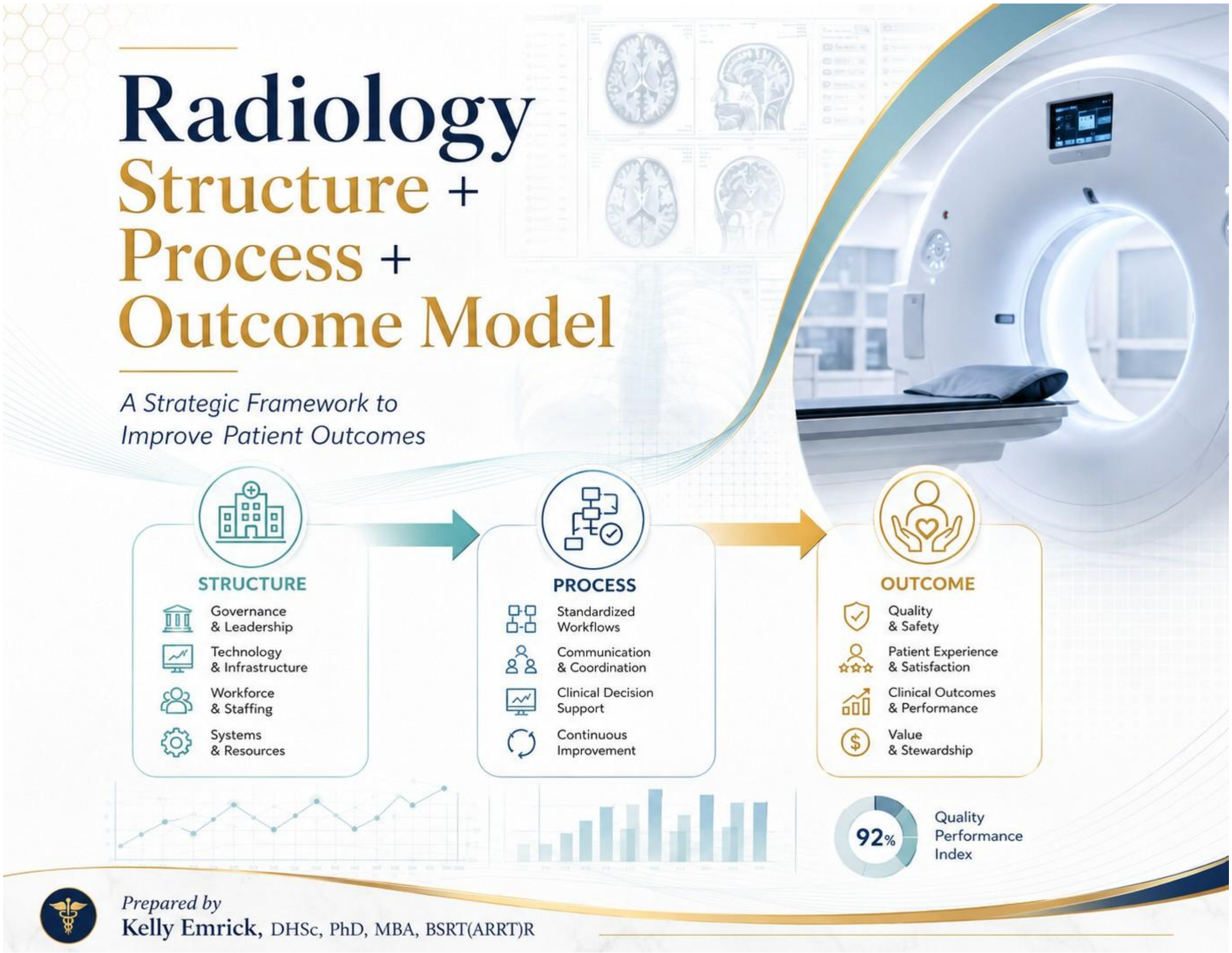
RADIOLOGY QUALITY & OUTCOMES



The Radiology Structure-Process-Outcome (SPO) Model

A Framework for Improving Diagnostic Quality, Timeliness, Safety, Patient Understanding, and Pathway-Level Clinical Outcomes

From operational capability to patient value

A practical enterprise model that connects staffing, safety, clinical workflow, communication, and disease-specific outcomes in a single governance architecture.

Prepared for	Radiology executive leadership, medical directors, operational leaders, and quality governance teams
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Research basis	Peer-reviewed literature and professional guidance synthesis current through June 2026

Purpose of this report

This report translates the Donabedian Structure-Process-Outcome model into an actionable radiology performance architecture. It is designed to guide leadership decisions, dashboard construction, clinical audit, and staged operational deployment. It is not a substitute for local clinical policy, legal review, accreditation requirements, or regulatory consultation.

Executive Summary

Radiology increasingly operates at the intersection of diagnostic medicine, operational throughput, patient safety, digital communication, and therapeutic decision-making. Nevertheless, many radiology performance systems continue to overweight volume, report turnaround time, and budget variance while undermeasuring the department's contribution to diagnostic accuracy, clinical action, patient comprehension, and pathway-level outcomes. The Structure-Process-Outcome (SPO) model provides a disciplined remedy. In the Donabedian tradition, structure defines the resources and organizational conditions that enable reliable care; process describes what the department does; and outcomes reflect what patients and care teams experience as a result (Donabedian, 1988; Agency for Healthcare Research and Quality [AHRQ], n.d.).

Applied to radiology, the central proposition is straightforward: scanner capacity, staffing, accreditation, interoperability, governance, and subspecialty alignment do not matter merely because they are organizational assets. They matter because they enable more appropriate ordering, safer imaging, faster and clearer reporting, reliable closed-loop communication, and ultimately better diagnostic and treatment decisions. The model therefore rejects a productivity-only frame and instead organizes performance around an evidence-linked causal chain from capability to execution to patient value.

Core conclusion

The most defensible radiology quality strategy is a layered scorecard: a small set of universal structure and process measures for the whole department, paired with pathway-specific outcomes where radiology has a plausible and measurable influence on treatment timing, diagnosis, safety, or patient experience.

