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HUMAN–AI COLLABORATION READINESS AMONG ALLIED HEALTHCARE PROFESSIONALS IN SAUDI ARABIA: A NARRATIVE REVIEW

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1.2 Abstract

Background: Artificial intelligence (AI) is increasingly embedded in diagnostic, decision-support, and administrative workflows across healthcare systems. Allied healthcare professionals (AHPs) — including nurses, pharmacists, radiographers, laboratory technologists, physical and respiratory therapists — form the largest segment of the clinical workforce, yet their readiness for human–AI collaboration remains comparatively under-studied relative to physicians. Saudi Arabia's Vision 2030 digital-health agenda makes this an especially timely question for the Kingdom's health system.

Objective: This narrative review synthesizes recent evidence on AI readiness, trust, and adoption among allied healthcare professionals, with particular attention to the Saudi Arabian context, and proposes an integrative multi-level readiness framework.

Methods: A structured narrative literature search was conducted in PubMed for studies published largely between 2021 and 2026 addressing AI knowledge, attitudes, trust, and adoption among allied health and related clinical professionals. Twenty-three studies meeting relevance criteria were screened, extracted, and thematically synthesized; direct quotations were avoided in favor of original synthesis.

Results: Six recurring themes emerged: (1) a persistent knowledge–enthusiasm or awareness–practice gap; (2) a "trust-optimism paradox" in which positive general attitudes coexist with low trust in specific AI recommendations; (3) discipline-specific variation in perceived task fit across allied professions; (4) organizational and governance barriers to workflow integration; (5) uneven curricular and continuing-education preparation; and (6) a broader national digital-health readiness culture in Saudi Arabia that is more advanced at the policy level than at the point-of-care allied-workforce level.

Conclusions: Readiness for human–AI collaboration among Saudi allied healthcare professionals is best understood as a multi-level construct spanning individual, professional/task, organizational, and system layers. Calibrated — rather than blind — trust, built through transparent, explainable, and role-specific AI training, appears central to safe and sustained adoption. Targeted, profession-specific AI literacy programs aligned with Vision 2030 governance structures are recommended.

Keywords: artificial intelligence; allied health personnel; technology adoption; trust; Saudi Arabia; Vision 2030; human-AI collaboration; digital health readiness

2. Introduction

Artificial intelligence (AI) is no longer a peripheral experiment in healthcare; it is progressively woven into diagnostic imaging, laboratory analytics, clinical decision support, documentation, and hospital operations. A recent scoping review of 140 empirical studies of human–AI collaboration in healthcare found that most evidence to date concentrates on diagnostic interpretation, with far fewer studies addressing screening, triage, therapeutic decision-making, or administrative workflows, and that benefit from human–AI teaming depends heavily on task fit, workflow integration, adequate training, and appropriately calibrated — rather than blanket — trust (Strong et al., 2026).

Much of the empirical literature on AI readiness has historically centered on physicians and, more recently, nurses and nursing students, leaving a comparatively thinner evidence base for the broader category of allied healthcare professionals (AHPs) — pharmacists, radiographers and imaging technologists, laboratory and phlebotomy staff, physical and respiratory therapists, and related disciplines. These groups nonetheless perform much of the day-to-day, high-volume clinical and pre-analytical work into which AI tools are being introduced, from AI-assisted image triage in radiography departments to automated result-flagging in clinical laboratories. Understanding their readiness for human–AI collaboration is therefore not a secondary question but a central one for safe, effective implementation.

Saudi Arabia offers a particularly instructive setting in which to examine this question. Vision 2030 has driven substantial national investment in digital health infrastructure, value-based care reform, and medical-education modernization (Al-Jedai et al., 2026; Al-Jehani et al., 2026), and Saudi patients and the public already show relatively high willingness to adopt digital-health tools such as telenutrition and mobile-health applications for chronic-disease self-management (Eid, 2026; Alshahrani, 2025). Whether this policy-level and public-level readiness is mirrored among the allied healthcare workforce who will operate AI-enabled tools at the point of care is a distinct and under-examined question.

