IHE PaLM — Brief Profile Proposal: Digital Pathology – Quality Control (DPQC)

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Note: Rúben Fernandes (Sectra) and Mustafa Yousif, MD (Michigan Medicine / DICOM WG-26) have confirmed interest in DPQC profile development.

1. Proposed Workitem: Digital Pathology – Quality Control (DPQC)

A new IHE PaLM integration profile standardizing how **whole-slide imaging (WSI) quality-control (QC) observations and decisions** are **represented, exchanged, persisted, and made available to downstream workflow actors** — scanner, QC application, Image Manager/Archive (IMS), workflow manager, clinical AI and/or viewer. The profile will distinguish between **quality detection**, **fitness-for-purpose decision-making**, and **corrective workflow initiation**; the inclusion and phasing of corrective orchestration will be determined during profile development.

It covers **electronic and physical quality issues** throughout the digital specimen lifecycle (e.g., out-of-focus regions, unscanned tissue, folds, stitching artifacts, marker ink, mounting problems, and uneven staining). It is **separate from the Digital Pathology Evidence Creation (DPEC) profile** and addresses **DPIA Issue 11: Modeling and guidance for Quality Control (QC) processes**.

2. The Problem

Integration problem. WSI is central to primary diagnosis and downstream AI/algorithmic analysis, and slide quality directly determines fitness for either purpose. Today, WSI QC is performed **manually** or by **vendor-proprietary QC software** (e.g., Barco SlideRightQA), and the resulting findings are exchanged over **proprietary interfaces, if at all**. There is **no standardized, interoperable way** to record QC findings and decisions, communicate them to the archive, workflow manager, or viewer, or trigger corrective action.

Value statement (cost of the problem). Because no standard exists:

- QC results are not documented in an interoperable way.
- Bad slides may be stored, distributed and even read before being flagged, while good slides may be needlessly rescanned.
- Rescan, recut, and restain decisions are manual, subjective and/or non-traceable.
- Information about which regions are suitable for AI is lost, wasting computational resources on unsuitable images.

Expected benefits of solving it. Reduced proprietary integration, traceable quality-related decisions, less unnecessary rescanning and algorithm execution, and interoperable QC applications from multiple vendors. DICOM provides the building blocks; IHE PaLM defines the multi-actor workflow that ties them together.

3. Key Use Case

3a. Current situation (the problem in practice)

A laboratory scans a batch of glass slides; one has a large out-of-focus area. Either (i) an operator eventually notices it, or (ii) a proprietary QC tool detects it but reports it through a vendor-specific interface the lab's archive and viewer do not understand. The slide is stored with **no machine-readable quality status**, so a pathologist or AI algorithm may retrieve it before remediation, and any rescan decision is manual and untraced. The scan technician then struggles to locate the exact physical slide (station/rack/slot).

3b. Desired situation (intended interoperable workflow)

A **QC Application** (embedded in the scanner or independent) analyzes the complete WSI and publishes a **standardized, machine-readable QC result**:

- a **slide-level quality decision** (e.g., pass, fail) evaluated under an identified **QC policy** and, where applicable, for an identified **intended use**, together with the **findings** that support it (out-of-focus, unscanned tissue, stitching, ...);
- optional **region annotations** delineating each finding (including annotations on the **macro/associated image** for unscanned tissue); and
- an **Observer Context** identifying whether a *person* and/or *device* performed the QC.

This QC result is stored in the **Image Manager/Archive (IMS)** alongside the images. Downstream actors then behave consistently:

- an **authorized workflow actor** may request that a failed image set be withheld from routine clinical availability, using the applicable **Image Object Change Management (IOCM)** mechanism and according to local policy;
- for **scanner-remediable** findings (e.g., out-of-focus, unscanned tissue), the QC application or a workflow manager can request a **direct rescan** on the same scanner with adjusted parameters (denser focus points, z-stack, extended scan area);

- for **wet-lab** findings (recut, restain, re-coverslip, replace slide), the **Laboratory Information System (LIS)** — typically via **DPOW** — initiates the appropriate work order to the technologist;
- an **AI router** passes only slides whose decision permits their intended algorithmic use;
- a **viewer** displays the QC decision and highlights the associated regions;
- an initial implementation may simply **notify a human operator** with the slide's location and a QC result describing the findings, even *without* the images, and without automatically initiating corrective workflow.

Two candidate deployment topologies are in scope for analysis: **(1) QC-before-IMS ("gating")**, where failed slides are never persisted in the IMS; and **(2) QC-after-IMS ("post-hoc")**, where all data is stored first and QC results are pushed back into the IMS. A per-laboratory **QC policy** determines which findings contribute to a slide-level decision, the applicable thresholds, and, where represented, the intended use for which the decision applies.