Executive Finding	Management Implication
1. Outcome measurement must be pathway-specific	Generic outcomes, such as mortality or hospital-wide readmissions, are often too distal and confounded to be attributed to radiology. Stronger outcome measures link imaging to defined pathways such as stroke, breast imaging, oncology review, actionable incidental findings, or interventional radiology.
2. Communication is a high-value process domain	Critical and actionable result communication is one of the clearest pathways from radiology process reliability to diagnostic safety. Closed-loop designs should document notification, acknowledgment, escalation, and completion of the intended follow-up.
3. Timeliness is necessary but insufficient	Report turnaround time and access metrics should be stratified by care setting and paired with balancing measures such as clinically meaningful discrepancy rates, follow-up completion, and patient experience.
4. Data architecture is a strategic capability	EHR-RIS-PACS integration, structured reporting, dose monitoring, and auditable notification workflows transform quality measurement from a manual retrospective audit into a continuously learning operating system.
5. First-year deployment should be disciplined	The recommended first-year portfolio emphasizes six universal KPIs and four pathway-level measures, with governance, baseline validation, and monthly review before attempting broad outcome attribution.

This report proposes an 18-month implementation sequence. The first phase establishes governance, indicator definitions, data mapping, and baselines. The second builds high-reliability processes around critical result communication and report turnaround time. The third deploys appropriateness support, dose monitoring, and structured reporting in selected high-impact workflows. The final phases integrate pathway outcomes, risk, and equity stratification, and a formal evaluation of whether structural and process changes produced measurable patient benefit.

Report Navigation

1. Conceptual Foundation and Model Design

The SPO framework is derived from Donabedian's model of healthcare quality, which distinguishes structural capacity, care processes, and outcomes. The framework remains especially useful in radiology because imaging's clinical impact is often mediated through multiple handoffs: an order must be appropriate; the exam must be accessible and technically adequate; the interpretation must be accurate and timely; important findings must reach the responsible clinician or patient; and the resulting information must alter diagnosis, treatment, surveillance, or reassurance. A failure at any stage can diminish patient value even when image quality is excellent.

Radiology quality literature has long noted an imbalance toward structural indicators. Narayan et al. (2015) found that reported radiology quality measures were more commonly structural than process or outcome measures. That imbalance is understandable because structural measures are accessible, auditable, and familiar to accreditation systems. However, it creates a management risk: a department can appear compliant and technically capable while still experiencing delays, communication failures, missed follow-up, avoidable variation, or poor patient understanding. A modern SPO framework corrects this by treating structural measures as enablers rather than endpoints.

Methodologically, this report is an evidence-informed framework rather than a systematic review or meta-analysis. It synthesizes peer-reviewed radiology, emergency, stroke, communication, and patient-centered reporting literature with current professional guidance from the American College of Radiology (ACR), European Society of Radiology (ESR), Canadian Association of Radiologists (CAR), The Joint Commission, and related quality programs. The model prioritizes measures with clear definitions, feasible data sources, and plausible links to patient outcomes.

Design principle

Every KPI must answer three questions: (1) What element of care is being measured? (2) What decision or action will the measure inform? (3) What outcome or balancing measure will test whether the improvement helped rather than merely shifted the problem elsewhere?

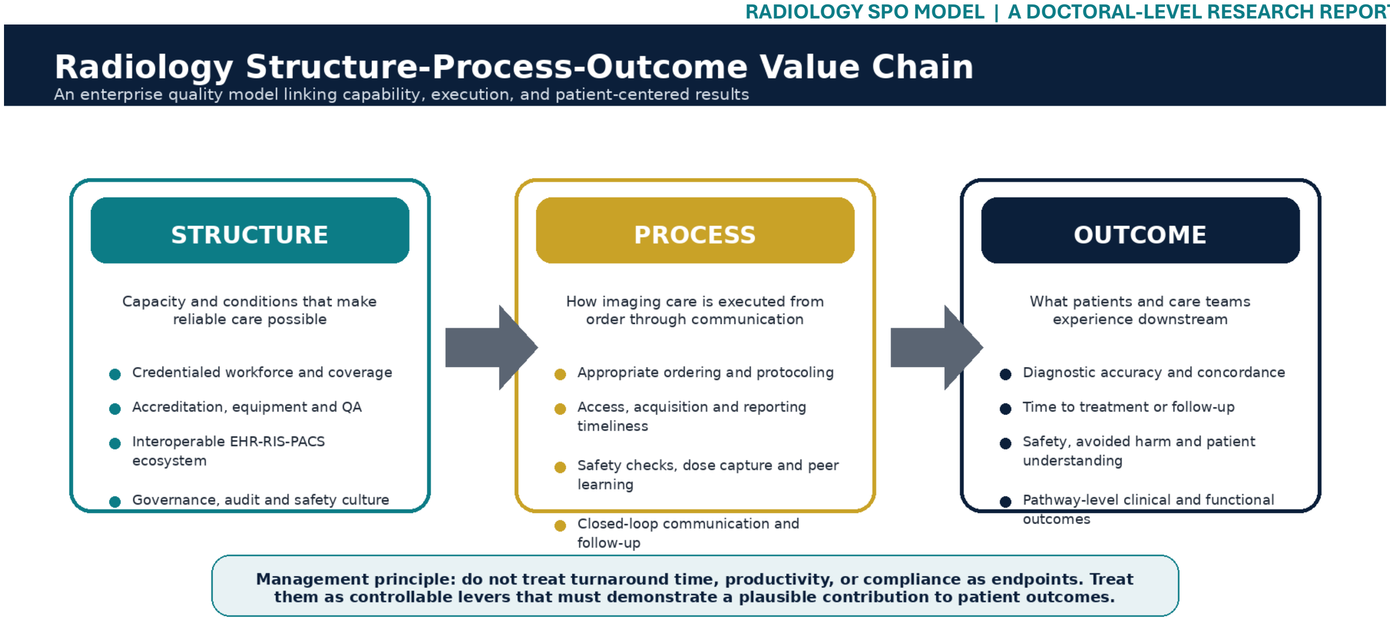

Figure 1. Radiology Structure-Process-Outcome Value Chain. The model treats structure as the capacity to deliver care, process as the execution of imaging work, and outcomes as the patient- and pathway-level consequences of that work.

