



CONTINUING PROFESSIONAL DEVELOPMENT IN MEDICAL LABORATORY SCIENCES, DENTAL ASSISTING, NURSING, AND HEALTH ADMINISTRATION

Ahood Saleh Alhomidi¹, Alhanouf Ahmed Al-Buraik², Abdullah Masad Sanat Almutairi^{3*},
Noof Omar Kaseb Aljohani⁴, Fann Hamoud Daher Alanazi⁵, Ranyah Mubarak Bajad
Alotibia⁶

^{1, 4, 5}Dental Department, Armed Forces Hospital–King Abdulaziz Air Base (KAAB) — Dhahran,
Eastern Province, Saudi Arabia

²Health Administration Department, Armed Forces Hospital–King Abdulaziz Air Base (KAAB) —
Dhahran, Eastern Province, Saudi Arabia

^{3*}Nursing Department, Qassim Armed Forces Hospital (QAFH) — Buraidah, Qassim, Saudi Arabia

⁶Nursing Department, Qassim Armed Forces Hospital (QAFH) — Buraidah, Qassim, Saudi Arabia

Abstract

Background: Continuing professional development (CPD) is expected to maintain competence as technology, regulation, service models and patient expectations change. Evidence and regulatory systems are uneven across medical laboratory sciences, dental assisting, nursing and health administration.

Objective: To map current CPD practices, requirements, delivery methods, participation patterns, barriers, facilitators, outcomes and future competency needs across the four professions.

Methods: A rapid scoping review was conducted using Joanna Briggs Institute principles and reported with PRISMA-ScR. Structured searches of PubMed/MEDLINE and PubMed Central, citation chaining and targeted searches of authoritative organizations were completed to 1 July 2026. The PCC framework included qualified professionals in the four fields, CPD and related lifelong-learning concepts, and healthcare, professional, educational and regulatory contexts worldwide. One reviewer screened and charted evidence. Descriptive and thematic synthesis was used; no meta-analysis was undertaken.

Results: Seventy-five records were logged, eight duplicate title/DOI entries were removed, and 67 unique records were screened. Forty-six sources were included: 38 scholarly sources and eight official regulatory or credentialing documents. The scholarly evidence comprised 8 laboratory, 6 dental-assisting, 10 nursing, 9 health-administration and 5 cross-professional sources. Nursing had the broadest evidence base; dental-assisting evidence was sparse and frequently embedded in mixed dental teams. Across professions, time, workload, cost, staff shortages, course relevance and employer support shaped participation. Online learning improved access and commonly improved knowledge or confidence, but sustained practice, patient and organizational outcomes were less consistently measured. Regulatory models ranged from fixed hours or points to reflective portfolio and revalidation systems.

Conclusion: CPD systems should move from attendance counting toward needs-based, competency- and outcomes-oriented models. Shared priorities include digital literacy, communication, teamwork, quality improvement, ethics, leadership, research literacy and change management, alongside

profession-specific technical competencies. Stronger employer support, protected time, equitable digital access and objective outcome evaluation are required.

Key Words: continuing professional development; continuing education; medical laboratory science; dental assistants; nursing; health services administration; lifelong learning; competency-based education; workplace learning; scoping review.

Introduction

Continuing professional development (CPD) is a career-long process through which health professionals maintain, extend and demonstrate the knowledge, skills, judgement and professional behaviours required for safe and effective practice. It is broader than traditional continuing education, which usually refers to discrete courses or credit-bearing activities. CPD may include formal education, self-directed learning, workplace learning, mentoring, simulation, quality-improvement work, reflective practice, certification, recertification and revalidation. The defining feature is purposeful development related to current or anticipated professional practice rather than attendance alone [1,5].

The case for CPD has strengthened as health systems face rapid technological change, complex regulation, workforce shortages, new disease threats, digital transformation and rising expectations for safety, transparency and patient-centred care. These pressures affect all health professions but do so in different ways. Laboratory professionals must keep pace with molecular diagnostics, automation, quality systems, point-of-care testing, biosafety and data interpretation. Dental assistants require current chairside, radiography, infection-prevention, occupational-safety, patient-communication and digital-dentistry capabilities. Nurses must maintain broad clinical competence while integrating evidence-based practice, digital health, simulation, leadership, care coordination and advanced roles. Health administrators require strategic leadership, finance, workforce planning, quality improvement, analytics, informatics, artificial-intelligence governance, cybersecurity and crisis management.

The four professions are operationally interconnected. Laboratory data inform diagnosis, monitoring and population surveillance; nurses translate diagnostic and therapeutic plans into direct care; dental assistants support safe and efficient oral-health delivery; and administrators design the structures, resources, governance and performance systems within which these professionals work. In large integrated or military healthcare systems, failures in one professional learning system can affect multiple downstream services. A cross-professional review can therefore reveal shared barriers and system-level solutions while preserving profession-specific competence.