See Appendix A, Figure 1, for the high-level DPQC workflow diagram.

4. Standards and Systems

Systems / actors involved (largely reused from the existing DPIA profile):

- **Acquisition Modality** (WSI scanner) — may itself perform QC.
- **QC Application** (new/derived actor; may be a third-party QC engine, e.g., Barco SlideRightQA) — creates the QC objects.
- **Image Manager / Image Archive (IMS/PACS/VNA)** — stores and serves images and QC objects; may act on IOCM rejection.
- **LIS / Workflow Manager** — orchestrates corrective actions (rescan / recut / restain / pull glass).
- **Image Display (viewer)** — presents the QC verdict and annotated regions.

Candidate standards and building blocks (to be evaluated during profile development):

- **DICOM Key Object Selection (KOS), TID 2010** — candidate carrier for the slide-level quality decision.
- **DICOM CP-2628** (WSI KOS Scan Quality) — under development at the time of this proposal; proposes explicit **pass** *(new Document Title, "No quality issues detected")* and **fail** *(113001, DCM, "Rejected for Quality Reasons")* semantics with Document Title Modifiers; separates *Slide Microscopy* reasons in **CID 7011**; uses **Observer Context (TID 1002)** for person/device; optional Key Object Description text. Final codes and semantics to be verified against the current CP text.
- **DICOM CP-2435** (Codes for WSI QC) — incorporated as **Final Text**; adds **"Quality"** to **CID 7150** and associates it with **CID 7164 Quality Segmentation Property Type** (codes such as out-of-focus, stitching, unscanned tissue).
- **DICOM Microscopy Bulk Simple Annotations** — introduced by **Supplement 222**, with relevant enhancements under development in **Supplement 255**; candidate mechanism for localized quality findings.
- **DICOM Image Object Change Management (IOCM)** — candidate mechanism when archive-level rejection or withholding of a failed image set is required, subject to local policy and authorization.
- **DICOM Completion KOS / "complete set"** (cf. CP-LAB-281 DPIA Scan-Complete KOS) — supports the requirement that slide-level QC is evaluated against the complete image set.
- **HL7 v2** and the **Digital Pathology Ordering Workflow (DPOW)** profile — candidate carriers for corrective work orders (rescan / recut / restain), including the manual technologist path via OBR-4 and SPM-21.
- **IHE PaLM DPIA** (Trial Implementation), **DPOW**, and **DPEC** — the surrounding profile family DPQC must interoperate with.

5. Discussion

Why IHE is the right venue. DICOM provides the QC *building blocks* but explicitly does **not** define the multi-actor, end-to-end workflow. The need is already an **open issue in DPIA (Issue 11)**, and the IHE PaLM co-chairs invited the work at the 8 July 2026 call. IHE's four-step process (use cases → specification over existing standards → implementation → Connectathon testing) is well suited to it.

Candidate technical approach.

- **Reuse** DPIA actors (Acquisition Modality, Image Manager/Archive, Image Display); **add** a QC Application actor and, where corrective workflow is in scope, a Workflow Manager actor (potentially delegating to DPOW).
- **New content modules** wrapping the candidate quality-decision KOS (CP-2628) and localized-finding annotations (CP-2435 + Bulk Simple Annotations), and defining the **identity, lifecycle, and relationships** among the Completion KOS, the Quality KOS, and any IOCM rejection object — covering repeated QC, superseded results, rescans, multiple observers, and restoration after remediation.
- **Transactions** via **DICOMweb STOW-RS, QIDO-RS, WADO-RS** (classic DIMSE to be considered) for storing/querying/retrieving QC objects; notifications to a workflow manager or human operator; and — if in scope — corrective work orders.
- Document **per-laboratory QC policy** (gating issues, thresholds, intended use) as a concept rather than an on-the-wire artifact in the initial phase.
- Consider **phasing**: (1) publish findings and notify a human; (2) publish decisions and support authorized archive-level hold/rejection; (3) corrective workflow orchestration.

Risks / open issues to address.

- Whether to make the **dependency on the complete image set** explicit (link to Completion KOS) and how a Quality KOS references the assessed image set.
- Whether to **separate detection, decision, and correction** into distinct scopes or phases; and, for correction, how to split **scanner-remediable rescans** (potentially initiated directly to the scanner) from **wet-lab actions** (recut / restain / re-coverslip)

that must be initiated via the LIS / DPOW, including whether direct QC-to-scanner control is permitted or must always be mediated for audit and specimen traceability.