2. The Radiology SPO Value Chain

The radiology SPO model is best understood as a value chain rather than as three disconnected columns. Structure shapes what the organization can reliably do. Process reveals whether those capabilities are consistently translated into clinically useful imaging care. Outcomes test whether the department's work changed something that matters: diagnostic accuracy, time to treatment, avoidable harm, patient understanding, or disease-specific clinical results. The causal connection is not perfectly linear. External factors such as referring-clinician behavior, bed capacity, payer authorization, patient preference, and downstream treatment availability influence outcomes. Nonetheless, the SPO chain provides a transparent hypothesis of how improvement should occur.

This approach has direct consequences for dashboard design. A report-turnaround dashboard without discrepancy monitoring can incentivize speed at the expense of deliberation. A radiation-dose dashboard without image-quality review can reward underexposure. An appropriateness dashboard without access monitoring can reduce orders but unintentionally worsen delays. A robust SPO scorecard, therefore, pairs each primary measure with a balancing measure and, where possible, an outcome measure. That analytic discipline is central to avoiding metric gaming and misinterpretation.

3. Structure Domain: Capacity, Governance, and Digital Infrastructure

The structural domain captures whether the department possesses the prerequisites for reliable, safe, and clinically responsive imaging. It includes workforce composition, credentialing, equipment capability, accreditation, information-system interoperability, service coverage, quality governance, and an organizational culture that supports peer learning and corrective action. While no single universal staffing ratio can be prescribed across modalities and sites, a radiology SPO model should measure capacity relative to demand by modality, care setting, daypart, and case complexity.

Structural Element	Operational Definition	Primary Data Sources	Why It Matters
Workforce capacity and coverage	Radiologist and technologist FTE relative to demand; vacancy rate; after-hours attending coverage; subspecialty assignment for high-risk cases.	HRIS; scheduling; PACS/RIS volumes; worklists.	Excess workload and fatigue can degrade diagnostic performance; extended attending coverage has been associated with materially shorter TATs for emergency CT reports (Jalal et al., 2021; Stec et al., 2018).
Equipment and protocol capability	Modality uptime; preventive maintenance; protocol availability; image-quality QC pass rate; technologist competency.	Vendor service data, physics reports, PACS metadata.	Reliability reduces repeat exams, delays, and variation; dose monitoring reveals outlier protocols and wrong-protocol use.
Accreditation and clinical audit maturity	Current modality accreditation, regulatory compliance, peer learning, audit calendar, and corrective-action closure.	Accreditation files, committee minutes, and peer-learning platform.	Accreditation and audit create a formal mechanism for image quality, personnel qualifications, safety, and continuous improvement.
Digital interoperability	Integration of EHR, CPOE, RIS, PACS, reporting, dose monitoring, and follow-up/notification tools.	Interface logs; EHR audit trails; architecture inventory.	Closed-loop programs require auditable notification and follow-up capability (Schwartz et al., 2021).
Governance and leadership	Named quality owners, multidisciplinary council, executive sponsor, escalation pathways, and resource allocation process.	Charters; dashboards; corrective-action logs.	Sustains improvement beyond one-time projects and makes ownership visible.

A notable structural issue is cognitive capacity. Radiologist fatigue and burnout are not merely workforce satisfaction concerns; they are patient-safety concerns. Systematic reviews describe fatigue as present in radiology and potentially associated with diminished diagnostic performance (Stec et al., 2018). Therefore, coverage adequacy should not be reduced to vacancy counts alone. The SPO model recommends monitoring worklist volatility, studies per staffed hour, overnight burden, high-complexity case mix, and delay accumulation by shift, while retaining human review of whether the workload design is clinically sustainable.

