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From evidence to practice: determinants, outcomes and strategies for implementing oncological structured reporting in Swedish radiology – a national cross-sectional survey

Gustav Alvfeldt

gustav.alvfeldt@ki.se

Karolinska Institutet

Peter Aspelin

Karolinska Institutet

Lennart Nedar

Karolinska Institutet

Nina Sellberg

Karolinska Institutet

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Abstract

Background

Structured reporting templates are described as improving report quality, consistency and clinical communication, yet adoption in routine practice remains limited. In Sweden, an evidence-based national template for rectal cancer staging has been available since the mid-2010s, but it remains unclear which determinants shape its adoption and how adoption translates into perceived outcomes. This study assessed the implementation status of these templates, with primary focus on rectal cancer, and characterised the associated determinants, outcomes and strategies.

Methods

A national cross-sectional web-based survey of clinically active radiologists and radiology department heads was conducted between August and November 2025. The updated Consolidated Framework for Implementation Research was used to identify barriers and facilitators, Proctor's taxonomy to evaluate service and implementation outcomes, and the Expert Recommendations for Implementing Change to link barriers to evidence-based strategies. Analyses were descriptive, with proportions reported as Wilson 95% confidence intervals. Professional role was the primary moderator, and findings were organised as retrospective determinant-to-strategy pathways, linking observed determinants and outcomes to proposed strategies.

Results

Of 50 respondents, 34 reported active use and 33 were analysed for determinants and outcomes. Implementation was most commonly champion-driven (48% of rollouts), and local champions were rated as strong facilitators more often than formal management (36% vs 21%). No respondent rated incentives as a strong facilitator or implementation cost as a major barrier (both 0%, 95% CI 0–10%). Templates were perceived to improve clinical effectiveness while creating workflow friction for a minority (Service Effectiveness 91% improved; Service Efficiency 44% improved, 19% worsened). Among active users, adoption ratings exceeded continued-engagement and sustainment ratings (79% vs 39%).

Conclusions

Structured reporting templates were perceived to deliver clear clinical value but to create workflow friction that fell unevenly across professional roles, and high adoption was not matched by continued engagement and sustainment. Uptake rested on local champions rather than economic levers, so strategies that pair champion engagement with workflow adaptation and formal organisational

ownership may be needed. Because the sample was small and self-selected and the design was cross-sectional, causal relationships and strategy effects were not tested.

Background

Structured reporting in radiology can enhance clinical communication and decision-making [1–4], yet adoption in routine practice remains limited [5]. In Sweden, an evidence-based national reporting template for radiological staging of rectal cancer was introduced in 2014 [6]. A subsequent evaluation found that 48% of clinically relevant information aligned with evidence-based standards in reports written in 2010, against 93% for template-based reports written in 2016 [7–9]. The implementation challenges seen in radiology are recognised internationally [5], and evidence-based interventions are known to take years to become established in practice [10, 11].

While the structural and clinical value of standardised reporting has been documented [12, 13], it remains unclear which contextual determinants act as barriers and facilitators to adoption, how adoption translates into perceived outcomes for the radiologists and departments using the templates, and which implementation strategies are appropriate for the determinants identified. To our knowledge, no Swedish national-level implementation evaluation has mapped the determinants that drive or hinder sustained adoption of reporting templates for cancer imaging.

This study aimed to assess the current implementation status of structured radiology reporting templates for oncological imaging in Sweden, with primary focus on rectal cancer staging, and to identify and characterise the associated determinants, perceived outcomes, and strategies, to inform evidence-based recommendations for sustained adoption and use in routine clinical practice. The analysis draws on three implementation-science frameworks: the Consolidated Framework for Implementation Research (CFIR) for determinants that hinder or enable adoption, Proctor's taxonomy for outcomes, and the Expert Recommendations for Implementing Change (ERIC) for strategies.

Four research questions are addressed:

1. What is the current implementation status of structured reporting templates for cancer staging in Swedish radiology?
2. Which CFIR determinants are perceived as facilitators and barriers to the adoption and use of reporting templates, among both current users and non-users?
3. How do active users perceive the impact of template-based reporting on service outcomes (e.g. clinical effectiveness, efficiency, and safety) and on implementation outcomes (e.g. adoption, acceptability, and sustainability)?
4. Which implementation approaches were used in actual rollouts of radiology reporting templates in Sweden?

For each question, variation by professional role and hospital type was examined.

The implementation object, "the thing" being implemented [14, 15], is here the structured reporting templates for oncological imaging, in particular the national staging template for primary rectal cancer developed by the Swedish Society of Gastrointestinal and Abdominal Radiology (SFGAR) [6], which constitute the evidence-based innovation (EBI) [16] against which all determinants and outcomes are assessed. The implementation context is the radiology departments at university, county, district and private hospitals in Sweden, and the general radiologists, abdominal subspecialists and department heads working there, who are the primary users and key decision-makers.

Methods

Study design and setting

This exploratory Swedish national retrospective study employed a cross-sectional, web-based survey design to identify and characterise implementation determinants and outcomes across heterogeneous implementations of structured reporting templates. The survey was active from August 2025 to November 2025. The study protocol was vetted and approved by the Swedish Ethical Review Authority (Ethics approval number: 2025-00754-02). Extended detail on the survey structure, response formats and value mapping, the CFIR constructs selected, and the reclassification of professional roles is provided in Additional file 1 (Extended methods).

The study was conducted within the Swedish publicly funded healthcare system, organised across 21 regions, in which hospital types differ in case complexity and subspecialty composition [17] and oncological care is coordinated through standardised cancer care pathways [18]. Reporting templates for cancer imaging are developed nationally by the radiological societies but adopted locally by the individual radiology department.

The unit of observation and analysis was the individual respondent, who reported on implementation within their department.

Participants

The study population consisted of clinically active radiologists and radiology department heads, with a focus on professionals involved in oncological imaging. All respondents represented the main hospital types in the Swedish publicly funded healthcare system.

Recruitment was conducted through purposive criterion sampling. The survey was distributed nationally via the Swedish Society of Medical Radiology (SFMR) through three sequential mailings to the society's department heads network. The survey was additionally presented at the national radiology conference Röntgenveckan in September 2025.

Survey responses contained no identifying information, and respondents answered at the level of their clinical workplace and professional role rather than as named individuals. A final optional item invited contact details for a possible follow-up interview; responses to this item were not used, and all data were

handled and analysed in de-identified form, as stated in the participant information. The purpose of the study was presented at distribution, and submission of the anonymous survey was treated as implied consent. No written informed consent was obtained.

Survey instrument

The survey was developed by the main author (GA) and consisted of 29 questions with multiple items (Additional file 2). It was internally reviewed by the research group (PA, NS, LN) and iteratively refined for clarity and face validity.

Because the implementations studied had already occurred without a centrally specified strategy, framework-driven prospective data collection was not possible. Items were therefore worded in clinical and operational terms, so that respondents could answer without prior knowledge of implementation science. They were mapped to the CFIR constructs and Proctor's outcomes after data collection. The mapping was fixed before any analysis and is documented in Additional file 3, so that construct selection could not follow the results.

One principal branching question separated respondents by the implementation status of their department (Fig. 2). Active users (Branch 1) received items on determinants, Service Outcomes and Implementation Outcomes; non-users (Branch 2) received items on barriers to future adoption and readiness to implement. Both branches were subdivided as shown in Fig. 2.