This narrative review addresses three related aims: first, to synthesize what is currently known about AI knowledge, attitudes, trust, and adoption among allied healthcare professionals, drawing on both Saudi-specific and closely comparable regional and international evidence; second, to identify recurring cross-cutting themes that characterize readiness (or its absence) across allied disciplines; and third, to propose an integrative, multi-level framework that can guide workforce-development and governance efforts for human–AI collaboration in Saudi allied healthcare settings.

3. Methods

3.2 Design

This is a narrative (non-systematic) literature review. Given the heterogeneity of allied health disciplines and outcome measures involved, and the goal of synthesizing cross-cutting conceptual themes rather than pooling effect sizes, a narrative rather than systematic or meta-analytic design was judged most appropriate, consistent with recommended practice for emerging, conceptually diverse fields.

3.3 Search strategy

A structured search was conducted in PubMed covering publications primarily from 2021 through mid-2026. Search terms combined concepts of artificial intelligence with readiness, adoption, knowledge/attitudes/practice, trust, and human-AI collaboration, cross-referenced with terms for allied health personnel, nurses, pharmacists, radiographers, laboratory technologists, physical therapists, and Saudi Arabia. Reference lists of key reviews were also examined to identify additional relevant studies (snowball approach).

3.4 Eligibility and selection

Studies were included if they reported empirical data (quantitative, qualitative, or mixed-methods), a systematic/scoping review, or a substantive narrative/perspective analysis addressing AI knowledge, attitudes, trust, adoption, or organizational readiness among healthcare professionals, with priority given to (a) allied health disciplines specifically, (b) Saudi Arabian settings, and (c) closely comparable Gulf/Middle Eastern or international contexts offering transferable insight. Purely technical AI-performance studies

(e.g., diagnostic-accuracy validation without a human-factors component) were excluded unless they contributed directly to discussion of trust or workflow integration. Twenty-three studies met these criteria and were retained for thematic synthesis; their key characteristics are summarized in Table 1.

3.5 Synthesis approach

Included studies were extracted into a structured evidence table (author/year, country, design, population, key findings, and relevance) and then grouped inductively into recurring themes through iterative comparison. No original quotations from included articles are reproduced; all findings are synthesized and paraphrased in the author's own words, in keeping with academic paraphrasing standards.

4. Results

Table 1 summarizes the 23 studies retained for synthesis, spanning Saudi Arabia, neighboring Gulf/Middle Eastern countries (Jordan), and internationally comparable settings (Germany, China, Portugal, Pakistan, Canada, Türkiye, Italy, Sweden, France, India). Six cross-cutting themes emerged from this evidence base.

4.2 Table 1. Evidence extraction summary

Author (Year)	Setting	Design	Population	Key finding	Relevance
Abedin et al. (2026)	Germany	Cross-sectional survey (n=148)	Mixed healthcare professionals	High AI enthusiasm (86.5%) but only 20.3% felt well-informed; knowledge-enthusiasm gap uncorrelated (r<0.20)	Individual-level readiness gap
Venkatesan et al. (2026)	Saudi Arabia (Asir region)	Cross-sectional KAP survey (n=333)	Pharmacy students & graduates	82.6% AI-aware, but only 42.3% used AI tools; awareness-practice gap	Direct Saudi allied-health evidence
Mersal et al. (2026)	Saudi Arabia (5 universities)	Multicenter cross-sectional (n=622)	Nursing students	Positive attitudes (3.94/5) yet low trust in AI recommendations (2.28/5); trust-optimism paradox	Direct Saudi trust-calibration evidence
Abu Assab et al. (2026)	Jordan	Qualitative, reflexive thematic analysis (n=22)	Physicians, nurses, pharmacists, allied health	Conditional trust; AI viewed as adjunct not substitute; accountability and system-readiness concerns	Regional professional trust model
Kılıç et al. (2026)	Türkiye	Instrument validation (n=412)	Nursing students	Validated 8-item AI Perception Scale (Turkish); two-factor structure (role impact, preparedness)	Measurement tool for readiness
Ringeval et al. (2026)	Canada	Survey, NCA/fsQCA (n=177)	Medical students	Belief in future relevance and positive curricular attitude are necessary conditions for adoption intention	Educational readiness determinants
Shawli et al. (2024)	Saudi Arabia	Qualitative interviews	Physical therapists	Perceived workflow benefits but concerns over patient-privacy, therapeutic relationship, and over-reliance	Direct Saudi allied-health evidence
Ahmed et al. (2024)	Pakistan	Multicentre cross-sectional (n=342)	Clinical laboratory technical staff	76.3% favored more AI use; concerns over security and reduced personal touch	Laboratory/allied-health parallel