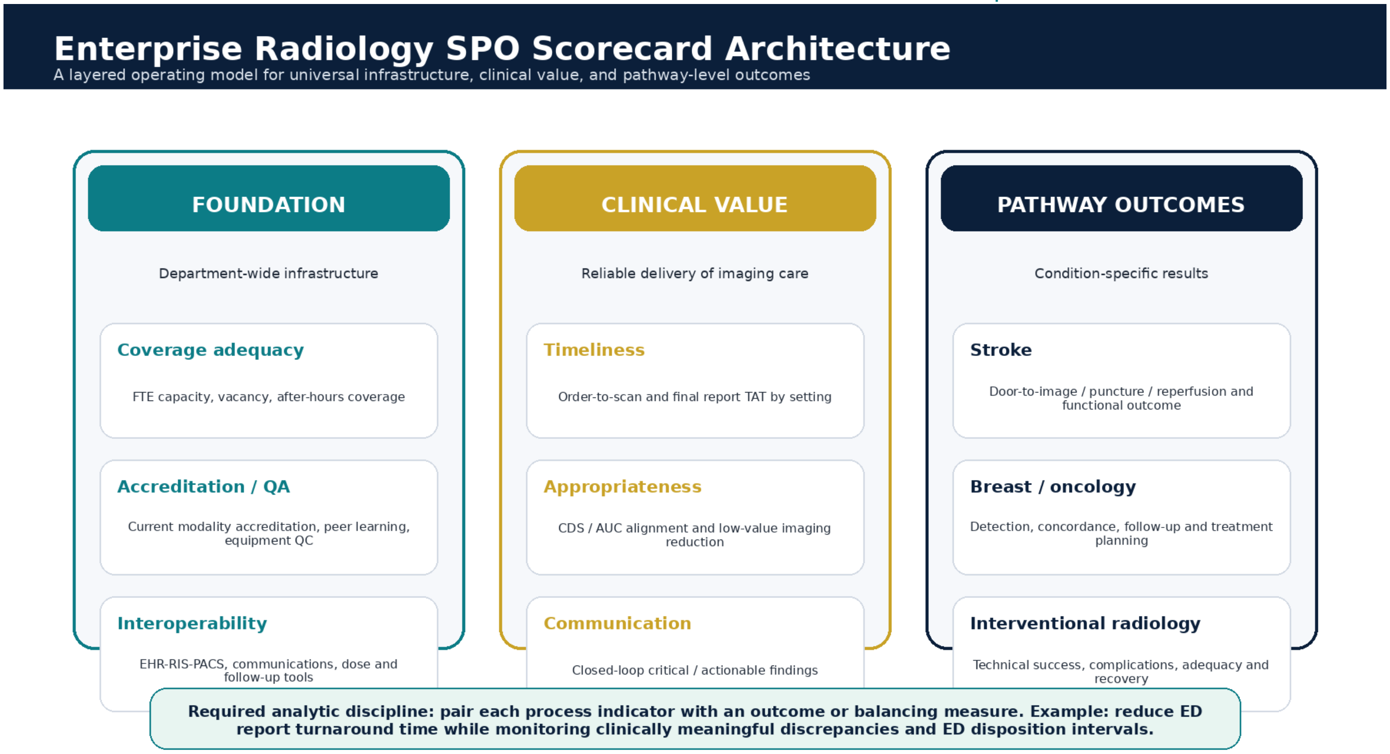

Figure 2. Enterprise Radiology Scorecard Architecture. The proposed scorecard separates universal infrastructure and process reliability from pathway-specific outcomes.

4. Process Domain: Appropriate, Safe, Timely, and Communicative Imaging

Process measures represent the operational behavior of the imaging system. They are typically more actionable than outcomes because the department can redesign them directly. The most important process domains are appropriateness, access, protocoling, acquisition quality, safety checks, reporting timeliness, structured reporting, communication, and completion of recommended follow-up. These processes should be measured with timestamp-based data whenever possible, reserving manual audit for validation and nuanced quality review.

Process Domain	Operational Definition	Evidence / Management Link
Appropriateness and decision support	Percent of advanced imaging orders rated usually appropriate; frequency of targeted low-value exams; CDS use and override patterns.	ACR Appropriateness Criteria and CDS are intended to support the right test at the right time. A randomized trial found a 6% reduction in targeted high-cost imaging orders with CDS (Doyle et al., 2019).
Access and order-to-scan timeliness	Order-to-schedule; order-to-completion; cancellation/no-show; protocoling delay; site-level availability.	For acute stroke, door-to-imaging interval standards provide a well-established example of a pathway. For routine care, stratify wait times by modality, urgency, site, payer, and patient characteristics.
Reporting turnaround time	Completion-to-preliminary and completion-to-final report time, measured by setting, acuity, modality, daypart, and percentile distribution.	TAT is a process measure, not an outcome by itself. Use with discrepancy, clinician satisfaction, and downstream treatment timing.

Process Domain	Operational Definition	Evidence / Management Link
Critical and actionable results communication	Percent communicated within policy; acknowledgment documented; escalation success; follow-up completion.	Closed-loop communication is one of the strongest patient-safety processes in radiology. Quality initiatives have demonstrated large gains in policy adherence (Anthony et al., 2011).
Safety reliability	Contrast screening; patient identification; correct protocol; dose capture; extravasation documentation; avoidable repeats.	Monitor dose and adverse events against local and registry benchmarks. Pair dose reduction with image adequacy.
Structured reporting and coded capture	Use of approved templates; completion of required elements; coded recommendations; patient-friendly summary availability.	Structured reports can improve completeness and information processing, although direct hard-outcome evidence varies by use case (Nobel et al., 2022; ESR, 2023).

Closed-loop communication standard

A closed-loop process should record: (1) classification of the finding, (2) person contacted, (3) time of contact, (4) acknowledgment, (5) escalation when acknowledgment fails, and (6) completion of the intended follow-up when the finding is actionable but nonemergent. The Joint Commission identifies these closed-loop elements as essential for reducing diagnostic error.

5. Outcome Domain: Diagnostic, Safety, Experience, and Clinical Measures

Outcome measures are the ultimate test of whether a radiology system is helping patients. They are also the most difficult to define and attribute. A valid radiology outcome framework, therefore, avoids relying primarily on generic hospital mortality, readmission, or patient satisfaction scores. Instead, it focuses on outcomes that are proximate to imaging and linked to specific clinical pathways. Examples include clinically meaningful diagnostic discrepancy, pathology-radiology concordance, interval cancer rate, time to treatment, complication rate, missed follow-up, patient understanding of reports, and functional outcome after time-critical imaging pathways.

Outcome Family	Operational Definition	Evidence / Management Link
Diagnostic accuracy and concordance	Clinically significant discrepancies; pathology-radiology concordance; second-review changes; interval cancers where applicable.	Breast imaging and selected oncology pathways offer mature, benchmarkable approaches. Subspecialty review can alter interpretation and treatment planning in complex cases.
Time to treatment/follow-up	Door-to-needle, door-to-puncture, door-to-reperfusion; biopsy-to-treatment plan; follow-up completion after actionable findings.	In the ANGIOCAT trial, a direct-to-angiosuite workflow reduced median door-to-arterial-puncture time from 42 to 18 minutes and improved 90-day functional outcome in selected stroke patients (Requena et al., 2021).
Patient safety	Contrast reaction and extravasation; wrong-patient or wrong-site imaging; avoidable repeats; dose outliers; missed follow-up.	Dykes et al. (2015) reported a median CT contrast extravasation rate of 0.21% in a national registry. The measure must be interpreted in terms of severity and case mix.
Patient experience and understanding	Wait-time experience; comprehension of report; complaints; portal use; anxiety related to release of results.	Patient-oriented report formats and lay explanations can improve understanding and satisfaction, but implementations require clear scope, clinician alignment, and careful validation.
Pathway-level clinical outcomes	Functional outcome, cancer detection, treatment-plan change, biopsy adequacy, technical success, complication, ED LOS.	Use only where radiology has a credible causal role and data linkage is available. Risk adjust when clinical severity or referral selection influences outcomes.

The critical methodological point is attribution. A fast and accurate report may still be followed by delayed clinical action because of factors outside radiology. Conversely, a poor outcome may occur despite optimal imaging. The appropriate analytic response is not to avoid outcomes; it is to select pathway-specific outcomes, use risk adjustment where feasible, make confounders visible, and interpret results through a multidisciplinary governance forum rather than as an isolated radiology score.