CPD policy has increasingly shifted from input models, which count hours or credits, toward models that require reflection, evidence of relevance and demonstration of effects on practice. However, this shift is incomplete. Fixed-hour systems remain common because they are simple to administer, whereas outcome-based systems are harder to standardize and audit. Evidence also suggests that knowledge gain is easier to demonstrate than durable behavior change, service improvement or patient benefit [5,8,9]. This creates a risk that organizations equate compliance with learning and learning with improved outcomes without measuring the intermediate steps.

The literature is uneven. Nursing CPD has been addressed by multiple reviews, whereas dental assistants are often grouped with dentists, hygienists or other dental healthcare workers. Medical laboratory evidence has expanded, particularly in African settings, but remains geographically concentrated. Health-administration literature often focuses on leadership competencies, formal development programs or professional credentials rather than CPD participation as a unified

construct. No recent review was identified that compared current practice, regulation, participation, outcomes and future needs across these four professions while treating dental assisting independently.

This scoping review therefore aimed to map current CPD practices and regulatory requirements; identify delivery methods, participation and completion patterns; synthesize barriers, facilitators and reported outcomes; compare the four professions; and identify emerging competencies and strategies for stronger CPD systems. The review was designed to answer nine questions covering current practice, regulatory requirements, delivery, participation, determinants, outcomes, interprofessional differences, future needs and system-strengthening strategies.

Table 1. Definitions and conceptual distinctions used in the review

Term	Working definition	Interpretation in this review
Continuing professional development	Career-long, purposeful maintenance and development of competence, professional behaviour and capability.	Umbrella concept encompassing formal, informal, workplace, digital and reflective learning.
Continuing education / continuing professional education	Discrete post-qualification educational activity, often measured in contact hours or credits.	Treated as one component or delivery mechanism of CPD.
Lifelong learning	Ongoing learning across the professional lifespan, including self-directed and informal learning.	May occur outside regulatory documentation or accredited activities.
Competency maintenance	Activities and assessment intended to preserve safe performance of defined professional tasks.	Includes simulation, observed practice, audit, checklists and proficiency assessment.
Workplace learning	Learning embedded in routine work, mentoring, supervision, case review and quality improvement.	May be formal or informal; organizational culture strongly influences effectiveness.
Certification/recertification	Credentialing process verifying competence against defined standards and maintenance requirements.	May be mandatory for a role or voluntary as a professional credential.
Revalidation/re-registration	Periodic renewal demonstrating continued fitness to practise.	May combine hours, practice evidence, feedback, reflection, declarations and portfolio review.

2. Methods

2.1 Design and reporting

A rapid scoping-review design was used because the objective was to map a heterogeneous body of empirical studies, reviews, program evaluations and regulatory documents rather than estimate a single intervention effect. The methods followed the JBI approach to scoping reviews and the PRISMA extension for scoping reviews (PRISMA-ScR) [2–4]. The term “rapid” indicates the use of

a single reviewer and accessible bibliographic and official sources rather than a fully duplicated, subscription-database workflow.

2.2 Eligibility framework

Eligibility was structured using Population, Concept and Context (PCC). The population comprised qualified professionals in medical laboratory sciences, dental assisting, nursing and health administration. Dental assisting was searched specifically using dental assistant, dental assisting, dental auxiliary, dental support personnel, dental healthcare personnel and dental nurse terminology. Dentistry-only evidence was excluded unless dental-assistant data were separately reported or the study provided directly relevant team-level evidence.

Table 2. Information sources, search dates and records logged

Source	Search date	Coverage	Records logged	Use
PubMed/MEDLINE	1 July 2026	2015–1 July 2026; older landmarks allowed	52	Structured profession-specific combinations of CPD and workforce terms.
PubMed Central and citation chaining	1 July 2026	No additional date restriction for landmark evidence	9	Full-text verification, backward and forward citation leads.
Official regulatory, credentialing and professional websites	1 July 2026	Current requirements	14	Targeted searches of SCFHS, ASCP BOC, HCPC, GDC, DANB, NMC, NMBA and ACHE plus supporting pages.
Total initially logged			75	Eight duplicate title/DOI records were removed before screening.

Table 3. Eligibility criteria using the PCC framework

Domain	Inclusion	Exclusion
Population	Qualified medical laboratory professionals; dental assistants/dental nurses/auxiliaries; nurses; health administrators, healthcare managers and health information managers.	Pre-licensure students unless directly relevant to transition-to-practice; dentists/hygienists without extractable dental-assistant evidence; unrelated professions.
Concept	CPD, continuing education, lifelong learning, competency maintenance, workplace learning, mandatory education, certification, recertification, revalidation, simulation and	Initial qualification only; patient education; general training without professional-development relevance.