Author (Year)	Setting	Design	Population	Key finding	Relevance
Oliveira-Sousa et al. (2025)	Portugal	Cross-sectional survey (n=66)	Nuclear medicine & radiotherapy technologists	Infrastructure often present but clinical implementation of advanced imaging AI remained limited (<10%)	Infrastructure-practice gap in AHPs
Conti et al. (2026)	Italy	Viewpoint/review	Radiologists (breast imaging)	AI can introduce new cognitive biases (anchoring, automation, confirmation) alongside benefits; explainability aids calibrated trust	Cognitive/human-factors dimension
Strong et al. (2026)	International (scoping review)	Scoping review (140 studies)	Mixed clinical professionals	Effective human-AI collaboration depends on task fit, workflow integration, training, and calibrated trust	Core theoretical synthesis
Khumalo & Alaqra (2026)	Sweden	Qualitative interviews (UTAUT lens)	Oncology healthcare professionals	Acceptance driven by trust and workflow alignment; risk of automation bias and skill erosion	Theoretical (UTAUT) grounding
Shi et al. (2026)	China	Nationwide cross-sectional (n=4024)	Physicians	Extended UTAUT: performance expectancy, social influence, facilitating conditions predict >90% acceptance	Large-scale UTAUT validation
Ye et al. (2025)	China (Greater Bay Area)	Cross-sectional PLS-SEM (n=163)	Family caregivers (AI nursing tech.)	Trust and institutional support drive adoption intention; perceived risk weakens social influence	Trust-risk modeling parallel
Haykal (2026)	France	Narrative review	Hospital systems	Sustainable AI integration requires workflow alignment, clinician co-design, and interdisciplinary governance	Organizational-level readiness
Aldosari (2026)	Saudi Arabia	Critical narrative review	Healthcare administration/informatics	Proposes governance roadmap emphasizing data readiness, validation, and workforce readiness	Saudi system-level governance model
Abu Assab et al.† / Certo et al. (2026)	Portugal	Qualitative (28 interviews)	Public-health experts	Readiness depends less on technology than governance, interoperability, and workforce capacity	System-level readiness parallel
Al-Jehani et al. (2026)	Saudi Arabia	Narrative review	Medical education	AI integration in curricula growing but formal competencies (data literacy, ethics) remain limited	Saudi educational-readiness context
Al-Jedai et al. (2026)	Saudi Arabia	Perspective paper	National health system (Vision 2030)	Digital/value-based care reforms advancing, but fragmented systems and	Saudi system-level digital context

Author (Year)	Setting	Design	Population	Key finding	Relevance
				limited HTA capacity persist	
Eid (2026)	Saudi Arabia	National cross-sectional (n=930)	Public (telenutrition)	54.9% willing to use telenutrition; digital-readiness clusters vary by demographic group	Saudi digital-health readiness culture
Alshahrani (2025)	Saudi Arabia	Cross-sectional (n=1098)	Hypertension patients (mHealth)	85.6% willingness to adopt mHealth; education level predicts adoption	Saudi digital-health readiness culture
Oweidat et al. (2025)	Jordan	Cross-sectional correlational	Nurses	Positive AI attitudes/practices predicted intent to stay; barriers reduced retention	Workforce-retention link to AI
Theophilus Yesupatham et al. (2026)	India	Cross-sectional (n=268)	Medical (biochemistry) undergraduates	High awareness (88.4%) but only 19% formally trained; willingness to train (52.6%)	Education-training gap parallel

