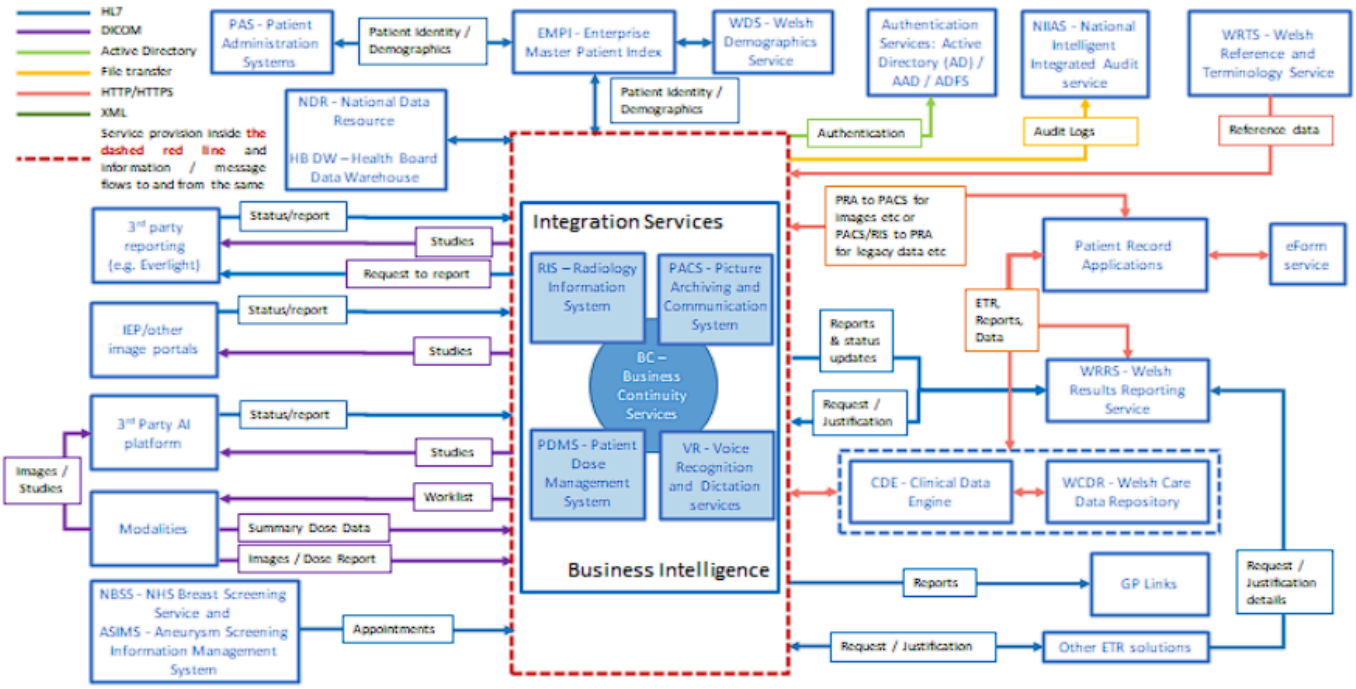


Figure 2

Integrations within Radiology systems, Adapted from the Radiology Informatics System Procurement (RISP) business case [Internal organisational document]

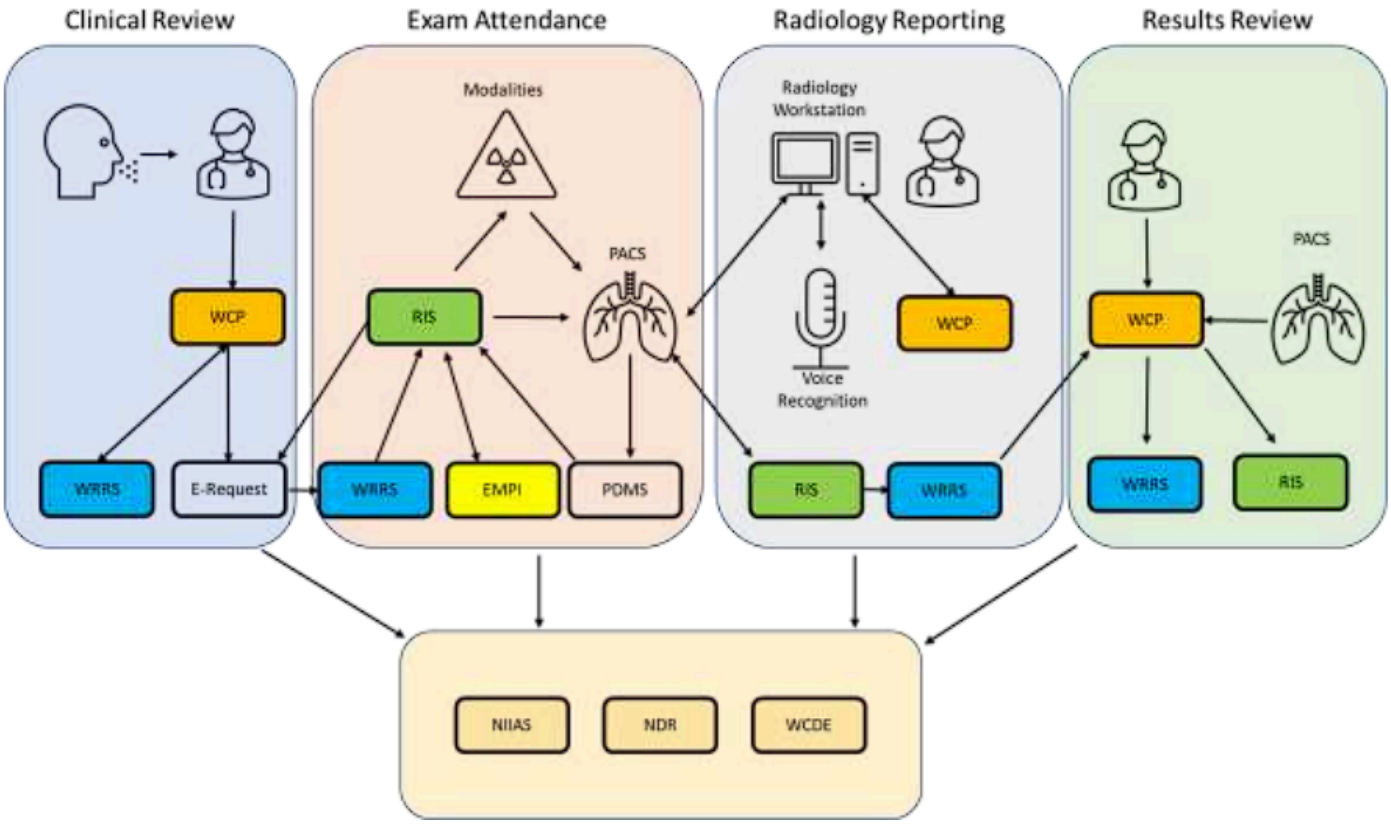


Figure 3

Radiology Interface Solutions, Adapted from the Radiology Informatics System Procurement (RISP) business case [Internal organisational document]

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- Appendix1.docx