Domain	Inclusion	Exclusion
	online learning.	
Context	Hospitals, primary care, laboratories, dental clinics, military or integrated systems, universities, professional associations, regulators and public/private healthcare organizations worldwide.	Non-health settings without direct relevance.
Evidence type	Primary quantitative, qualitative and mixed-method studies; systematic/scoping reviews; program evaluations; official standards and reports.	Promotional material, opinion without substantive evidence, unverifiable sources and duplicates.
Publication period/language	January 2015–1 July 2026; older landmark studies when essential; English or reliably translated evidence.	Older non-landmark material; sources that could not be interpreted reliably.

2.3 Search strategy

The search combined controlled vocabulary where available with title/abstract keywords for CPD and each profession. The core CPD block included “continuing professional development,” “continuing education,” “professional development,” “lifelong learning,” “competency development,” “competency maintenance,” “workplace learning,” “mandatory education,” recertification, revalidation, online learning and simulation-based education. Separate profession blocks reduced the risk that the large nursing literature would obscure smaller dental-assisting and laboratory evidence bases.

2.4 Selection and data charting

The search log contained 75 records. Titles and DOI identifiers were normalized and 8 duplicate records were removed. One reviewer screened 67 unique records against the PCC criteria. Twenty-one records were excluded because they did not address CPD, concerned initial education only, included dentistry without relevant dental-assistant information, involved an ineligible population or lacked substantive evidence. Forty-six sources proceeded to synthesis. Because screening was not independently duplicated, reviewer agreement statistics were not calculated.

A structured data-charting form captured citation, year, country/region, profession, design, setting, sample, CPD definition, mandatory or voluntary status, delivery format, participation or completion data, barriers, facilitators, competency domains, outcomes, numerical estimates and limitations. Numerators and denominators were retained when available. Self-reported outcomes were distinguished from objective knowledge tests, observed competence, practice change, patient outcomes and organizational outcomes.

2.5 Synthesis and appraisal

Evidence was grouped into cross-professional, medical laboratory sciences, dental assisting, nursing and health administration categories. Descriptive counts were calculated from the charted dataset. Quantitative estimates were not pooled because participation definitions, interventions, settings and outcomes were highly heterogeneous. Qualitative themes were synthesized for barriers, facilitators, delivery methods and future competencies. Critical appraisal was not used as an exclusion criterion, consistent with the mapping purpose of a scoping review; design limitations were recorded and used to temper interpretation.

2.6 Ethics

The review used published and publicly accessible information and did not involve participants, patient records or identifiable private data. Formal research-ethics approval was therefore not required, subject to institutional policy.

3. Results

3.1 Search and source selection

Figure 1 summarizes source selection. Of 75 records logged, 8 duplicates were removed and 67 unique records were screened. Twenty-one were excluded, leaving 46 included sources: 38 scholarly sources and 8 official regulatory or credentialing documents. The scholarly evidence included 8 laboratory sources, 6 dental-assisting sources, 10 nursing sources, 9 health-administration sources and 5 cross-professional sources.

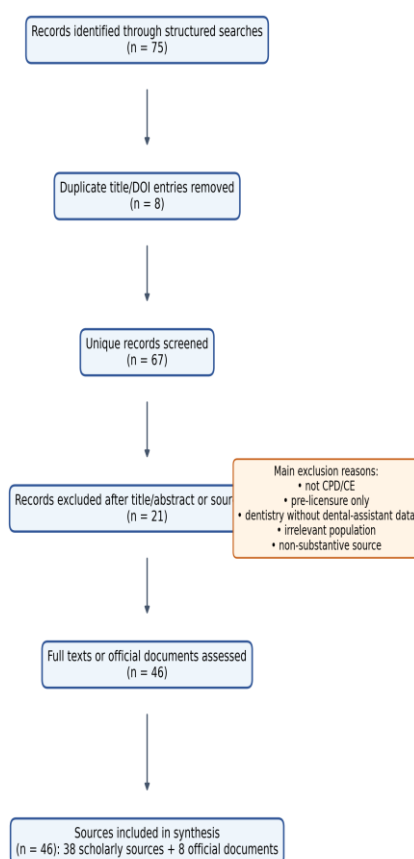


Figure 1. PRISMA-ScR flow diagram for the rapid scoping review

3.2 Characteristics of the included evidence

Of the 38 scholarly sources, 28 (73.7%) were published from 2021 through July 2026. One older dental-assisting study from 2011 was retained as a landmark because it separately identified dental assistants and measured both immediate learning and six-month behavior. The evidence was

geographically uneven: international or multicountry reviews were common, laboratory studies were concentrated in sub-Saharan Africa, dental-assisting studies came mainly from Saudi Arabia, Australia, the United States and Türkiye, and health-administration studies included international reviews with a smaller number of national program evaluations.