4.3 Theme 1: The knowledge–enthusiasm and awareness–practice gap

Across disciplines and countries, a strikingly consistent pattern is a mismatch between positive general attitudes toward AI and actual knowledge or practical use. Among a mixed sample of healthcare professionals in Germany, 86.5% believed AI would transform medical practice, yet only 20.3% felt well informed about healthcare AI, and knowledge and enthusiasm correlated only weakly ($r < 0.20$) (Abedin et al., 2026). A closely parallel pattern appeared in a Saudi sample of pharmacy students and graduates centered on the Asir region, where 82.6% reported AI awareness and 76.9% familiarity with ChatGPT specifically, yet only 42.3% had actually used AI tools for academic or professional purposes (Venkatesan et al., 2026). Medical undergraduates in India showed an analogous profile: high awareness (88.4%) alongside minimal formal training (19%), though more than half expressed willingness to undergo structured AI training (Theophilus Yesupatham et al., 2026). Together, these findings suggest that enthusiasm alone is a poor proxy for readiness, and that awareness-raising campaigns without accompanying structured competency-building are unlikely to close the practical adoption gap.

4.4 Theme 2: The trust-optimism paradox and calibrated trust

A second, related theme concerns the specific role of trust as distinct from general attitude. In a multicenter Saudi study of 622 nursing students across five universities, overall attitudes toward AI were strongly positive (mean 3.94/5.00) and perceived benefits were rated highly (3.98/5.00), yet trust in AI-generated clinical recommendations specifically was low (2.28/5.00) — a pattern the authors termed a "trust-optimism paradox" (Mersal et al., 2026). Notably, perceived risk was positively, not negatively, associated with trust, suggesting that awareness of AI's limitations may paradoxically support more confident and appropriately calibrated engagement, particularly among students with prior AI education. Qualitative work among Jordanian healthcare professionals — including physicians, nurses, pharmacists, and allied health staff — similarly found "conditional" rather than blanket trust, with AI viewed as an adjunct to, rather than a substitute for, professional judgment, and accountability, algorithmic bias, and system readiness cited as recurring concerns (Abu Assab et al., 2026). Comparable dynamics appear internationally: oncology professionals in Sweden described trust as pivotal to acceptance and as something that both precedes and grows from successful integration (Khumalo & Alaqra, 2026); a large Chinese physician survey using an extended Unified Theory of Acceptance and Use of Technology (UTAUT) model found organizational support and perceived clinical benefit — rather than raw familiarity — as the strongest predictors of acceptance (Shi et al., 2026); and a UTAUT-based study of family caregivers of AI-nursing-technology users in China found that trust and institutional support positively predicted adoption intention while

perceived risk weakened the effect of social influence (Ye et al., 2025). Collectively, this theme indicates that the operative construct for readiness is not trust in the abstract, but calibrated trust — confidence proportionate to a system's demonstrated and explainable reliability.