Table 1
Respondent characteristics and implementation status (n = 50).

Demographic variable	Total (n = 50)	1a. Incl. CRC (n = 30)	1b. Excl. CRC (n = 4)	2a. Planning (n = 4)	2b. No plans (n = 12)
Professional role					
Abdominal radiologist	11	9 (82%)	0 (0%)	1 (9%)	1 (9%)
Radiologist, general	23	15 (65%)	3 (13%)	1 (4%)	4 (17%)
Radiologist, other subspecialty	6	2 (33%)	1 (17%)	0 (0%)	3 (50%)
Department head	10	4 (40%)	0 (0%)	2 (20%)	4 (40%)
Hospital type					
County hospital	26	19 (73%)	2 (8%)	2 (8%)	3 (12%)
District hospital	11	6 (55%)	1 (9%)	0 (0%)	4 (36%)
University hospital	10	4 (40%)	1 (10%)	1 (10%)	4 (40%)
Private hospital	3	1 (33%)	0 (0%)	1 (33%)	1 (33%)

Distribution of professional role and hospital type for all respondents (n = 50), by the implementation status of their department. Count (n) and proportion (%) within each row. Descriptive distribution of the sample; no confidence intervals are reported.

The survey used four question formats: (i) Five-point unipolar Likert scale for identifying determinant strength, (ii) Five-point bipolar items for Service Outcomes, (iii) Single- or multiple-choice categorical items and, (iv) Open-ended free-text fields placed after certain questions to capture context, examples, and reasoning.

Data preparation and analysis

All data-handling and analytical decisions, with their rationale, consequences and supporting references, are documented in an analytical audit trail (Additional file 3) to guard against post hoc construct selection. The decisions with most impact on interpretation are given below.

Professional role was self-reported. Four respondents who selected 'Other' and provided clarifying free text were reclassified to existing categories based on stated professional identity and organisational perspective.

One of the 34 respondents reporting active use (ID 14) was excluded from the determinant and outcome analyses, having stated in free text that they did not personally use the templates and had entered fictitious answers to complete mandatory items. These analyses are therefore based on 33 active users.

All Likert matrix items were mandatory in the survey tool. The analysed dataset therefore contains no item-level missing data, and the denominator for every reported proportion equals the full branch or subgroup population.

All five-point Likert scales were collapsed to three ordinal categories, since five-level distributions produce sparse cells at this sample size, where a single respondent can shift a category by up to 25 percentage points [19]. Top-box methodology (the proportion of respondents endorsing the strongest valence category of the collapsed scale) was used as the primary summary statistic for CFIR determinants, both for facilitators and for barriers. This provides a binary valence judgement per construct that is comparable across constructs and across subgroups and has been used in prior survey-based studies [20, 21].

Throughout, "facilitator" and "barrier" represent the analytical role of a construct within CFIR. The tables keep the response wording shown to respondents (contributions, challenges, or reasons for non-implementation).

For Service Outcomes, top-box reporting was not applied; both extremes of the bipolar scale were retained, since a top-box presentation would conceal whether the innovation simultaneously improves one outcome dimension and worsens another.

Cross-tabulation of professional role against hospital type revealed strong collinearity: all 23 general radiologists worked at county or district hospitals and none at university hospitals, while all active users at university hospitals were subspecialists (Additional file 4, Tables S1–S2). Professional role was therefore used as the primary moderator for descriptive subgroup analyses.

Two further decisions were made for the segmented subgroup analyses. The 'Other subspecialty' group (n = 3 among active users) was excluded as a comparative professional role, on statistical grounds and because the group is clinically heterogeneous; their responses were kept in the total column. The Department head group (n = 4) was kept as a separate comparative role despite its size, since departmental leadership is a central CFIR construct, and this population is naturally small.

Wilson score intervals [22] were calculated for all proportions reported as estimates, including subgroup, domain-aggregated and zero-count proportions, since the method retains reliable coverage at small n and at extreme proportions. All intervals are 95% and given in square brackets; none are reported for the descriptive sample (Table 1). Most intervals are wide and overlap, so proportions are described as observed values rather than ranked differences.

All proportions are reported as integer percentages using round-half-to-even (banker's) rounding; columns may therefore not sum to exactly 100%.

Category-level aggregates for CFIR domains and Proctor Service Outcomes were calculated by dividing summed responses by the total number of item-by-respondent observations; Implementation Outcomes,

each measured by a single item, were not aggregated. Domain-level aggregates are not comparable between branches, since the number and composition of items differ.

Analyses were exclusively descriptive. No inferential hypothesis tests were performed and no multiple-comparison corrections applied, in keeping with the study's exploratory purpose. No sensitivity analyses were performed; the analysis considered and rejected is documented in Additional file 3. All result tables, including those not reproduced in the main text, are provided as Additional file 4 (Tables S1–S20), so that the full analysis can be inspected.

Free-text responses were reviewed by GA and used to triangulate and contextualise the quantitative findings, with quotations reported illustratively in the Results. No formal qualitative coding was done.

The use of a large language model as a computational and manuscript-preparation aid is described under Declarations.

Frameworks and causal pathway approach

The updated Consolidated Framework for Implementation Research (CFIR) [23] was selected because it is designed to identify barriers and facilitators that can explain implementation outcomes [24, 25]. Covering all 48 constructs and 19 subconstructs in a single survey is neither practical nor desirable [25, 26], so a subset of constructs from four of the five domains was used. The Implementation Process domain was not operationalised, since rollouts introduced at different times by different stakeholders across heterogeneous departments do not permit meaningful assessment of process constructs; instead, a single categorical item captured how each rollout was carried out (Table 3).

Table 3
How the implementation was carried out in the department (n = 33 active users).

Implementation approach	**Proportion (n = 33)**
Driven by individual champions rather than a formal organisational decision	48% (16) [33–65%]
Stepwise implementation (e.g. certain examination types first)	33% (11) [20–50%]
Pilot project followed by wider roll-out	6% (2) [2–20%]
Full implementation at once	6% (2) [2–20%]
Do not know*	6% (2) [2–20%]
Single-choice item; percentages may not sum to 100% because of rounding. Proportion with Wilson 95% CI. *Two respondents answered "Other"; their free-text comments stated that the implementation predated their employment and that they did not know, and these were therefore reclassified as "Do not know".	

Proctor et al.'s Implementation Outcomes Framework (IOF) [27], one of the most widely used outcome taxonomies [28], was used to assess perceived outcomes. Two of its three layers were applied: Service Outcomes, capturing perceived consequences for clinical service delivery, and Implementation

Outcomes, capturing the characteristics of the implementation effort itself. Service Outcomes were grouped into Service Effectiveness, Service Efficiency and Service Safety, together with a fourth, study-specific category, Organisational Effectiveness, which is not part of Proctor's taxonomy but was influenced by the Institute of Medicine's Learning Healthcare System concept [29]. Implementation Outcomes were assessed with seven components common to Proctor's framework and the CFIR Outcomes Addendum: Acceptability, Adoption, Appropriateness, Feasibility, Fidelity, Penetration and Sustainability [27, 30]. The third layer, Client Outcomes, was not applied.

ERIC was selected for strategy identification and applied only at the interpretive stage, based on its demonstrated empirical linkage with CFIR and the established mapping of ERIC implementation strategies to CFIR-identified barriers [31].