Figure 3. First-Year KPI Portfolio. The model distinguishes universal enterprise measures from outcomes selected for defined clinical pathways.

6. Integrated KPI Framework and Data Architecture

The minimum viable scorecard should be limited enough to drive action. Excessive KPI proliferation produces reporting fatigue and obscures accountability. The recommended portfolio includes six universal enterprise KPIs and four pathway-level KPIs. Each measure should have a written specification that includes: the numerator, the denominator, the inclusion and exclusion rules, the owner, the cadence, the source system, the target or benchmark, the stratification logic, and the balancing measure.

KPI	Suggested Operational Definition	Cadence	Primary Owner	Balancing Measure
Critical results of closed-loop success	% of critical/actionable findings communicated, acknowledged, and documented within policy timeframe.	Monthly	Quality lead + informatics	Missed follow-up events; response-time distribution
Report TAT by setting.	Median and p90 completion-to-final report time for ED, inpatient, outpatient, and stat pathways.	Weekly/monthly	Section chiefs	Clinically meaningful discrepancies; ED LOS
Coverage adequacy	Vacancy rate, uncovered shifts, study volume per staffed shift/FTE, and subspecialty routing compliance.	Monthly	Operations	Worklist carryover, overtime, fatigue indicators
Appropriateness / CDS alignment	% advanced imaging orders are usually rated as appropriate; override pattern by service line.	Monthly	Radiology informatics + referrer leaders	Delayed needed imaging; repeat exam rate
Dose and safety control	% CT protocols within local benchmark; outlier rate; extravasation; avoidable repeats; serious identification events.	Monthly	Physicist + modality lead	Image-quality adequacy: clinical repeat imaging

KPI	Suggested Operational Definition	Cadence	Primary Owner	Balancing Measure
Structured-report adoption	% priority studies using approved templates and coded recommendation fields.	Monthly	Subspecialty chief	Report TAT; referrer satisfaction
Stroke pathway outcome	Door-to-image, door-to-puncture, door-to-reperfusion, and functional outcome, where registry is available.	Monthly / quarterly	Stroke program	Hemorrhage, transfer delay, selection bias
Breast/oncology outcome	Cancer detection; recall/PPV where relevant; pathology concordance; interval findings; MDT treatment-plan influence.	Quarterly / annual	Breast/oncology leads	Case mix; follow-up completeness
Incidental finding follow-up	% actionable nonemergent findings with documented intended follow-up and completion.	Monthly / quarterly	Navigator/quality lead	Patient access/contact failures
Interventional outcome	Technical success, complications, specimen adequacy, symptom/function outcome, readmission where appropriate.	Quarterly	IR service lead	Case complexity; patient acuity

Data architecture should be designed to minimize manual abstraction. Structure data should flow from HR, credentialing, accreditation, medical physics, and inventory systems. Process data should originate in EHR, RIS, PACS, reporting, communication, scheduling, and dose-monitoring systems. Outcome data should be limited initially to sources with reliable linkage: pathology, cancer registry, stroke registry, peer-learning system, interventional database, and patient-experience platform. Manual audit remains valuable for validation, but it should not be the only source of a program's operational intelligence.

Analytic standard

Display operational measures as run charts or statistical process control charts with explicit time windows. Stratify by modality, site, acuity, daypart, language preference, payer category, disability accommodation, and other relevant access variables when sample size permits. Avoid presenting a single aggregate that conceals service-line variation.

7. Evidence-Based Intervention Portfolio

The intervention portfolio should prioritize changes that are both measurable and causally plausible. The strongest initial interventions are not necessarily the most technologically sophisticated. They are the interventions that close known failure points: delayed communication, fragmented follow-up, avoidable access delay, inappropriate ordering, unsafe protocol drift, and lack of learning from discrepancies. The table below summarizes an implementation portfolio tailored to radiology leadership.

Intervention	Primary SPO Target	Core Steps	Resource Intensity	Expected Value	Evidence
Closed-loop critical and unexpected findings program	Process -> outcome	Alert tiers; embedded notification; acknowledgment and escalation; navigator pathway for non-emergent findings.	Medium-high	Improves documentation, reliability, and follow-up; reduces exposure to diagnostic delay.	High
Report TAT and coverage redesign	Structure + process	Demand/capacity modeling; worklist routing; dedicated acute coverage; escalation plan; report-status visibility.	Medium-high	Improves speed and access when matched to demand; monitors quality balancing measures.	Medium-high
Appropriateness / CDS deployment	Structure + process	Integrate ACR criteria at order entry; provide feedback to high-variance ordering groups; govern overrides.	Medium-high	Can reduce targeted low-value imaging and improve appropriateness.	Medium

Intervention	Primary SPO Target	Core Steps	Resource Intensity	Expected Value	Evidence
Dose monitoring and protocol optimization	Structure + process -> safety outcome	Automate dose capture; benchmark; identify outlier protocols; quarterly physics-modality review.	Medium	Detects protocol drift and supports safety/accreditation readiness.	Medium-high
Structured reporting in high-impact pathways	Process -> outcome	Start with a limited template set, required fields, coded recommendation capture, and co-design with referrers.	Medium	Improves completeness and data reuse; clinical-outcome effect varies by pathway.	Medium
Peer learning and clinical audit	Governance + process	Just-culture review; targeted audit; action closure; feedback loops.	Low-medium	Improves learning culture and identifies system vulnerabilities.	Medium
Patient-friendly report layer	Process -> experience outcome	Lay summary; glossary; visual aids; explicit next steps; pilot comprehension testing.	Low-medium	It can improve patient understanding and satisfaction when well implemented.	Medium
Pathway redesign: acute stroke	Process -> clinical outcome	Prenotification; predefined imaging; direct routing; real-time interval review; multidisciplinary simulation.	High	Can improve time to reperfusion and functional outcome in selected pathways.	High

Resource intensity is deliberately expressed as a planning category rather than a universal cost estimate. Local costs depend on existing infrastructure, volume, vendor configuration, labor market, informatics capabilities, and whether the program is implemented at a single site or at enterprise scale. The practical implication is to pilot one or two interventions, confirm data quality and user adoption, then scale selectively.