4.5 Theme 3: Discipline-specific variation in perceived task fit

Readiness is not uniform across allied disciplines; it appears to depend substantially on how directly AI intersects with a profession's core tasks. Saudi physical therapists, interviewed qualitatively, welcomed AI's potential to support treatment planning and outcome prediction but expressed concern about data privacy, erosion of the therapeutic relationship, and over-reliance undermining clinical judgment (Shawli et al., 2024). Clinical laboratory technical staff in Pakistan expressed broadly favorable views (76.3% in favor of expanded AI use, citing time savings and improved test performance) while raising security concerns and, among younger staff particularly, fear of job displacement (Ahmed et al., 2024). Nuclear medicine and radiotherapy technologists in Portugal illustrated a related but distinct pattern: most departments already possessed AI/imaging-compatible infrastructure, yet actual clinical use of advanced applications (e.g., PET-based tumor-hypoxia assessment) remained below 10%, indicating that infrastructure readiness does not automatically translate into practice readiness (Oliveira-Sousa et al., 2025). In diagnostic radiology, a viewpoint analysis of breast-imaging AI cautioned that integration without adequate understanding of consequences can introduce new cognitive biases — anchoring, automation bias, and confirmation bias — that a radiologist's existing analytical skill must be preserved and reinforced, rather than displaced, to counteract (Conti et al., 2026). These discipline-specific findings suggest that a single, generic “AI readiness” instrument is unlikely to capture the construct adequately across the full range of allied professions.

4.6 Theme 4: Organizational and governance barriers

Even where individual professionals are receptive, organizational and system-level barriers frequently constrain workflow integration. A narrative analysis of AI integration into hospital workflows identified fragmented electronic medical record systems, inconsistent data quality, financial constraints, cybersecurity risk, and resistance to workflow disruption as recurring obstacles, and emphasized that sustainable adoption depends on phased deployment, clinician co-design, and interdisciplinary governance rather than technical performance alone (Haykal, 2026). A Saudi-authored critical review proposed a governance roadmap for AI in healthcare administration and clinical informatics emphasizing data readiness, model validation, workflow integration, institutional accountability, post-deployment monitoring, and workforce readiness as jointly necessary conditions (Aldosari, 2026). Findings from Portuguese public-health experts similarly concluded that progress in AI-enabled surveillance depends less on the maturity of the underlying technology than on systemic reform, data harmonization, and governance aligned with recognized international frameworks (Certo et al., 2026). At the Saudi national level, a perspective paper on the shift toward value-based healthcare under Vision 2030 documented meaningful progress in digital-health integration and real-world data infrastructure, but also persistent fragmentation across systems and limited technical capacity for advanced health-technology assessment (Al-Jedai et al., 2026) — a policy-level picture that is broadly consistent with, and helps contextualize, the workflow-level barriers reported elsewhere in this literature.

4.7 Theme 5: Uneven educational and curricular preparation

A fifth theme concerns the adequacy of formal training relative to the pace of AI deployment. A Canadian survey of medical students using Necessary Condition Analysis and fuzzy-set Qualitative Comparative Analysis found that a belief in the future clinical relevance of AI and a positive attitude toward its inclusion in the curriculum were themselves necessary — not merely helpful — conditions for strong adoption intentions, implying that curricular design must build motivation and perceived relevance, not only technical familiarity (Ringeval et al., 2026). A Saudi narrative review of AI in medical education described growing use of adaptive learning platforms, simulation, and AI-supported assessment under the Vision 2030 umbrella, but noted that formal integration of AI-related competencies — data literacy, algorithm interpretation, ethical use — remains limited within current curricula (Al-Jehani et al., 2026). Instrument-development work in Türkiye, validating an 8-item Turkish version of the Shinners AI Perception Scale

among nursing students, offers a practical measurement tool — spanning perceived impact on professional role and perceived preparedness — that could be adapted for Arabic-language use in Saudi allied-health education and workforce-readiness assessment (Kılıç et al., 2026).

4.8 Theme 6: A national digital-health readiness culture that outpaces point-of-care AI readiness

Finally, evidence from the Saudi general population and patient groups suggests a broader digital-health readiness culture that is, at present, more advanced than the AI-specific readiness documented among allied professionals. A national cross-sectional survey found 54.9% of Saudi adults willing to use telenutrition services, rising to 78.5% when considering a family member, alongside distinct "digitally engaged," "selective," and "hesitant" adoption segments (Eid, 2026). Similarly, 85.6% of surveyed hypertension patients expressed willingness to adopt mobile-health applications for self-management (Alshahrani, 2025). This relatively high public willingness to engage with digital-health tools, set against the more cautious, conditional, and unevenly distributed readiness documented among nurses, pharmacists, and other allied professionals in Themes 1–5, suggests that closing the AI-readiness gap in Saudi healthcare may depend as much on workforce-facing investment as on continued public-facing digital-health expansion.