To visualise the relationships between identified determinants, observed outcomes, and recommended implementation strategies, the causal pathway diagram (CPD) method was applied [32]. As originally specified, a CPD is prospective and strategy-centred, tracing a defined strategy forward to the determinant it targets, and the outcomes expected to follow. Since our aim is to identify and characterise empirical determinants and outcomes that observed implementations have produced, we have applied the CPD method retrospectively and determinant-centred (Fig. 1) [33]. Because this application is retrospective and determinant-centred, we refer to the resulting diagrams as determinant-to-strategy pathways: hypothesis-generating maps for future strategy testing. Given the cross-sectional design, their moderator and precondition roles mark determinants hypothesised to shape a pathway rather than statistically tested effects.

Reporting

The study is reported in accordance with the STROBE statement for cross-sectional studies [34]. The completed STROBE checklist is provided as Additional file 5.

The Standards for Reporting Implementation Studies (StaRI) [35] were considered but not applied, as they presuppose a prospectively specified implementation strategy, which the retrospective implementations studied here lacked.

Results

The sample consisted of senior specialists and department heads. One respondent (ID 14) was excluded from the determinant and outcome analyses but retained in the descriptive reporting of respondent characteristics and implementation status (Table 1), where their responses remained valid.

Respondent characteristics and implementation status

A total of 50 respondents answered the survey. The survey used branching logic with two analytical branches (Table 1 and Fig. 2). Of all the respondents, 84% (42/50) answered that they assessed colorectal cancer cases in their clinical practice.

Adoption of cancer-oriented reporting templates was highest among abdominal radiologists (82%, 9/11) and general radiologists (78%, 18/23). Abdominal radiologists also showed the highest adoption of the colorectal cancer (CRC)–specific templates.

County hospitals showed the highest adoption rate for cancer reporting templates. Adoption at university hospitals and among private healthcare institutions was considerably lower. The proportion of respondents with no plans to implement structured reporting templates was also highest in the university hospital setting.

Facilitators for implementation

Outer Setting (61%) was the highest-rated facilitator domain (Table 2), driven by adherence to reporting guidelines (Policies and Laws, 67%) and demand from referring physicians (Partnerships and Connections, 55%). It was rated at 69% by general radiologists, 44% by abdominal radiologists and 38% by department heads. The perceived clinical value of the innovation was also highly rated (53%), particularly quality assurance and patient safety (Innovation Relative Advantage, 73%) and reduced inter-reader variability (Innovation Design, 61%). These two domains were rated higher than the two internally oriented domains, Inner Setting (19%) and Individuals (29%), the only domains in which the 'Little / None' category outweighed 'Strong / Very strong' (68% and 38% of items respectively; Additional file 4, Table S8). The highest-rated internal facilitators were improved workflows (Compatibility, 42%) and strong local champions – individuals who actively drive adoption – (Implementation Leads, 36%).

Table 2
Facilitators for implementation by professional role (n = 33 active users).

Facilitator (CFIR domain / construct)	Total (n = 33)	General rad. (n = 18)	Abdominal rad. (n = 8)	Dept. head (n = 4)
Clinical value (Innovation)	**53% (52/99) [43–62%]**	**54% (29/54) [41–66%]**	**50% (12/24) [31–69%]**	**25% (3/12) [9–53%]**
Quality assurance and patient safety (Innovation Relative Advantage)	73% (24) [56–85%]	78% (14) [55–91%]	62% (5) [31–86%]	50% (2) [15–85%]
Standardisation of reporting structure and content (Innovation Design)	61% (20) [44–75%]	61% (11) [39–80%]	62% (5) [31–86%]	25% (1) [5–70%]
Evidence of benefit (Innovation Evidence Base)	24% (8) [13–41%]	22% (4) [9–45%]	25% (2) [7–59%]	0% (0) [0–49%]
External demand / pressure (Outer Setting)	**61% (40/66) [49–71%]**	**69% (25/36) [53–82%]**	**44% (7/16) [23–67%]**	**38% (3/8) [14–69%]**
Adherence to guidelines (Policies and Laws)	67% (22) [50–80%]	78% (14) [55–91%]	50% (4) [22–78%]	25% (1) [5–70%]
Demand from referring physicians (Partnerships and Connections)	55% (18) [38–70%]	61% (11) [39–80%]	38% (3) [14–69%]	50% (2) [15–85%]
Organisation and work environment (Inner Setting)	**19% (19/99) [13–28%]**	**17% (9/54) [9–29%]**	**25% (6/24) [12–45%]**	**17% (2/12) [5–45%]**
Improved workflows (Compatibility)	42% (14) [27–59%]	39% (7) [20–61%]	62% (5) [31–86%]	25% (1) [5–70%]
Clear information / training initiatives (Access to Knowledge & Information)	15% (5) [7–31%]	11% (2) [3–33%]	12% (1) [2–47%]	25% (1) [5–70%]
Incentives or bonus schemes (Incentive Systems)	0% (0) [0–10%]	0% (0) [0–18%]	0% (0) [0–32%]	0% (0) [0–49%]
Participants and leadership (Individuals)	**29% (19/66) [19–41%]**	**25% (9/36) [14–41%]**	**31% (5/16) [14–56%]**	**38% (3/8) [14–69%]**
Strong local champions (Implementation Leads)	36% (12) [22–53%]	22% (4) [9–45%]	50% (4) [22–78%]	50% (2) [15–85%]
Management decision (High-/Mid-level Leaders)	21% (7) [11–38%]	28% (5) [12–51%]	12% (1) [2–47%]	25% (1) [5–70%]

Proportion reporting 'Strong / Very strong contribution' with Wilson 95% CI in brackets. Aggregated domain-level values in bold; domain denominators reflect the number of given responses (e.g., 2 items × 33 = 66). Domains are presented in CFIR 2022 order; constructs are ordered by descending top-box proportion within each domain. 'Other subspecialty' (n = 3) is included in the Total column but not reported as a separate role column.

Formal education and training (Access to Knowledge & Information) were rated as a strong or very strong facilitator by 15% of respondents. Implementation was most commonly reported as champion-driven: 48% described rollout by individual champions, and local champions were more often rated as strong facilitators than formal management decisions (Implementation Leads 36% vs High-/Mid-level Leaders 21%). No respondent rated incentives or bonus schemes as a strong or very strong facilitator (Incentive Systems, 0%; Wilson 95% CI 0–10%). Likewise, no respondent rated implementation cost as a large or very large barrier (Innovation Cost, 0%; Wilson 95% CI 0–10%).

Barriers for implementation

No barrier domain was strongly endorsed (Table 4). At domain level, organisation and resources (Inner Setting, 16%) were reported somewhat more often as large or very large challenges than template characteristics (Innovation, 10%), while the highest individual construct was difficulty standardising and designing the templates (Innovation Design, 24%). The medical evidence base (Innovation Evidence Base, 6%) and implementation cost (Innovation Cost, 0%; Wilson 95% CI 0–10%) were infrequently or not endorsed as major barriers.

Table 4
Implementation barriers by professional role (n = 33 active users).

