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Review Article

Organizational Readiness and Managerial Drivers of Digital Technology Adoption in Periodontal and Orthodontic Care Centers in Saudi Arabia

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ABSTRACT

Digital technologies are becoming increasingly embedded in dental imaging, records, communication, treatment planning, remote follow-up, and clinical decision support, yet their organizational adoption is often interpreted too narrowly as technology acquisition or clinician acceptance. This non-empirical healthcare-organization analysis examines how readiness and managerial conditions may shape digital technology adoption in periodontal and orthodontic care centers in Saudi Arabia. It distinguishes technology availability from organizational readiness, adoption decision, implementation, workflow integration, routinization, and realized service benefit. The analysis integrates Saudi dental and health-system evidence with international implementation, interoperability, workforce, teleorthodontic, and dental AI literature. It argues that specialty-care adoption is a configuration problem in which managerial commitment cannot substitute for infrastructure, workforce capability, workflow fit, governance, or technology-specific validation. Periodontal and orthodontic workflows remain related but non-interchangeable. A proposed readiness architecture is organized around workflow fit, managerial coordination, interoperable infrastructure, workforce capability, clinical validity, and proportionate governance. The model is conceptual rather than empirically validated and is intended to organize implementation questions rather than predict adoption or clinical benefit.

Keywords: Digital dentistry, Organizational readiness, Periodontal care, Orthodontic care, Health information technology, Saudi Arabia

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Introduction

Digital technology adoption in healthcare is not a single event. A technology may be purchased, made technically available, accepted by some users, and even used repeatedly without becoming reliably embedded across the work required to deliver care. The NASSS framework distinguishes adoption from nonadoption, abandonment, scale-up, spread, and sustainability and locates complexity across technology, adopters, organizations, wider systems, and change over time [1]. In specialty dental care, a scanner, imaging platform, electronic record, remote-care channel, or AI application can therefore exist without being integrated into the sequence through which information is captured, verified, interpreted, protected, and acted upon.

Implementation theory also cautions against treating individual acceptance as a sufficient explanation. A systematic review of theories used in eHealth implementation found a strong concentration on acceptance-oriented models and comparatively less use of structural and relational perspectives [2]. The updated Consolidated Framework for Implementation Research similarly organizes implementation determinants across the innovation, individuals, inner setting, outer setting, and implementation process [3]. These approaches support a more operational question than whether clinicians like digital tools: under what conditions can a specialty dental center absorb them into dependable routine work?

Digital maturity research reinforces this distinction. In general practice, maturity has been described through processes, staff, organizational rules, technical infrastructure, outcomes, and external conditions [4]. Applied cautiously to specialty dentistry, this suggests that readiness is a configuration of capabilities rather than an inventory of purchased systems [5]. This article analyzes that configuration in Saudi periodontal and orthodontic care while separating Saudi evidence from international transfer and avoiding claims of validated readiness scores or causal managerial effects.

Digital technology adoption in Saudi periodontal and orthodontic care

Saudi evidence supports heterogeneous digital uptake rather than transformation. Practicing dentists reported variation in digital-technology use and training and identified awareness, education, and the clinical evidence base among perceived barriers [6]. The cross-sectional self-report design does not establish specialty-center adoption rates or managerial causation; it shows only that exposure, training, perceived usefulness, and actual use may diverge.

The wider Saudi health-information environment adds a system-level boundary. A multicase study comparing Saudi Arabia and Estonia described Saudi healthcare data as distributed across isolated sectors and emphasized coordinated stewardship and interoperable custodians [7]. This does not establish fragmentation in every dental center, but it shows that local workflows may depend on external identity, exchange, referral, or governance arrangements beyond chairside technology.

Adjacent Saudi dental evidence also separates access from capability. Prosthodontic postgraduate program directors reported constraints involving resources, equipment cost, and trained faculty [8], while university dental faculty showed a gap between awareness of additive manufacturing and practical experience [9]. These are not periodontal or orthodontic care-center prevalence estimates; they support only the broader distinction among awareness, access, competence, and routine use.