8. High-Impact Clinical Pathways

8.1 Acute Stroke

Acute stroke is the clearest example of radiology's pathway-level impact because imaging directly influences treatment eligibility and timing. AHA Target: Stroke materials identify door-to-imaging and door-to-interpretation intervals as central measures. In the ANGIOCAT randomized clinical trial, direct transfer to the angiography suite for selected patients with suspected large-vessel occlusion reduced the time from hospital arrival to arterial puncture and improved functional outcome at 90 days (Requena et al., 2021). Not every institution can replicate a direct-to-angiosuite model; however, the lesson generalizes: prebuilt imaging protocols, rapid activation, clear roles, and real-time interval review are radiology-controlled or radiology-influenced levers with credible outcome pathways.

8.2 Breast Imaging and Oncology

Breast imaging provides perhaps the most mature radiology outcome infrastructure because performance metrics such as cancer detection rate, recall/abnormal interpretation rate, positive predictive value, sensitivity, specificity, and interval cancer rate can be linked to registry and pathology data. MQSA requires an annual medical outcomes audit, and modern performance benchmarking provides a foundation for clinically meaningful comparisons. The SPO model recommends extending the breast-imaging logic to other oncology services through structured staging reports, pathology correlation, MDT participation, and tracking of whether radiologic interpretation altered treatment planning.

8.3 Emergency Radiology

Emergency radiology should focus on the reliability of access, the availability of final reports, critical-result communication, and downstream disposition. Lean process redesign can reduce CT acquisition delays, while continuous attending coverage can reduce report turnaround time in emergency and trauma settings. The SPO risk is over-focusing on speed. ED quality dashboards must pair TAT with clinically meaningful discrepancy surveillance, repeat imaging, consultation impact, and clinician feedback.

8.4 Interventional Radiology

Interventional radiology requires a hybrid SPO approach because it is both diagnostic and therapeutic. Structural measures include operator credentialing, nursing and anesthesia support, equipment readiness, emergency coverage, and access to pre- and post-procedural imaging. Process measures include time-out reliability, anticoagulation review, antibiotic prophylaxis when applicable, specimen handling, discharge education, and follow-up. Outcomes should be procedure-specific: technical success, diagnostic yield, complication rate, symptom relief, functional recovery, repeat intervention, and unplanned utilization. Generic one-size-fits-all outcome measures should be avoided.

8.5 Outpatient and Routine Imaging

Outpatient radiology is often where access and communication failures accumulate silently. Priority measures include order-to-schedule time, patient cancellations and no-shows, authorization delays, imaging completion, report availability, patient-friendly explanations, and follow-up closure for actionable incidental findings. Stratification by travel distance, language need, insurance category, disability accommodation, and scheduling channel can reveal inequities that aggregate service-level averages conceal.

9. AI, Health Equity, and Patient-Centered Reporting

9.1 AI as a Controlled Structural and Process Intervention

Artificial intelligence should be positioned as a potential structural and process intervention rather than a presumed outcome. Its benefits must be demonstrated in the local workflow. Appropriate applications may include worklist triage, quantitative measurement, image-quality support, dose monitoring, structured data extraction, follow-up tracking, and patient-friendly report summaries. The evaluation standard should include intended use, local validation, human oversight, drift monitoring, analysis of false positives and false negatives, workload effects, and the impact on the clinical process that the tool claims to improve.

Recent mammography research indicates that AI-supported screening can improve detection-related measures in specific programs. However, those findings should not be generalized to all modalities or workflows without local evidence. The model, therefore, requires AI governance to specify: the clinical use case, eligible population, comparator workflow, responsible human reviewer, performance threshold, escalation procedure, equity analysis, and stop criteria. AI must be evaluated as part of an SPO chain, not as a standalone product metric.

9.2 Health Equity as a Cross-Cutting Measurement Requirement

Equity is not a separate dashboard add-on; it is a measurement discipline that should be applied to structure, process, and outcomes. Structural equity asks whether the department offers accessible sites, interpreter support, disability accommodations, digital access, and scheduling capacity across the population served. Process equity examines whether wait times, no-show rates, authorization friction, communication success, and follow-up completion differ across populations. Outcome equity asks whether diagnostic yield, delayed follow-up, treatment timing, patient understanding, and safety events vary across groups after accounting for relevant clinical and social factors.

Equity measurement safeguard

Do not interpret group differences as evidence of patient noncompliance without examining the structural and process conditions that precede them. Transportation, digital access, language, work schedule, financial exposure, referral patterns, authorization, and contact-data quality can all shape measured outcomes.

9.3 Patient-Centered Reporting

Patients increasingly access radiology reports directly through portals, sometimes before a treating clinician discusses the findings. A patient-centered reporting strategy should not replace clinical counseling; it should make the report more understandable and action-oriented. A limited pilot may include a plain-language summary, defined terminology, an explanation of the impression, explicit next steps, and a contact pathway for questions. The pilot should measure comprehension, satisfaction, anxiety, message volume, clinician concerns, and unintended misunderstanding. Evidence suggests that report format can influence patient information processing, but implementation should be iterative and subject to governance (van der Mee et al., 2025).

10. Governance, Implementation Roadmap, and Evaluation

A functional SPO program requires a governance model that has decision rights, not merely a committee calendar. The recommended structure is a radiology quality and outcomes council led by a radiology executive or medical director and supported by operational leadership, informatics, medical physics, nursing/technologist representation, quality and safety, patient experience, and high-priority clinical partners such as stroke, oncology, emergency medicine, and interventional services. The council should review performance, validate data, identify variation, authorize corrective action, and escalate resource constraints.