Barrier (CFIR domain / construct)	Total (n = 33)	General rad. (n = 18)	Abdominal rad. (n = 8)	Dept. head (n = 4)
Template characteristics (Innovation)	**10% (13/132) [6–16%]**	**8% (6/72) [4–17%]**	**19% (6/32) [9–35%]**	**6% (1/16) [1–28%]**
Difficulty standardising and designing the templates (Innovation Design)	24% (8) [13–41%]	28% (5) [12–51%]	38% (3) [14–69%]	0% (0) [0–49%]
Difficulty adapting to local needs (Innovation Adaptability)	9% (3) [3–24%]	6% (1) [1–26%]	25% (2) [7–59%]	0% (0) [0–49%]
Quality of the evidence for structured templates (Innovation Evidence Base)	6% (2) [2–20%]	0% (0) [0–18%]	12% (1) [2–47%]	25% (1) [5–70%]
High implementation costs (Innovation Cost)	0% (0) [0–10%]	0% (0) [0–18%]	0% (0) [0–32%]	0% (0) [0–49%]
Organisation and its resources (Inner Setting)	**16% (16/99) [10–25%]**	**15% (8/54) [8–27%]**	**21% (5/24) [9–40%]**	**17% (2/12) [5–45%]**
Competing priorities (Relative Priority)	21% (7) [11–38%]	17% (3) [6–39%]	25% (2) [7–59%]	25% (1) [5–70%]
Insufficient training and competence (Access to Knowledge & Information)	15% (5) [7–31%]	17% (3) [6–39%]	25% (2) [7–59%]	0% (0) [0–49%]
Technical and system-related deficiencies (IT Infrastructure)	12% (4) [5–27%]	11% (2) [3–33%]	12% (1) [2–47%]	25% (1) [5–70%]
Individuals and roles (Individuals)	**13% (17/132) [8–20%]**	**10% (7/72) [5–19%]**	**25% (8/32) [13–42%]**	**12% (2/16) [3–36%]**
Low user acceptance (Characteristics: Motivation)	21% (7) [11–38%]	17% (3) [6–39%]	38% (3) [14–69%]	25% (1) [5–70%]
Few people able to support implementation (Other Implementation Support)	18% (6) [9–34%]	17% (3) [6–39%]	25% (2) [7–59%]	25% (1) [5–70%]
Absence of strong local champions (Implementation Leads)	6% (2) [2–20%]	0% (0) [0–18%]	25% (2) [7–59%]	0% (0) [0–49%]

Proportion reporting 'Large / Very large challenge' with Wilson 95% CI. Aggregated domain-level values in bold. Domains in CFIR 2022 order. 'Other subspecialty' (n = 3) is included in the Total column but not reported as a separate role column.

Barrier (CFIR domain / construct)	Total (n = 33)	General rad. (n = 18)	Abdominal rad. (n = 8)	Dept. head (n = 4)
Template characteristics (Innovation)	**10% (13/132) [6–16%]**	**8% (6/72) [4–17%]**	**19% (6/32) [9–35%]**	**6% (1/16) [1–28%]**
Absence of organisational support from leadership (High-/Mid-level Leaders)	6% (2) [2–20%]	6% (1) [1–26%]	12% (1) [2–47%]	0% (0) [0–49%]

Proportion reporting 'Large / Very large challenge' with Wilson 95% CI. Aggregated domain-level values in bold. Domains in CFIR 2022 order. 'Other subspecialty' (n = 3) is included in the Total column but not reported as a separate role column.

The low domain-level figure for the Innovation domain conceals a marked role difference: abdominal radiologists rated the domain almost twice as high as the group (19% against 10%), driven by difficulties in standardising and designing the templates (38%) and adapting them locally (Innovation Adaptability, 25%).

Within the Individuals domain, the abdominal radiologists' 25% came mainly from low user acceptance (Characteristics: Motivation, 38% in this group) and an absence of strong local champions (Implementation Leads, 25%, against 0% for both other roles). A lack of personnel to support implementation was reported across roles (Other Implementation Support, 18% overall).

Within the Inner Setting domain, competing priorities ranked highest (Relative Priority, 21%). Department heads alone reported no training concerns (Access to Knowledge & Information, 0%) but the highest concern about IT Infrastructure (25%).

Taken together, abdominal radiologists emerged as the group reporting the highest barrier valence across all three domains (Innovation 19%, Inner Setting 21%, Individuals 25%), consistent with the role-dependent friction pattern described earlier. All role-level estimates rest on small subgroups (n = 4–18) with wide confidence intervals and should be read as tendencies.

Barriers and potential facilitators for non-users

Among the 16 respondents whose departments had not implemented reporting templates, the most prominent barriers were a lack of demand from referring physicians (Partnerships and Connections, 62%) and of local champions (Implementation Leads, 62%), followed by a lack of personnel able to support implementation (Other Implementation Support, 56%). The absence of a formal organisational decision was reported less often than the absence of champions (High-/Mid-level Leaders, 44% against 62%). At the aggregated domain level, the Innovation domain (29%) and the Inner Setting domain (36%) were rated lower than the Individuals domain (48%) and the Outer Setting domain (62%) (Additional file 4, Table S19).

Five constructs shared the highest rating as potential facilitators for a future implementation (69% each, [44–86%]): quality assurance and patient safety (Innovation Relative Advantage), demand from referring physicians (Partnerships and Connections), improved workflows (Compatibility), clear information and training initiatives (Access to Knowledge & Information), and increased user acceptance (Characteristics: Motivation). Economic incentives were rated lowest (Incentive Systems, 12%). The two biggest differences from the active users concerned training initiatives (69% versus 15%) and evidence of benefit (Innovation Evidence Base, 62% versus 24%). Adherence to guidelines diverged in the opposite direction (Policies and Laws, 44% versus 67%) (Table 2; Additional file 4, Table S20).

As a barrier to implementation, insufficient evidence of benefit (Innovation Evidence Base) was not endorsed by any of the four respondents planning to implement (0%), whereas the twelve respondents with no current plans endorsed it more often (42%). These figures should be read as weak indications rather than robust differences.

Perceived service outcomes

Clinical benefit and appropriateness were the strongest category (Service Effectiveness, 91% improved against 2% worsened) (Table 5), with standardisation of reports showing the highest single proportion in the dataset (97%) and completeness, clarity and guideline adherence following (91%, 91% and 85%). The pattern held across professional roles (88–92%).

Table 5
Perceived service outcomes (n = 33 active users).

Outcome category and variable (Proctor)	Improved / Strongly improved	Unchanged	Worsened / Strongly worsened
Clinical benefit and appropriateness (Service Effectiveness)	**91% (120/132) [85–95%]**	**7% (9/132) [4–12%]**	**2% (3/132) [1–6%]**
Standardisation of reports	97% (32) [85–99%]	3% (1) [1–15%]	0% (0) [0–10%]
Completeness of reports	91% (30) [76–97%]	3% (1) [1–15%]	6% (2) [2–20%]
Clarity of reports	91% (30) [76–97%]	6% (2) [2–20%]	3% (1) [1–15%]
Adherence to national guidelines	85% (28) [69–93%]	15% (5) [7–31%]	0% (0) [0–10%]
Resource efficiency and workflow (Service Efficiency)	**44% (58/132) [36–52%]**	**37% (49/132) [29–46%]**	**19% (25/132) [13–26%]**
Communication with referring physicians	70% (23) [53–83%]	27% (9) [15–44%]	3% (1) [1–15%]
Length of reports	45% (15) [30–62%]	33% (11) [20–50%]	21% (7) [11–38%]
Reporting/review time	36% (12) [22–53%]	42% (14) [27–59%]	21% (7) [11–38%]
Perceived workload	24% (8) [13–41%]	45% (15) [30–62%]	30% (10) [17–47%]
Patient safety (Service Safety)	**45% (15/33) [30–62%]**	**55% (18/33) [38–70%]**	**0% (0/33) [0–10%]**
Radiological misinterpretations	45% (15) [30–62%]	55% (18) [38–70%]	0% (0) [0–10%]
Learning organisation (Organisational Effectiveness)	**59% (39/66) [47–70%]**	**36% (24/66) [26–48%]**	**5% (3/66) [2–13%]**
Education and supervision	67% (22) [50–80%]	24% (8) [13–41%]	9% (3) [3–24%]
Service follow-up and research	52% (17) [35–67%]	48% (16) [33–65%]	0% (0) [0–10%]

Bipolar scale with Wilson 95% CI. Aggregated category-level values in bold. Organisational Effectiveness is a study-specific category and is not part of Proctor's original taxonomy.