International dental evidence reinforces technology specificity. Hungarian dentists reported markedly different familiarity across digital and teledentistry technologies [10]. The implication is not geographic transfer of those proportions but recognition that “digital adoption” hides distinct learning curves, workflow effects, and support requirements [11]. The TAS-D Delphi study similarly organized teledentistry acceptance around performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit, while calling for further psychometric evaluation [12]. Acceptance intention is therefore an informative construct but not an organizational endpoint. A center may view a technology favorably while lacking the infrastructure, governance, workflow design, or staff capability needed for stable implementation.

Organizational readiness in specialty dental centers

Organizational readiness should first be separated from the decision to adopt. In a mixed-method implementation study of community-based organizations using a digital health intervention, readiness varied even among organizations that had formally adopted the intervention; organizational priority, fit, and client context helped distinguish readiness states [13]. That study was conducted outside dentistry and its numerical readiness scores should not be transferred to Saudi specialty care. The conceptual distinction is nevertheless highly relevant: authorization to purchase or launch a technology does not demonstrate preparedness to incorporate it into specialty workflows.

Digital maturity literature similarly supports multidimensional assessment rather than a single purchasing threshold. An overview of digital maturity consulting emphasized the need for robust, context-sensitive assessment capable of describing current state, setting targets, and tracking progress while acknowledging substantial heterogeneity among maturity models [14]. For periodontal and orthodontic centers, the proposed implication is that readiness should be assessed where technology meets workflow: what information the task depends on, which systems must connect, which roles change, what managerial coordination is required, and which evidence boundary limits interpretation.

Outcome associations require caution. In US hospitals, advanced digital maturity was associated with higher quality and safety measures after adjustment [15]. The cross-sectional hospital design cannot establish causation or transfer those associations to Saudi specialty dentistry. It therefore supports only a boundary claim: maturity may matter, but adoption analysis must remain separate from technology-to-benefit inference.

A workflow-level diagnostic is therefore more informative than a generic barrier list because periodontal and orthodontic services may depend on different combinations of imaging, longitudinal records, scanning, appliance monitoring, treatment planning, remote communication, and administrative coordination [16].

Table 1. Proposed specialty-workflow readiness diagnostic for periodontal and orthodontic digital adoption

Specialty lane	Workflow state	Readiness chain	Friction and evidence boundary
Periodontal	**Periodontal diagnostic review**	**Digital dependency** → Clinical findings, imaging, and longitudinal records must be available together **Organizational precondition** → Standardized capture and retrievable linkage across visits **Readiness signal** → Required information can be assembled without parallel manual reconstruction	**Adoption friction** — Fragmented records, duplicate entry, or disconnected image access **Evidence boundary** — Proposed workflow synthesis; direct Saudi specialty-center validation is unavailable
Periodontal	**Periodontal longitudinal monitoring**	**Digital dependency** → Repeated measures, images, and treatment history must remain comparable over time **Organizational precondition** → Stable documentation conventions and ownership of follow-up information **Readiness signal** → Prior and current information can be reviewed within the routine encounter	**Adoption friction** — Inconsistent entry, inaccessible historic data, or unclear responsibility **Evidence boundary** — Does not imply that digitization improves periodontal outcomes
Orthodontic	**Orthodontic digital diagnostic and planning workflow**	**Digital dependency** → Imaging, scans, records, and planning software must remain coherently linked **Organizational precondition** → Defined responsibility for acquisition, verification, and plan documentation **Readiness signal** → Information passes from acquisition to planning without avoidable re-entry	**Adoption friction** — Interface discontinuity, version uncertainty, or duplicate work **Evidence boundary** — Orthodontic technology evidence is stronger than Saudi organizational evidence
Orthodontic	**Orthodontic remote follow-up workflow**	**Digital dependency** → Secure communication must connect with the longitudinal record **Organizational precondition** → Clear task boundaries, escalation criteria, and documentation rules **Readiness signal** → Remote encounters generate traceable information and a defined next action	**Adoption friction** — Stand-alone messaging or unclear escalation responsibility **Evidence boundary** — Remote acceptability does not establish substitution for in-person care
Cross-specialty	**Cross-specialty digital service configuration**	**Digital dependency** → Shared infrastructure must support different specialty tasks **Organizational precondition** → Governance, interoperability, workforce competence, and managerial coordination **Readiness signal** → Common systems support specialty-specific work while preserving role clarity	**Adoption friction** — Treating all technologies and specialties as one adoption state **Evidence boundary** — Proposed organizational synthesis requiring local evaluation