- Representing findings that **extend outside the tissue area** (e.g., marker ink on bare glass) with current segmentation property types.
- **Semantics and lifecycle of QC decisions** — a slide acceptable for one purpose may not be acceptable for another; the profile should bind decisions to a QC policy (and, where applicable, an intended use) and identify superseded results across rescans, multiple observers, and software versions.
- **Control- vs. patient-tissue localization** (DICOM can flag presence but not location; QC thresholds may differ).
- Whether **additional quality-reason codes** are needed now or added later via the normal DICOM CP process.
- Avoiding **duplicate QC processing and repeated charging for the same analysis**, and unnecessary AI computation on unsuitable slides.

Business case & piloting. The lack of a standard drives proprietary integration, unnecessary rescans, undetected quality issues, and wasted algorithmic computation. Candidate pilots include **Barco** (SlideRightQA) and **Sectra** (IMS/viewer), alongside DPIA Connectathon scanner, archive, and viewer vendors. Demonstrators could cover QC-pass, QC-fail with *Out-of-focus* and *Stitching*, and *Unscanned tissue* annotated on the macro image.

Appendix A: High-Level Workflow Diagram

The preliminary workflow diagram is provided here for reference. The two deployment topologies and the scope of rescan orchestration remain subject to DPQC review.

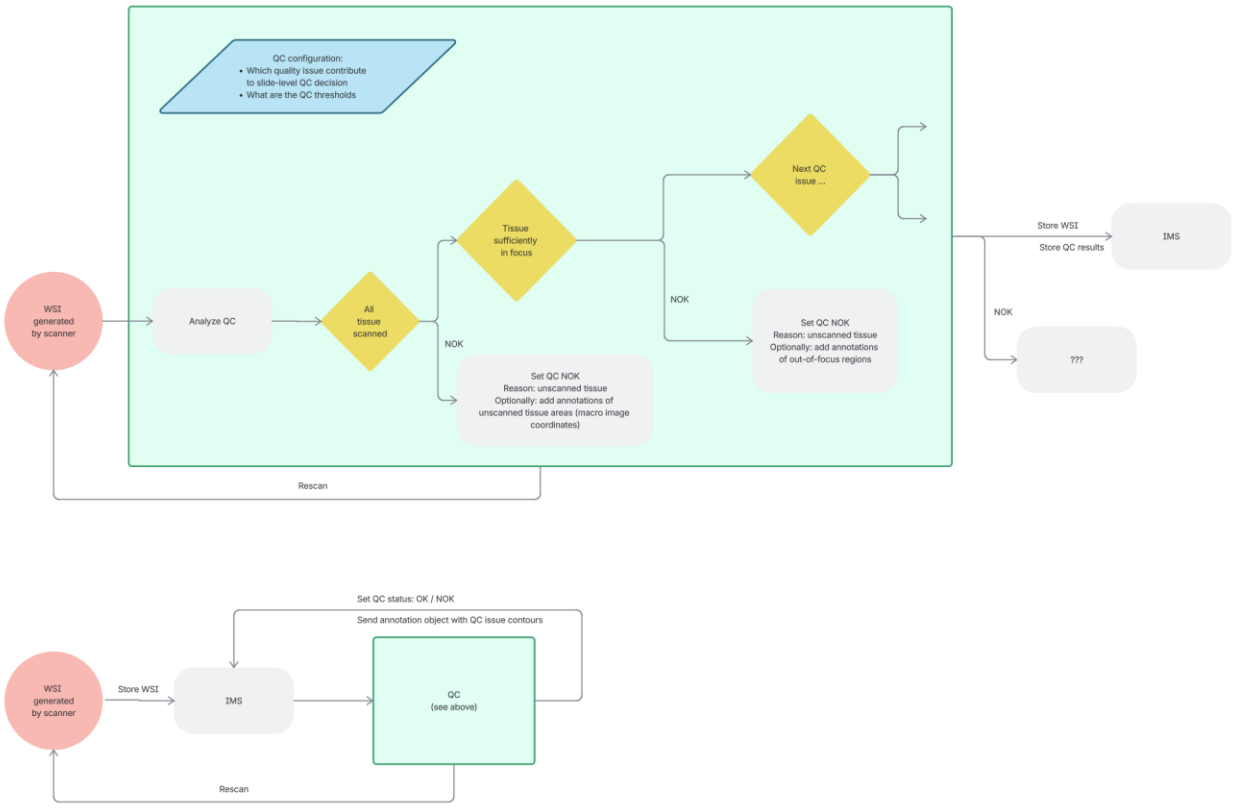


Figure 1. High-level DPQC workflow. The diagram is preliminary and is included to show the two candidate deployment topologies; rescan orchestration remains an open scope question.