Resource efficiency and workflow was the weakest category (Service Efficiency, 44% improved, 19% worsened) and the one with the largest share of non-positive responses (56%). Perceived workload was

the only construct in which deterioration (30%) exceeded improvement (24%), followed by review time and report length (both 21% worsened), while communication with referring physicians moved in the opposite direction (70% improved). By professional role (Additional file 4, Table S14), abdominal radiologists reported the most workflow concern (31% worsened against 14% of general radiologists), and department heads the lowest improvement of any group (12%, with 69% perceiving no change).

No respondent perceived a deterioration in radiological misinterpretations (Service Safety, 0% worsened [0–10%]), with the remainder divided between improvement (45%) and no change (55%). Department heads perceived an improvement more often (75%) than the radiologist groups (38–39%), although with only four respondents this is a weak indication.

Organisational Effectiveness was the second most improved category (59% improved, 36% unchanged, 5% worsened), primarily for education and supervision (67%) but also for service follow-up and research (52%). Abdominal radiologists reported the highest improvement (88%), compared with 47% of general radiologists and 25% of department heads, and were the only group to report no deterioration.

Ten respondents commented on other perceived effects. Two themes recurred: that templates, being dichotomous by design, make diagnostic uncertainty and modifying factors harder to convey, and that their checklist structure provides cognitive support against missed findings. Two further themes concerned the clinical relevance of mandatory parameters and the untapped potential for transferring structured data to downstream systems such as quality registries.

Perceived implementation outcomes

The templates were considered highly appropriate for their intended use (Appropriateness, 82%) and adoption was high (Adoption, 79%), whereas satisfaction among radiologists was lower (Acceptability, 64%) (Table 6). Usability in everyday work showed a similar split (Feasibility, 70% high or very high, but 12% low or very low).

Table 6
Implementation outcomes (n = 33 active users).

Implementation outcome (mapped to Proctor)	High / Very high	Neutral	Low / Very low
Appropriateness for the intended use (Appropriateness)	82% (27) [66–91%]	12% (4) [5–27%]	6% (2) [2–20%]
Adoption of the templates at the clinic (Adoption)	79% (26) [62–89%]	15% (5) [7–31%]	6% (2) [2–20%]
Fidelity to the template without altering its content (Fidelity)	73% (24) [56–85%]	18% (6) [9–34%]	9% (3) [3–24%]
Integration of the templates into routine practice (Penetration)	73% (24) [56–85%]	21% (7) [11–38%]	6% (2) [2–20%]
Feasibility of the templates in the workflow (Feasibility)	70% (23) [53–83%]	18% (6) [9–34%]	12% (4) [5–27%]
Satisfaction among radiologists (Acceptability)	64% (21) [47–78%]	27% (9) [15–44%]	9% (3) [3–24%]
Continued engagement and sustainment of the templates (Sustainability)	39% (13) [25–56%]	48% (16) [33–65%]	12% (4) [5–27%]

Proportions with Wilson 95% CI, sorted by descending 'High / Very high'.

The most notable finding is that only 39% reported high continued engagement in maintaining the templates (Sustainability). Most respondents were neutral in this respect (48%), while 12% rated continued sustainment as low or very low.

Broken down by professional role (Additional file 4, Table S16), general radiologists reported high figures for both Adoption (89%) and Appropriateness (89%), whereas the corresponding figures for abdominal radiologists were 50% and 62%. Across most outcomes, positive ratings were lower for abdominal radiologists than for general radiologists, and the proportion of negative (Low / Very low) ratings was correspondingly higher, around 25% on most outcomes for the abdominal group, compared with 0–11% for general radiologists. One outcome reversed this pattern: continued engagement and sustainment (Sustainability) was rated higher by abdominal radiologists (62%) than by general radiologists (33%).

Fidelity to the template (Fidelity) and integration into practice (Penetration) were both rated high (73% each). Unlike the remaining outcomes, department heads gave these outcomes the highest ratings of any professional role (100%).

Discussion

This study explored the determinants and outcomes shaping the implementation of structured reporting templates for oncological imaging in Sweden. Three key patterns emerged along the pathway from determinants to outcomes: Champion-Driven Diffusion, Standardisation–Complexity Mismatch, and

Adoption–Sustainment Gap. Patterns varied descriptively by professional role, but subgroup estimates were imprecise and were not tested inferentially.

Champion-Driven Diffusion

The implementations followed a bottom-up logic that could be seen across several survey questions. Respondents reported that nearly half of the implementations were driven by local champions (48%), and among the facilitators strong, local champions was rated higher (Implementation Leads, 36%) than formal management decisions (High-/Mid-level Leaders, 21%). This aligns with the role attributed to local champions in Rogers' Diffusion of Innovations theory [36]. The corresponding barriers appear to point towards organisational factors (Inner Setting, 16%) and the people within them (Individuals, 13%) rather than towards the innovation itself (Innovation, 10%), which strengthens the perception that the templates themselves are not the critical determinant of implementation.

No respondent rated incentives as a strong facilitator or implementation cost as a major barrier (both 0% [0–10%]) – an observed pattern of low endorsement, not proof that economic factors are irrelevant. In a tax-financed, public healthcare setting such as Sweden's, economic factors appear to act as neither a stick nor a carrot [37, 38], which raises the question of whether implementation strategies developed in market-based healthcare environments are transferable to a context like this.

The non-users mirror this pattern. Their two most frequently reported barriers were a lack of demand from referring physicians and an absence of strong local champions (both 62%), and the absence of a formal organisational decision ranked below the absence of champions (44% against 62%), the same ordering seen among active users on the facilitator side. External demand and local champions may therefore be the triggers for implementation, a hypothesis that only prospective work can test.

Standardisation–Complexity Mismatch

Another core finding was the tension between high perceived clinical value and adverse workflow effects for a minority. The templates were perceived to deliver high clinical benefit and appropriateness (Service Effectiveness, 91%), most strongly for standardisation of reports (97%). Resource efficiency and workflow was the weakest category (Service Efficiency, 44% improved, 19% worsened), and perceived workload was the only measure where degradation (30%) exceeded improvement (24%), while communication with referring clinicians stood out in the opposite direction (70% improvement).

The friction was not evenly distributed across radiologists. The positive ratings were similar across the board (Service Effectiveness, 88–92%), but the abdominal radiologists reported higher workflow degradation (31%) than the general radiologists (14%). The abdominal radiologists also reported the highest learning effect (Organisational Effectiveness, 88% against 47% for general radiologists) and were the only group reporting no deterioration. However, this co-occurrence should not be interpreted as a causal trade-off. On the determinant side, the abdominal radiologists rated the innovation as a barrier twice as often as the group (Innovation, 19% compared with 10%). This appears to be driven by

difficulties in standardising and designing the templates (Innovation Design, 38%) and in making local adaptations (Innovation Adaptability, 25%), compared with the general radiologists (28% and 6% respectively).