5. Discussion

Synthesizing across these six themes, readiness for human–AI collaboration among allied healthcare professionals emerges not as a single trait but as a multi-level construct. Figure 1 proposes an integrative framework in which individual-level factors (AI knowledge, calibrated trust, attitudes, and perceived risk–benefit balance) are nested within, and shaped by, professional/task-level factors (scope-of-practice fit, role-specific training, interprofessional collaboration), which are in turn shaped by organizational-level factors (infrastructure, leadership support, institutional governance) operating within a system-level policy environment (national digital-health strategy, Vision 2030 alignment, regulatory frameworks). The framework depicts these levels as mutually reinforcing rather than strictly hierarchical: individual clinicians' calibrated trust both depends on, and provides feedback to, organizational and system-level governance decisions.

This framework helps reconcile findings that might otherwise appear contradictory. For example, the coexistence of high enthusiasm with low practical trust (Themes 1–2) is not paradoxical once trust is recognized as a professional/task-level phenomenon requiring role-specific evidence of reliability, rather than a simple extension of general technology optimism. Likewise, the observation that infrastructure readiness in Portuguese imaging departments did not translate into clinical-practice adoption (Theme 3) is consistent with an organizational-level bottleneck — workflow integration and interdisciplinary training — sitting between infrastructure and individual use, exactly as the framework's organizational layer predicts.

For the Saudi context specifically, several practical implications follow. First, given the awareness-practice gap documented even among Saudi pharmacy trainees (Venkatesan et al., 2026), structured, discipline-specific AI-literacy curricula — rather than generic awareness sessions — appear necessary across allied health training programs, echoing the curricular recommendations of Al-Jehani et al. (2026). Second, because trust appears to be calibrated through transparency and explainability rather than generated by exposure alone, Saudi institutions introducing AI-assisted tools into laboratory, imaging, pharmacy, or rehabilitation workflows should prioritize explainable-AI design and structured, supervised exposure over passive rollout. Third, the governance-roadmap literature (Aldosari, 2026; Haykal, 2026) suggests that Saudi healthcare organizations — including quality and patient-safety functions such as those overseeing phlebotomy, laboratory, and other allied-service KPI frameworks — are well positioned to extend existing accreditation-aligned quality-management structures (e.g., CAP, JCI, CBAHI) to encompass AI-specific governance domains: data readiness, model validation, workforce competency, and post-deployment monitoring. Finally, the national digital-health readiness culture evident among Saudi patients (Eid, 2026; Alshahrani, 2025) represents an underused asset: public comfort with digital-health tools could be leveraged to build parallel confidence among the allied workforce through shared platforms, transparent communication, and phased, clinician-co-designed implementation.

6. Strengths and Limitations

This review's principal strength is its explicit focus on allied healthcare professionals — a workforce segment often subsumed under broader "healthcare professional" categories in prior AI-readiness literature — and its attempt to integrate Saudi-specific, regional, and international evidence into a single conceptual framework relevant to Vision 2030 workforce planning.

Several limitations should be acknowledged. As a narrative rather than systematic review, this synthesis does not follow PRISMA methodology, was not registered prospectively, and may be subject to selection bias in study identification; formal risk-of-bias appraisal and meta-analytic pooling were not undertaken. Direct empirical evidence specific to Saudi allied health disciplines beyond nursing and pharmacy — for example, phlebotomy, respiratory therapy, and rehabilitation professionals specifically within Saudi Arabia — remains sparse in the indexed literature, so several themes rely on closely comparable regional (Jordanian) or international evidence extrapolated to the Saudi context; this extrapolation should be interpreted as informative rather than definitive. Most included primary studies are cross-sectional and self-reported, limiting causal inference about the drivers of trust and adoption, and several instruments (e.g., the Shinners scale) remain in early stages of cross-cultural validation, with no Arabic-language validation yet identified in this search. Finally, the field is moving rapidly; several included studies were published in the first half of 2026, and the evidence base should be expected to expand and shift meaningfully within a short time horizon.