Note: The table is a proposed manuscript-level diagnostic synthesis. It does not assign readiness scores, rank centers, or report observed Saudi specialty-center outcomes.

Managerial leadership and strategic commitment

Managerial leadership is most defensible when framed as an implementation function rather than an independent cause of adoption. Normalization Process Theory focuses attention on the work through which an intervention becomes understood, engaged with, enacted, and appraised in routine practice [17]. In a specialty dental center, managerial contribution can therefore be examined through concrete activities: defining priorities, assigning responsibility, protecting time for adaptation, coordinating across clinical and administrative roles, establishing escalation pathways, and responding to problems identified after deployment.

Case-based implementation-science analysis of electronic-health-record-driven learning systems illustrates why such coordination matters. Reported challenges included team-science demands, limited implementation-science expertise, data and technology constraints, time and resources, method fit, and equity considerations [18]. The settings were not specialty dental centers, but the managerial implication transfers more plausibly than any effect estimate: strategic commitment has to operate through interdependent conditions rather than substitute for them.

In Saudi specialty care, leaders may determine investment priorities, training expectations, ownership of interface failures, pilot-to-routine transition, vendor management, and privacy or security responsibility. These choices shape implementation conditions but do not prove success; weak interoperability, staff capability, workflow fit, or governance can still destabilize a strongly sponsored program.

The proposed interpretation is conditional. Managerial commitment may strengthen readiness when it coordinates infrastructure, workforce adaptation, workflow redesign, and governance. It becomes misleading when treated as a master variable independent of organizational constraints. Leadership should therefore be evaluated through what it enables, coordinates, and corrects rather than through endorsement alone.

Digital infrastructure and interoperability

Digital availability becomes infrastructure only when information can move dependably through the systems that a workflow actually uses. A comprehensive review of electronic health records and interoperability shows that as digital use expanded, data exchange, reuse, and integration became increasingly central while interoperability remained a persistent challenge [19]. Specialty dentistry adds its own interfaces: imaging, scanning, clinical records, scheduling, communication, and decision-support environments may each function independently yet create discontinuity when information crosses system boundaries.

Identity and access constitute a separate implementation seam. A rapid review of federated digital identifiers found considerable variation in implementation and adoption across jurisdictions and limited evidence about downstream effects on patient care [20]. The implication for specialty centers is not that a particular identity architecture should be adopted. Rather, authentication, access continuity, and identity matching should be treated as explicit infrastructure and governance functions.

Technology choices can exchange one problem for another. A systematic review of blockchain applications described potential advantages in privacy, interoperability, and information access alongside integration, cost, resistance, and security limitations [21]. Novel architecture therefore should not be assumed to solve interoperability; the information pathway must remain usable, traceable, secure, and compatible with clinical workflow.

For periodontal and orthodontic centers, interoperability should therefore be traced at specific seams rather than discussed as an abstract property. The relevant question is where information changes systems, formats, owners, or purposes, because these transitions create both operational and governance consequences.