Standardised templates with a fixed structure appear to cut both ways: valued for producing more uniform reporting across radiologists (Innovation Design, 61%), but a source of friction when cases are complex and demand flexibility and nuance. Distinguishing between the function of an innovation and the form it takes locally has been proposed as a way to resolve this tension, standardising what the intervention is meant to achieve while allowing its expression to vary with context [39]. The friction may fall on the local form of the template rather than on its intended function. This mechanism was hypothesised and not measured directly, although it is triangulated by the free-text responses, in which "diagnostic nuance" was a recurring theme.

The friction described appears to be restricted to workflow and not to patient safety; there was no perceived increase in radiological misinterpretations (Service Safety, 0% worsening, 45% improvement, and 55% unchanged). The reported mismatch concerns perceived efficiency rather than perceived effectiveness or safety. Whether this trade-off is acceptable requires prospective evaluation and stakeholder judgement.

Adoption–Sustainment Gap

Further along the pathway, another gap emerges, between adopting the templates and maintaining them over time. The templates themselves were considered fit for purpose (Appropriateness, 82%) and showed high adoption at the departments (Adoption, 79%), but the continued commitment was lower (Sustainability, 39%). The predominance of neutral rather than negative ratings suggests uncertainty or limited commitment rather than active rejection. Formal organisational ownership was not measured directly.

Apart from Sustainability, the lowest proportion of positive ratings concerned satisfaction (Acceptability, 64%), and Feasibility and Sustainability carried the highest proportion of low ratings (12% each). The gap thus separates how the templates are judged and adopted, where positive ratings are high and negative ratings low (Appropriateness and Adoption), from the ongoing experience of using them (Feasibility, Acceptability and Sustainability). It appears that it is not the template as a tool that falters, but the organisational context that must carry it over time.

The coexistence of champion-driven implementation and lower sustainability ratings suggests a possible relationship, but a cross-sectional design cannot show that reliance on champions produced the sustainment gap. A dependence on the local champion as the driving force is powerful as a catalyst for getting implementation started, but it can leave continued engagement and sustainment vulnerable and dependent on individuals [40–42]. A related observation is that Sustainability was the only outcome where the abdominal subspecialists rated higher than the general radiologists (62% compared with 33%), even though they were the group experiencing the most workflow friction. An interpretation is therefore

that the abdominal radiologists hold a greater self-interest in templates designed by and for their own domain of expertise. This role difference rests on a very small subgroup (n = 8) and should be read as a tendency.

A separate role-related observation concerns the department heads, whose ratings were not uniformly more positive or negative than the radiologists', but systematically different: the leaders more often perceived improved patient safety (Service Safety, 75% versus 38–39%) yet reported the lowest workflow gains of any group (Service Efficiency, 12% improved, 69% unchanged) and rated both integration into routine practice (Penetration) and adherence to the templates (Fidelity) at 100%, whereas the radiologists were at 50–72%. A possible interpretation is that the leadership level perceives the implementation as completed once adopted rather than as a process requiring continuous maintenance, which would also account for the passive stance on sustainment, where 75% of the leaders' responses were neutral. These interpretations rest on four respondents and are hypotheses rather than measured mechanisms.

Implications for practice: from CFIR determinants to ERIC strategies

By mapping the identified determinants and outcomes to the ERIC compilation [31], we identify a set of complementary implementation strategies, addressing what was missing rather than replacing what worked.

For the identified determinants, where champions rather than formal mandates were the driving forces, the findings point to strategies that strengthen and prepare local champions (ERIC, "Identify and prepare champions") and build coalitions with key stakeholders (ERIC, "Build a coalition"), rather than to economically oriented strategies (e.g. ERIC, "Alter incentive/allowance structures" or "Develop disincentives").

To combat the unevenly distributed increase in workflow friction, the findings point towards greater adaptability, without compromising the intended purpose of the templates (ERIC, "Promote adaptability"), particularly for the subspecialists, so that more nuances can be accommodated in complex cases.

To address the hypothesised ownership gap associated with reliance on specific individuals, the findings support strategies that transfer responsibility for long-term sustainment from individual champions to organisational structures. These include securing formal commitments from stakeholders expected to carry the templates over time (ERIC, "Obtain formal commitments"), involving executive leadership in organisational ownership (ERIC, "Involve executive boards"), and using audit and feedback to make workflow friction visible across roles (ERIC, "Audit and provide feedback").

Notably, ERIC appears comparatively thin on strategies for upholding an innovation over time [43]. Consequently, the determinant observations made in this study have no self-evident one-to-one mapping to any single strategy and instead require a combination of them. This emphasises the need for a more developed strategic vocabulary for the sustainment phase of implementation than is currently available.

This mapping between determinants, outcomes and ERIC strategies is derived rather than tested: the study describes associations between determinants and outcomes but only infers that a given strategy might address them. The strategies are therefore hypotheses to test in a future prospective study and form the basis for the determinant-to-strategy pathways (Fig. 3).

Strengths and limitations

To our knowledge, this is the first implementation science-based assessment of structured reporting templates in the Swedish radiology context. Two theoretical frameworks were applied in conjunction, enabling determinants and outcomes to be distinguished conceptually, complemented by ERIC for mapping potential strategies. Uncertainty is reported consistently using Wilson confidence intervals, and all analytical decisions are documented in an analytical audit trail.

The most fundamental limitation is the sample size. Fifty individuals responded, and the determinant and outcome analyses rest on 33 active users, with smaller subgroups still for the subspecialists (n = 8) and the department heads (n = 4). Confidence intervals are correspondingly wide, and all role-based differences should be regarded as tendencies rather than tested differences. The department-head category is also heterogeneous: it was coded by organisational function, yet some of these respondents also reported reading colorectal examinations, which limits how differences between department heads and radiologists can be interpreted. Because the target population is not registry-defined, its size cannot be determined, and no response rate is reported. Responses were anonymous, so respondents from the same department could not be identified and no clustering could be accounted for.

As a cross-sectional survey, the study cannot establish cause-and-effect relationships over time, which is particularly relevant for the Adoption–Sustainment Gap, since sustainment was not measured longitudinally. All data are self-reported perceptions rather than objective measurements and carry a risk of self-selection bias in which engaged respondents and local advocates may be overrepresented, skewing the results towards a more positive view of the innovation.

A further limitation concerns the survey instrument. As noted in the Methods, the two branch-specific batteries did not cover identical constructs. On the facilitator side those presented to active users formed a subset of those presented to non-users, so every facilitator rated by active users could be compared across branches. On the barrier side the overlap was partial: Innovation Design was presented only to active users, and Partnerships and Connections, Compatibility and Incentive Systems only to non-users. Cross-branch comparisons are therefore restricted to constructs measured in both branches.

Downstream effects on referring clinicians, the MDT and patients were not measured and warrant a follow-up study.

The close relationship between professional role and hospital type motivated the choice of professional role as the primary moderator, but it also means that the independent significance of hospital type cannot be determined. The results apply within the Swedish publicly financed healthcare context and

should be read as hypothesis-generating material for future research rather than as a claim to general validity.