7. Conclusion

Readiness for human–AI collaboration among allied healthcare professionals in Saudi Arabia is shaped jointly by individual knowledge and calibrated trust, profession-specific task fit, organizational workflow integration and governance, and the broader Vision 2030 digital-health policy environment. Current evidence indicates a workforce that is generally enthusiastic but unevenly trained, trusting conditionally rather than uncritically, and operating within organizations whose infrastructure sometimes outpaces their governance and training investment. Advancing genuine readiness will likely require discipline-specific AI-literacy curricula, transparent and explainable AI tools, extension of existing accreditation-aligned quality frameworks to cover AI governance, and continued leveraging of the strong digital-health readiness already evident among the Saudi public. Future primary research directly targeting Saudi allied health disciplines beyond nursing and pharmacy — including phlebotomy, laboratory medicine, radiography, and rehabilitation professions — is needed to validate and refine the framework proposed here.

8. Declarations

Ethics approval and consent to participate: Not applicable. This is a narrative literature review of previously published, publicly available studies and did not involve human participants, primary data collection, or identifiable personal data.

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Data availability: No new data were generated or analyzed for this review; all sources synthesized are cited and publicly indexed in PubMed.

9. Figure

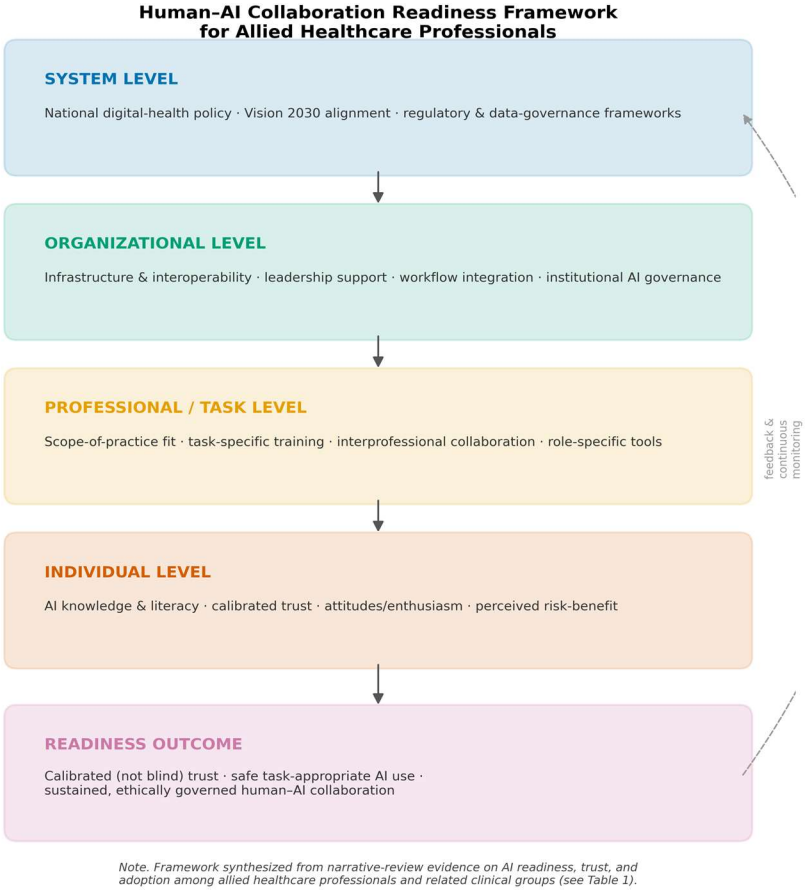

Figure 1. Proposed multi-level Human–AI Collaboration Readiness Framework for allied healthcare professionals, synthesized from the narrative-review evidence summarized in Table 1.

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