Table 2. Proposed interoperability bottleneck trace for specialty-dental digital work

System	Input-to-seam trace	Failure expression	Accountability and continuity
Digital imaging environment	**Incoming dependency** → Image acquisition plus correct patient and encounter linkage **Integration seam** → Imaging-to-clinical-record association	Images require manual reconciliation or become detached from decision context	**Accountable function** — Clinical informatics or designated record stewardship **Validation/continuity need** — Verify identity matching, retrieval, and longitudinal accessibility
Intraoral scanning and treatment-planning environment	**Incoming dependency** → Scan files plus clinical records and planning software **Integration seam** → Device-to-planning handoff	Duplicate import, conversion, or version uncertainty interrupts planning	**Accountable function** — Specialty clinical lead with technical support **Validation/continuity need** — Confirm compatible transfer and version control before routinization
Electronic clinical record	**Incoming dependency** → Documentation, prior history, imaging links, and orders **Integration seam** → Record-to-scheduling and administrative workflow	Staff maintain parallel systems or repeat entry	**Accountable function** — Operational management and record governance **Validation/continuity need** — Test end-to-end workflow rather than isolated screen functionality
Remote communication channel	**Incoming dependency** → Patient communication plus encounter documentation **Integration seam** → Remote interaction-to-longitudinal record	Clinically relevant information remains outside the formal record	**Accountable function** — Clinical service management with privacy oversight **Validation/continuity need** — Define capture, escalation, and retention rules

AI-supported decision environment	**Incoming dependency** → Valid source images or data plus software output **Integration seam** → Source-data-to-output-to-clinician interpretation	Output becomes separated from provenance or human review	**Accountable function** — Clinical governance and specialty leadership **Validation/continuity need** — Validate task fit, provenance, oversight, and fallback process

Note: These are proposed interoperability trace points derived from the manuscript's organizational analysis, not documented failures in sampled Saudi dental centers.

Workforce digital competence and workflow adaptation

Workforce readiness is not equivalent to basic software familiarity. A validation study among Catalan health professionals found that digital competence varied across professional profiles and supported tailoring development strategies to workforce needs [22]. The numerical competence distribution is not transferable to Saudi dentistry, but the role-specific principle is: different staff members interact with digital systems through different tasks, responsibilities, and risks.

A scoping review further found that digital competence is defined and measured heterogeneously across technical, methodological, social, and personal dimensions, with many instruments relying heavily on self-assessment [23]. For periodontal and orthodontic centers, competence should therefore be treated as task-linked capability rather than a single personal attribute. A clinician interpreting an AI-supported image, a dental assistant acquiring a scan, and an administrative employee managing remote communication may all be digital users while requiring different competencies.

Training design also matters. A systematic review found generally favorable competence development with practical exercises, interaction, and support, while emphasizing heterogeneity in interventions and outcomes [24]. This supports practical, role-sensitive learning but not claims that a particular program will improve Saudi dental outcomes.

Competence must also be followed into workflow. After electronic patient record implementation in an Irish teaching hospital, high acceptance coexisted with concerns involving communication, documentation, and work organization [25]. Adoption can therefore coexist with friction requiring redesign. Specialty-dental support should continue beyond go-live training to handoffs, duplicate work, documentation burden, escalation, and role clarity.

Table 3. Proposed role-workflow adaptation matrix for digital specialty dental care