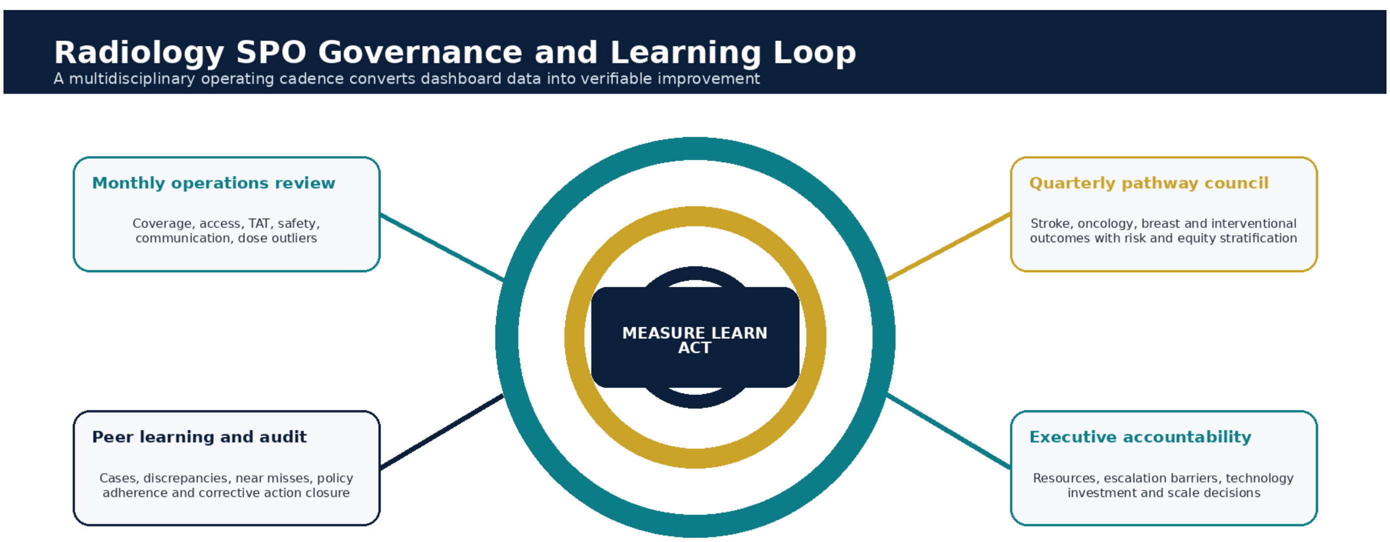

Figure 4. Governance and Learning Loop. A mature SPO program turns measurement into action through defined review forums, accountable owners, and closed corrective-action cycles.

10.1 18-Month Implementation Roadmap

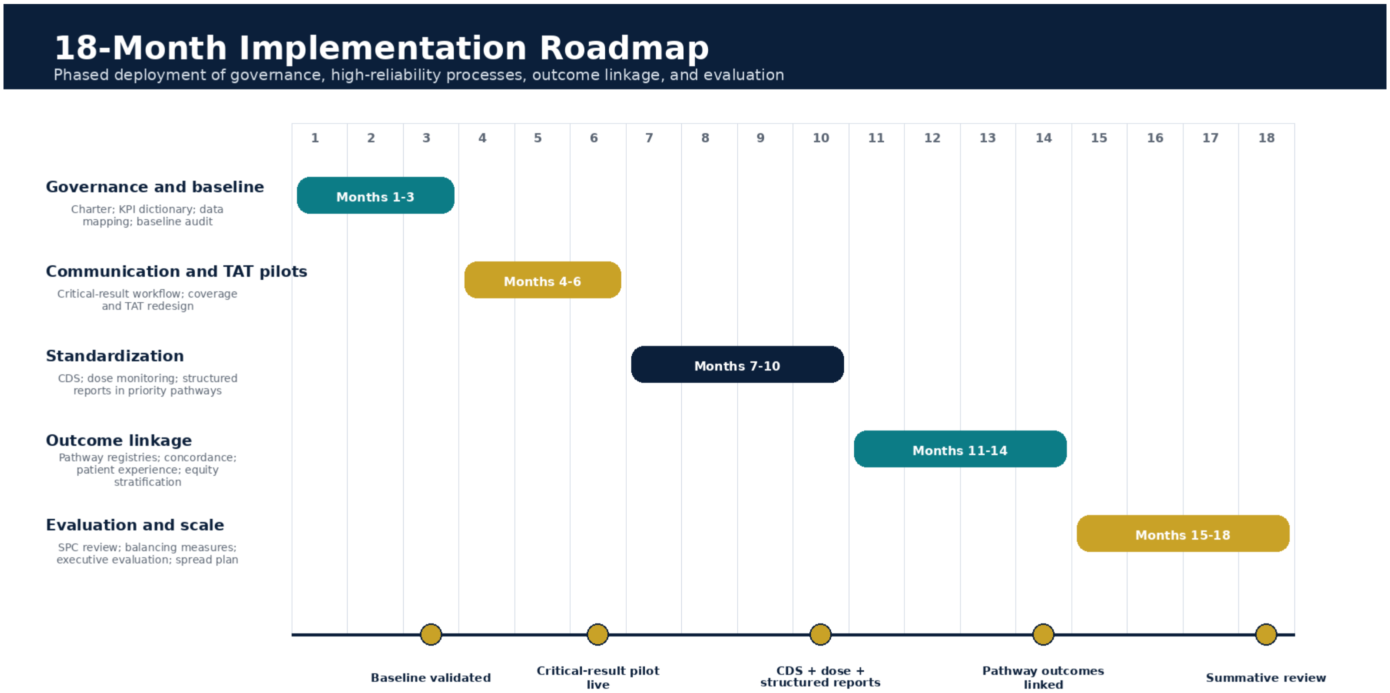

Figure 5. Eighteen-Month Implementation Roadmap. Progression from infrastructure and pilot work to outcome linkage and summative evaluation.