Conclusions

This national cross-sectional survey suggests that structured reporting templates for oncological imaging were perceived to deliver high clinical effectiveness while creating workflow costs for a minority. Implementation was most commonly champion-driven, with local champions rated as stronger facilitators than formal management. No respondent rated incentives as a strong facilitator or implementation cost as a major barrier, though absence of an effect cannot be inferred from this sample. High adoption among active users was not matched by continued engagement and sustainment. These patterns support, but do not test, the hypothesis that sustained implementation may require workflow adaptation and formal organisational ownership alongside local champions. Given the small, self-selected, cross-sectional sample, the findings and proposed ERIC strategies should be regarded as hypothesis-generating.

Abbreviations

CFIR
Consolidated Framework for Implementation Research
CI
Confidence interval
CPD
Causal pathway diagram
CRC
Colorectal cancer
EBI
Evidence-based innovation
ERIC
Expert Recommendations for Implementing Change
IOF
Implementation Outcomes Framework
IT
Information technology
MDT
Multidisciplinary team
SFGAR
Swedish Society of Gastrointestinal and Abdominal Radiology
SFMR
Swedish Society of Medical Radiology
StaRI

Standards for Reporting Implementation Studies
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Swedish Ethical Review Authority (reference number 2025-00754-02). To preserve anonymity, survey responses contained no identifying information, and respondents answered at the level of their clinical workplace and professional role rather than as named individuals. A final optional item invited contact details for a possible follow-up interview, and these were not used in any analysis. The purpose of the study was clearly presented to participants in conjunction with survey distribution and, as participation was entirely anonymous, no formal written informed consent was obtained. Completion and submission of the survey were considered to constitute implied consent to participate.

Consent for publication

Not applicable. The manuscript contains no individual person's identifiable data.

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Author Contribution

GA conceived and designed the study, developed the survey instrument, collected and analysed the data, and drafted the manuscript. PA, LN and NS contributed to the study design and to the interpretation of the results and revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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with structured reporting templates, this study would not have been possible.This work forms part of the doctoral thesis of GA at Karolinska Institutet.

Data Availability

The dataset with complete survey responses is available from the corresponding author on reasonable request. The extended methods (Additional file 1), the survey instrument (Additional file 2), the analytical audit trail (Additional file 3), the complete set of tables (Additional file 4) and the completed STROBE checklist (Additional file 5) are provided with this article.

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Figures

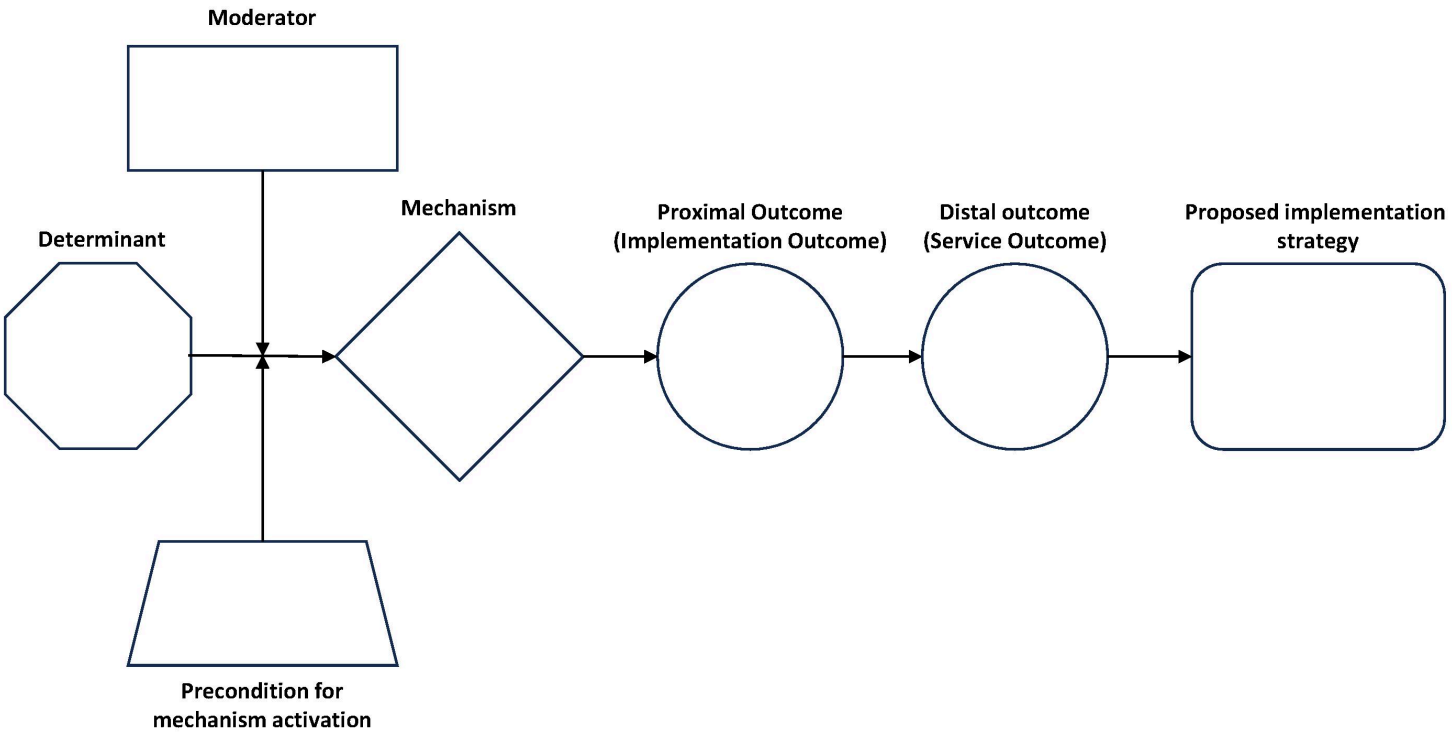


Figure 1

Determinant-to-strategy pathway diagram template.

Generic template for the retrospective, determinant-centred causal pathway diagrams used in this study. Each pathway runs from an empirically observed CFIR determinant (octagon), through a hypothesised mechanism (diamond), to a proximal implementation outcome and a distal service outcome (circles) and terminates in a proposed ERIC implementation strategy (rounded box). A moderator (rectangle, above the pathway) and a precondition for mechanism activation (trapezoid, below) may act on the determinant-to-mechanism link. The template is instantiated for each core finding in Fig. 3.