Role family	Responsibility	Digital task and competence	Managerial support	Risk and stability condition
Clinical roles	**Periodontal clinician**	**Task change** — Integrates longitudinal records, imaging, and digital decision inputs into assessment and follow-up **Competence requirement** — Interpretation, provenance checking, documentation, and recognition of technology limits	Protected learning time, specialty-specific protocols, and technical support	**Weak-adaptation risk** — Overreliance on incomplete information or parallel undocumented work **Adoption-stability condition** — Digital information is incorporated without displacing clinical judgment
Clinical roles	**Orthodontic clinician**	**Task change** — Uses scans, imaging, planning systems, remote information, or AI-supported outputs across treatment stages **Competence requirement** — Cross-system verification, planning oversight, and task-specific validation awareness	Defined planning workflow, escalation rules, and periodic review	**Weak-adaptation risk** — Version confusion, unverified output, or remote information used beyond task limits **Adoption-stability condition** — Tools remain integrated with clinician review and longitudinal records
Operational roles	**Clinical support staff**	**Task change** — Acquires or transfers images and scans and supports chairside digital tasks **Competence requirement** — Correct acquisition, patient linkage, file handling, and error recognition	Competency-based practice, supervised onboarding, and retraining after workflow change	**Weak-adaptation risk** — Mislinked or poor-quality inputs propagate downstream **Adoption-stability condition** — Acquisition standards and handoffs are repeatable across staff

Operational roles	**Administrative and records staff**	**Task change —** Coordinates scheduling, communication, access, and documentation across digital channels **Competence requirement —** Identity verification, record routing, privacy-aware communication, and exception handling	Clear responsibility maps and incident or escalation procedures	**Weak-adaptation risk —** Relevant information remains outside the formal record or reaches the wrong workflow **Adoption-stability condition —** Administrative channels connect reliably to clinical documentation
Team level	**Cross-role team**	**Task change —** Coordinates shared information across clinical and administrative work **Competence requirement —** Shared understanding of ownership for each handoff and exception	Routine workflow review rather than one-time technology training	**Weak-adaptation risk —** Duplicate entry, hidden workarounds, or responsibility gaps persist **Adoption-stability condition —** Problems are detected, assigned, corrected, and reassessed after deployment

Note: Role-workflow states are proposed synthesis. They do not describe a surveyed Saudi workforce or imply validated competency thresholds.

Patient-facing and clinical-decision technologies

Patient-facing and clinical-decision technologies make the distinction between technology availability and organizational readiness especially visible. Teleorthodontics illustrates the first boundary. In a US academic orthodontic setting during the COVID-19 period, patients reported high satisfaction and perceived time savings with teleorthodontic encounters, while provider perspectives were less uniformly positive [26]. This supports selected uses such as communication and follow-up, but the setting and period prevent a conclusion that remote care should replace comprehensive in-person orthodontic assessment in Saudi practice.

Artificial intelligence creates a different readiness problem because technical performance, clinical interpretation, and organizational implementation can diverge. A critical orthodontic review emphasized risk of bias, limited generalizability, and continuing specialist responsibility [27]. A subsequent scoping review found that AI did not consistently outperform experts and still required human supervision [28]. Orthodontic AI readiness therefore includes source-data quality, planning integration, provenance, professional oversight, and fallback workflow.

Periodontal AI should not be merged with orthodontic AI merely because both use machine learning. A 2026 systematic review of AI in periodontology identified expanding applications while highlighting risk-of-bias, external-validation, and generalizability concerns [29]. Periodontal adoption decisions may therefore depend on different source data, clinical tasks, longitudinal relationships, and validation expectations than orthodontic applications. The common organizational requirement is not one generic “AI readiness” score, but a task-specific ability to judge whether a digital output is sufficiently validated, interpretable, traceable, and compatible with the surrounding workflow.

Broader dental AI scholarship has emphasized limitations involving data quality and access, methodological rigor, demonstrated value, ethics, responsibility, generalizability, and trust [30]. These concerns prevent a technology-use-to-clinical-benefit inference. A center may be digitally advanced while appropriately declining to routinize a particular AI function when evidence, integration, or governance remains insufficient.

The preceding sections converge on a scientific rather than photographic representation of adoption readiness. **Figure 1** therefore maps where organizational, managerial, infrastructural, workforce, and clinical-technology conditions intersect before digital use can become routine specialty care.