Phase	Primary Work	Expected Deliverable
Months 1-3: Foundation	Create a charter, assign owners, develop a KPI dictionary, map source systems, establish data quality rules, and complete a baseline audit.	Deliverable: validated baseline scorecard and governance cadence.
Months 4-6: High-reliability pilots	Launch closed-loop critical-result communication and TAT/coverage redesign in selected services.	Deliverable: pilot run charts, adoption findings, and balancing-measure review.
Months 7-10: Standardization	Deploy decision support, dose-monitoring optimization, and structured reporting for one or two high-impact pathways.	Deliverable: standardized workflow and template library with audit feedback.
Months 11-14: Outcome linkage	Connect pathway data sources and start measuring stroke, breast/oncology, incidental finding, or IR outcomes.	Deliverable: pathway dashboard with risk and equity stratification.
Months 15-18: Evaluation and scale	Assess the association between structural/process improvements and outcome movement; refine; scale successful interventions.	Deliverable: executive evaluation report and next-cycle investment plan.

10.2 Evaluation Strategy

At three months, the evaluation should assess whether the necessary structures are in place: ownership, policies, interfaces, resource commitments, data feeds, and education. At six months, the evaluation should ask whether processes have changed: timeliness, closed-loop adherence, structured-report use, dose outlier review, and appropriateness. At 12 to 18 months, the evaluation should assess whether patient-centered outcomes have improved: fewer missed follow-ups, better pathway timing, safer event profiles, improved patient understanding, and service-line clinical outcomes where measurement is feasible. A change should not be declared successful simply because a dashboard metric improved; it should demonstrate no material deterioration in its balancing measures.

11. Strategic Recommendations

Recommendation	Rationale
Adopt the SPO model as the organizing framework for radiology quality governance.	Replace fragmented scorecards with a single logic that explicitly connects capability, operational behavior, and patient impact.
Start with ten KPIs, not fifty.	Implement six universal enterprise KPIs and four pathway measures. Expand only after data validity and ownership are established.
Make closed-loop communication the first high-reliability priority.	Critical and actionable result communication has a direct safety rationale and can be measured rigorously through audit trails.
Treat TAT as a balanced process measure.	Stratify by care setting and pair speed with accuracy, follow-up, and patient-flow outcomes.
Build pathway-level outcome measurement that is strongest where attribution is strongest.	Prioritize stroke, breast imaging, oncology MDT review, actionable incidental findings, and interventional radiology based on local volume and data access.
Develop an enterprise data architecture before overinvesting in visualization.	Reliable integration and KPI definition are more valuable than a visually sophisticated dashboard built on unstable data.
Govern AI as an intervention with explicit endpoints.	Require local validation, human oversight, drift surveillance, equity review, and defined stop criteria.
Apply equity stratification throughout the model.	Use it to identify structural and process barriers, not merely to describe outcome differences.

The final recommendation is cultural. Radiology leaders should define quality not as the absence of errors or the attainment of a throughput target, but as the reliable delivery of the right imaging information to the right patient and care team at the right time, in a form that enables action and demonstrably improves outcomes. The SPO model gives departments a practical architecture to manage toward that standard.

12. Limitations and Implementation Caveats

Caveat	Practical Response
Evidence maturity differs by domain.	Breast imaging and acute stroke have comparatively mature pathway-outcome measures. General radiology, structured reporting, and patient-friendly reporting have more heterogeneous direct outcome evidence.
Attribution is inherently limited.	Radiology affects downstream care but does not control all clinical decisions, access constraints, or patient factors. Interpret outcomes through pathways and multidisciplinary review.
Benchmarks are context-dependent.	Universal staffing and TAT thresholds are often not defensible across modalities, geography, staffing models, and case mix. Use external benchmarks when mature, local baselines are available elsewhere.
Data quality can become the implementation bottleneck.	Timestamp definitions, duplicate studies, amended reports, orders not performed, and cross-system matching must be validated before performance conclusions are drawn.
Equity analyses require appropriate governance.	Small sample sizes, missing demographic data, and potential misuse of group comparisons require privacy, statistical, and clinical review.

These caveats do not weaken the case for an SPO framework. They define the conditions for credible use. The framework should be treated as a disciplined quality-management system that evolves with data maturity, clinical priorities, and evidence.

Appendix A. Sample KPI Specification Sheet

The following specification can be used for any indicator in the SPO scorecard. Written definitions are necessary to ensure reproducibility, interpretability, and continuity across leadership transitions.

Specification Element	Example
KPI name	Closed-loop critical/actionable result success
Purpose	Measure whether high-priority imaging findings are communicated, acknowledged, and documented within established policy timeframes.
SPO domain	Process with direct safety-outcome linkage.
Numerator	Number of audited critical/actionable findings with documented communication and acknowledgment within the policy timeframe; include escalation process when required.
Denominator	All critical/actionable findings in the audited period, excluding only pre-specified and documented exceptions.
Data sources	Radiology reporting system, communication platform, EHR audit trail, incident reporting, and manual audit sample.
Frequency	Monthly dashboard; quarterly deep-dive by category, site, modality, and care setting.
Owner	Radiology quality lead with informatics support and assigned escalation owner.
Balancing measures	Time burden, false alerts, alert fatigue, documentation defects, unresolved follow-up, and patient complaints.
Equity stratification	Review communication and follow-up completion by language, contact reliability, insurance category, geography, and care setting when data are appropriate.
Action threshold	Locally established escalation threshold based on baseline and policy requirements; investigate special-cause variation and any missed high-severity events.

Appendix B. Sample SPO Governance Charter

Charter Element	Recommended Standard
Purpose	To oversee radiology performance through the integrated measurement of structure, process, and outcomes; to authorize corrective action; and to demonstrate patient-centered value.
Membership	Radiology executive/medical director, operations leader, quality and safety lead, informatics, medical physics, technologist/nursing representative, patient experience, and selected clinical pathway partners.
Cadence	Monthly operational scorecard review; quarterly pathway outcomes review; immediate review of serious communication or safety failures.

Charter Element	Recommended Standard
Decision rights	Approve KPI definitions; designate owners; prioritize pilots; recommend staffing, technology, and workflow changes; escalate unresolved barriers to executive leadership.
Required artifacts	KPI dictionary; run charts; action log; incident and peer-learning themes; audit calendar; equity stratification plan; annual outcomes review.
Culture standard	Just culture, nonpunitive learning, transparent data definitions, interdisciplinary collaboration, and separation of learning data from improper punitive use, where feasible.

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