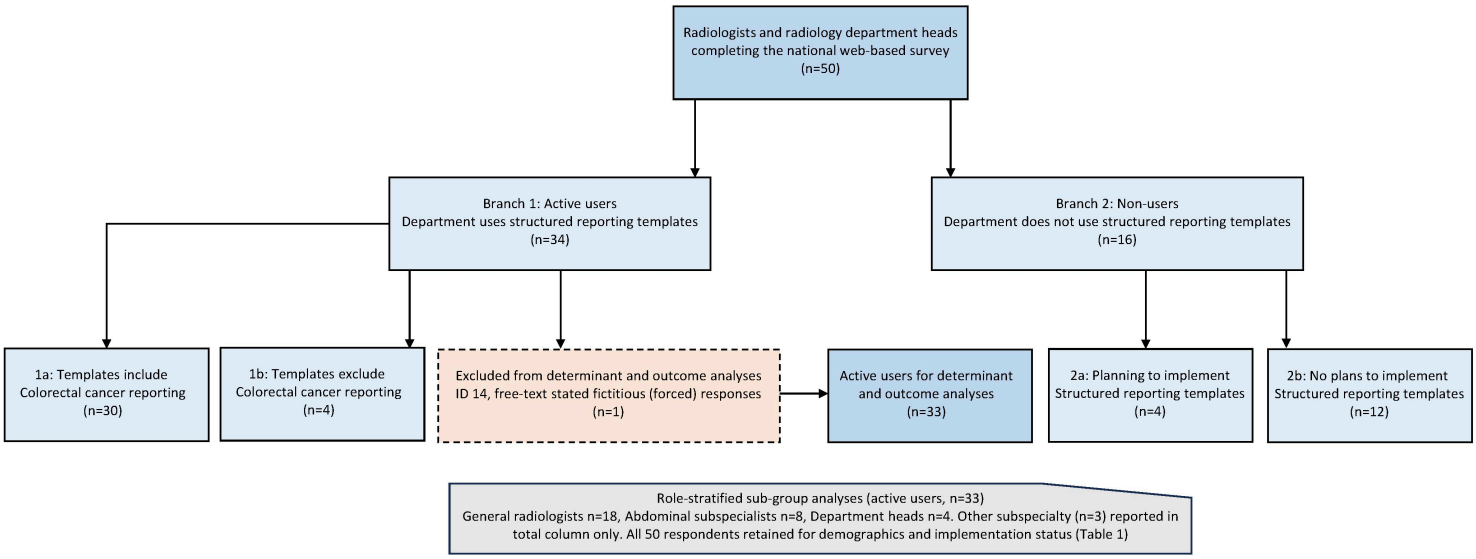


Figure 2

Participant flow through the survey branching logic (n=50).

All 50 respondents completed the national web-based survey and were routed by a single branching question into Branch 1 (active users, whose department uses structured reporting templates; n=34) or Branch 2 (non-users; n=16). Branch 1 was subdivided into departments whose templates include (1a, n=30) or exclude (1b, n=4) colorectal cancer reporting, and Branch 2 into departments planning to implement (2a, n=4) or with no plans to implement (2b, n=12). The dashed box marks one active user (ID 14) excluded from the determinant and outcome analyses for stating in free text that fictitious (forced) responses had been entered, giving an analytical population of n=33. Role-stratified subgroup analyses used general radiologists (n=18), abdominal radiologists (n=8) and department heads (n=4); the "Other subspecialty" group (n=3) was retained in the total column only. All 50 respondents were retained for the demographic and implementation-status reporting (Table 1).

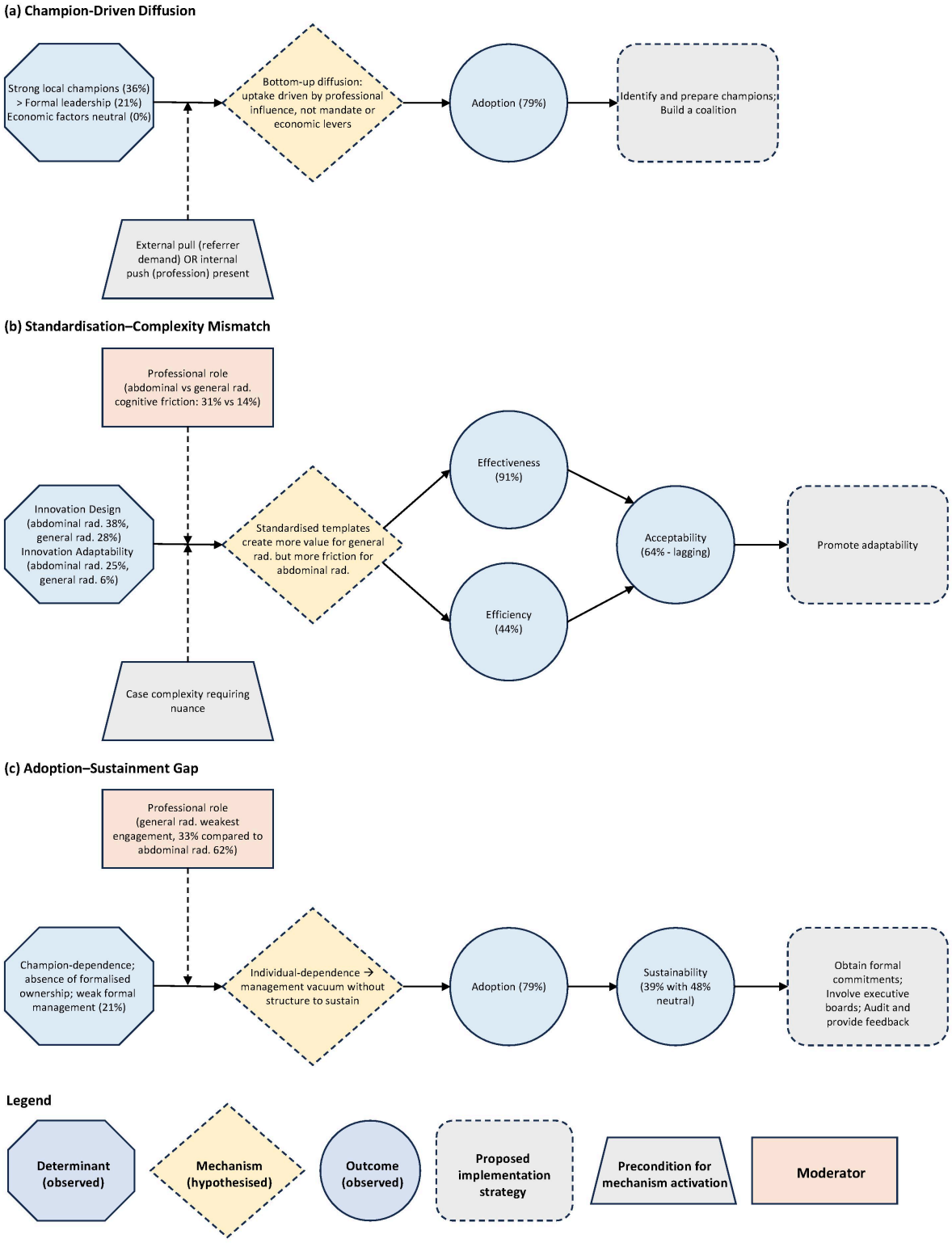


Figure 3

(a–c) Determinant-to-strategy pathways for the three core findings.

The three panels show (a) Champion-Driven Diffusion, (b) Standardisation–Complexity Mismatch, and (c) Adoption–Sustainment Gap. Each panel maps one finding from an observed CFIR determinant, through a hypothesised mechanism (optionally shaped by a moderator above the pathway or a

precondition below), to observed Proctor outcomes and a proposed ERIC strategy; node shapes are defined in the key. Solid nodes are based on observed survey measures; dashed nodes are inferred rather than measured. Moderators and preconditions vary between pathways and are omitted where none was clearly supported (no moderator in a; no precondition in c). The pathways are read retrospectively and are determinant-centred, and the strategy nodes are candidates for future testing, not evaluated effects. Role-related nodes rest on small subgroups (abdominal radiologists n=8, general radiologists n=18) and should be read as tendencies rather than established differences.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1Extendedmethods.docx
- Additionalfile2SurveyquestionsanditemsEN.docx
- Additionalfile3Analyticalaudittrail.docx
- Additionalfile5STROBEchecklist.docx
- Additionalfile4Completesetoftables.xlsx