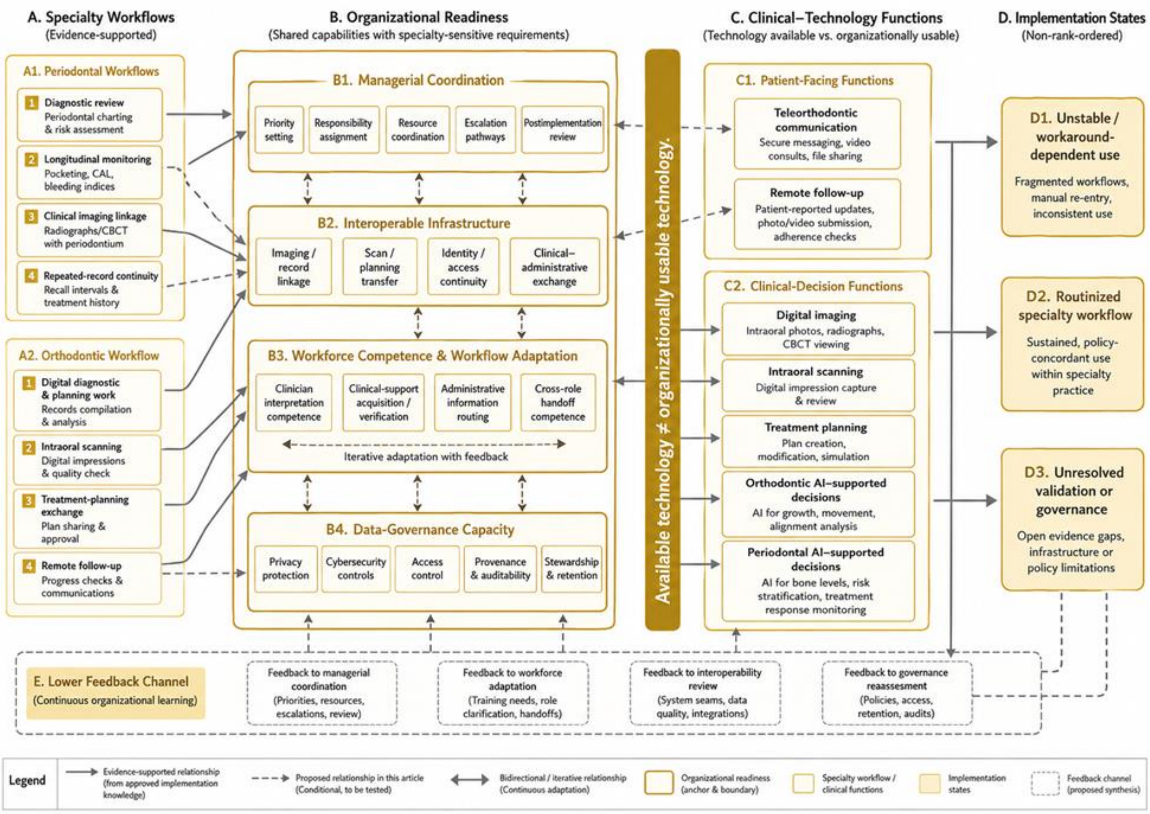

Figure 1. Cross-layer readiness field for digital adoption in Saudi periodontal and orthodontic care

Data governance, privacy, and cybersecurity

Digital adoption creates governance obligations that cannot be collapsed into a generic implementation barrier. Cybersecurity research in healthcare identifies vulnerability as sociotechnical, arising through combinations of human error, connected endpoints, legacy systems, insufficient investment, organizational processes, and rapidly changing technologies [31]. For periodontal and orthodontic centers, cybersecurity readiness cannot therefore be inferred from software procurement or technical safeguards alone. Access control, staff behavior, incident escalation, system maintenance, device management, and responsibility for third-party connections remain organizational functions.

Privacy introduces a related but analytically different problem. A systematic review of emerging digital technologies found that privacy concern and behavior vary with contextual factors including information sensitivity, recipient transparency, and conditions of data transmission [32]. Specialty dental information may move through imaging systems, treatment-planning environments, remote communication channels, cloud services, and longitudinal records, but the reviewed evidence does not establish a Saudi dental legal-compliance model for those flows. The organizational implication is narrower: governance controls should reflect what information is being used, why it is being accessed, who receives it, and where it moves.

Interoperability, privacy, and cybersecurity should consequently remain distinct even when they converge operationally. A system may exchange data effectively while exposing inappropriate access; conversely, restrictive controls may protect information while obstructing legitimate continuity of care. The proposed managerial task is to make these trade-offs explicit rather than classify all three as a single “digital barrier.” Governance should therefore be attached to data activity, sensitivity, access boundary, and continuity consequence.

Table 4. Proposed digital-governance decision ledger for specialty-dental information flows

Data-use scenario	Ledger entry	Decision detail	Continuity or compliance consequence
Clinical imaging linked to longitudinal records	**Exposure**	**Information sensitivity** — Identifiable diagnostic and treatment information **Access/interoperability boundary** — Imaging system to formal clinical record **Privacy/cybersecurity exposure** — Mislinking, excess access, or insecure transfer	

Clinical imaging linked to longitudinal records	**Control**	Role-based access, identity verification, and defined stewardship	Images remain traceable to the correct clinical context
Intraoral scan transferred into planning software	**Exposure**	**Information sensitivity** — Patient-specific anatomical data **Access/interoperability boundary** — Acquisition device to planning environment **Privacy/cybersecurity exposure** — Uncontrolled copying, version ambiguity, or third-party exposure	
Intraoral scan transferred into planning software	**Control**	Approved transfer pathway, version control, and access responsibility	Planning information remains attributable and recoverable
Remote orthodontic communication	**Exposure**	**Information sensitivity** — Patient communication and potentially clinical images **Access/interoperability boundary** — Patient-facing channel to formal record **Privacy/cybersecurity exposure** — Information retained outside governed records or transmitted insecurely	
Remote orthodontic communication	**Control**	Approved channel, escalation criteria, and documentation rule	Remote information enters the longitudinal care pathway appropriately
AI-supported image or data processing	**Exposure**	**Information sensitivity** — Source clinical data plus generated output **Access/interoperability boundary** — Clinical data environment to analytical system **Privacy/cybersecurity exposure** — Secondary use, unauthorized access, or uncertain provenance	
AI-supported image or data processing	**Control**	Defined input governance, human oversight, and output traceability	AI output remains linked to source data and professional interpretation
Cross-role record access	**Exposure**	**Information sensitivity** — Clinical, administrative, scheduling, and communication information **Access/interoperability boundary** — Clinical-administrative organizational boundary **Privacy/cybersecurity exposure** — Excess privilege or inappropriate disclosure	
Cross-role record access	**Control**	Minimum-necessary access, responsibility mapping, and periodic review	Staff perform legitimate tasks without undifferentiated access

Note: This ledger is a proposed organizational synthesis. It is not a cybersecurity assessment, privacy impact assessment, legal determination, or description of observed practices in Saudi specialty-dental centers.

A specialty-care adoption readiness architecture

The evidence across the preceding sections suggests that readiness is better represented as a configuration than as a single score. Implementation frameworks distinguish technology, users, organizational context, and sustainability [1], while contextual implementation research emphasizes interacting determinants rather than one dominant cause [3]. Digital maturity research likewise separates staff, processes, infrastructure, organizational rules, external conditions, and outcomes [4]. The proposed Specialty-Care Adoption Readiness Architecture therefore organizes readiness around six interacting conditions: workflow fit, managerial coordination, interoperable infrastructure, role-specific workforce capability, technology-specific clinical validity, and proportionate data governance.

Workflow fit concerns whether the technology supports the actual sequence through which specialty information is produced and acted upon. Managerial coordination concerns whether responsibility, resources, escalation, and adaptation are actively organized. Interoperable infrastructure concerns whether required data can cross system seams without unstable workarounds. Workforce capability concerns whether each role can perform, verify, and document its digital tasks. Clinical validity concerns whether the technology is sufficiently supported for the specific decision it is asked to inform. Governance concerns whether access, privacy, cybersecurity, provenance, and accountability remain proportionate to the information flow.

The architecture is explicitly proposed rather than empirically validated. Its central claim is not that all six conditions must reach a universal threshold. Instead, readiness is conditional: weakness in one condition may alter what another condition can accomplish. Managerial commitment cannot make a non-interoperable system interoperable; training cannot validate an inadequately evaluated AI application; and technically strong infrastructure cannot by itself resolve unclear workflow responsibility. Conversely, a clinically mature technology can remain organizationally unusable when access pathways, documentation responsibilities, or workforce competencies are unresolved.

Periodontal and orthodontic pathways also remain distinguishable within the architecture. Teleorthodontic follow-up, orthodontic planning, periodontal imaging, longitudinal periodontal monitoring, and AI-supported clinical tasks impose different information, validation, and coordination requirements. A shared organizational architecture can support both specialties without assuming identical readiness states. This distinction prevents the framework from collapsing specialty-specific evidence into a generic dental digitization model.

The architecture also separates readiness from realized benefit. A center may be ready to implement a tool whose clinical value remains uncertain, or possess a useful technology without the organization required for stable integration. It is therefore an implementation reasoning tool, not an outcome prediction model.

Implementation priorities for periodontal and orthodontic centers

The first proposed priority is workflow-specific readiness diagnosis before procurement or scale-up. Centers should identify the task being digitized, its information and system dependencies, affected roles, and evidence boundary. This prevents procurement from being mistaken for implementation.

Second, interoperability and governance should be designed together but evaluated separately. Saudi health-data evidence indicates that digitization can coexist with fragmented stewardship [7], while interoperability literature demonstrates that connectivity itself remains an implementation challenge [19]. Privacy and cybersecurity controls should therefore be incorporated into information-flow design rather than added after workflows are established. At the same time, a secure system that cannot support legitimate clinical continuity should not automatically be considered organizationally mature.

Third, workforce planning should be role-specific, practical, and continuous through postimplementation adaptation. Digital competence is multidimensional [23], educational approaches benefit from practical support [24], and postimplementation workflow friction can persist despite user acceptance [25]. Training should consequently extend from initial operation to verification, exception handling, documentation, troubleshooting, and reassessment after deployment.

Fourth, managers should establish explicit ownership of implementation seams. A large proportion of operational instability occurs not inside individual tools but where responsibility changes: image acquisition to interpretation, scan to planning, remote interaction to formal record, or AI output to clinician decision. Assigning ownership of these seams creates a managerial mechanism for identifying and correcting workarounds before they become normalized.

Finally, patient-facing and clinical-decision technologies should pass task-specific implementation gates addressing task purpose, input provenance, clinician oversight, record integration, and consequences of failure. Technical novelty alone is not organizational readiness. Proposed readiness dimensions require local validation before benchmarking, managerial evaluation, or policy comparison.

Conclusion

Digital technology adoption in Saudi periodontal and orthodontic care should be interpreted as an organizational configuration problem rather than a procurement event or simple measure of clinician acceptance. The proposed specialty-care adoption readiness architecture separates workflow fit, managerial coordination, infrastructure, workforce capability, clinical-technology validity, and governance while preserving their interactions. It also keeps periodontal and orthodontic workflows analytically distinct where their digital dependencies and validation requirements differ. The framework is conceptual, not a validated readiness instrument, causal model, or predictor of clinical benefit. Its contribution is to clarify conditions that should be examined before digital use is assumed mature and to identify where Saudi specialty-center evidence and prospective validation remain necessary.

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