Designs included cross-sectional surveys, qualitative studies, program evaluations, systematic and scoping reviews, a realist synthesis and a meta-analysis. Primary-study samples ranged from 37 dental assistants within a mixed-profession study and 70 dental assistants in a Saudi study to 2,297 healthcare managers and 11,134 regional laboratory training records. Review-level evidence ranged from 9 included studies to 86 reviews. This diversity supported evidence mapping but precluded direct pooled comparisons

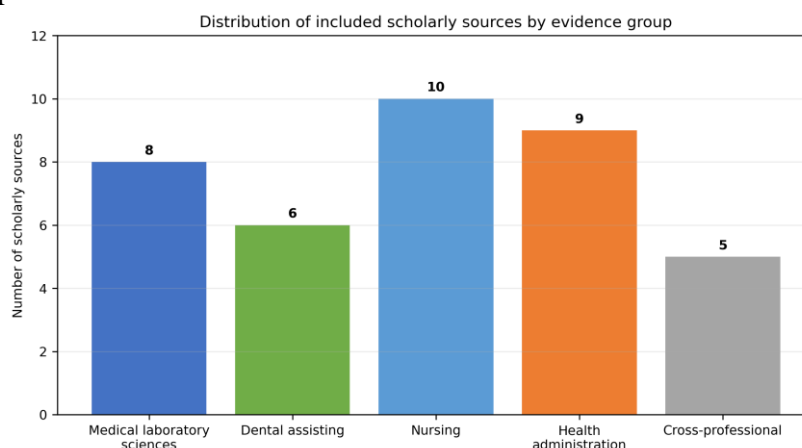


Figure 3. Distribution of included scholarly sources by evidence group.

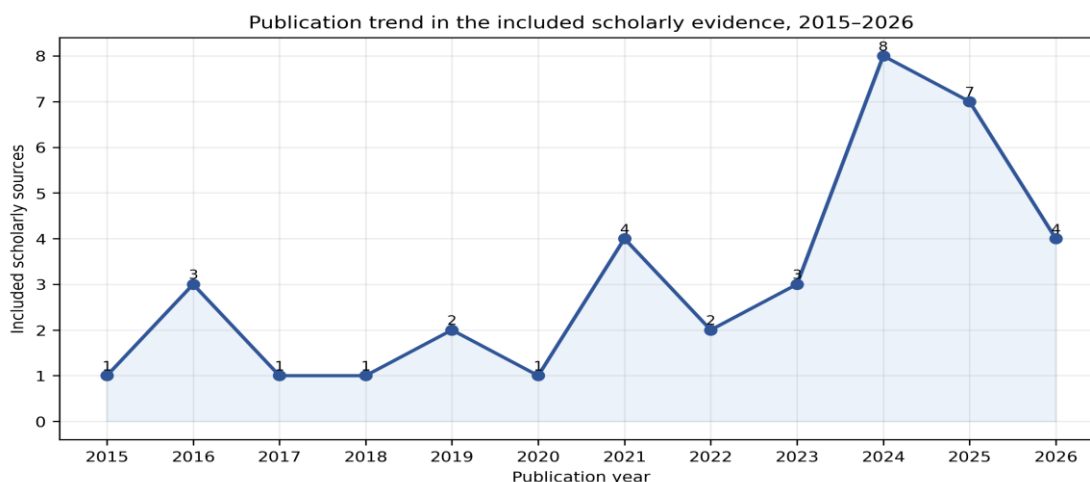


Figure 4. Publication trend from 2015 to July 2026.

Table 4. Characteristics of included scholarly evidence

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/determinants
Manley et al. 2018 [5]	United Kingdom	Cross-professional	Realist synthesis/case study	144 stakeholders across six groups	Workplace, facilitated and formal learning	Four transformation theories linked effective CPD to practitioner agency, knowledge translation and supportive workplace culture.	Stakeholder groups: 8, 15, 34, 38, 31, 8 and 10 participants across phases.	Ad hoc provision; weak learning culture; limited transfer support; Shared purpose; facilitation; workplace learning;

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/de terminants
								leadership
Longhini et al. 2021 [6]	International	Cross-professional	Scoping review	31 included reports from 1,149 records	Massive open online courses	MOOCs offered wide reach and varied teaching methods; effectiveness depended on course design, implementation and learner characteristics.	Target audiences ranged from 40 to 83,000 participants.	Digital access; attrition; limited interaction; variable design; Scalable access; flexible timing; pedagogic design
McMahon et al. 2024 [7]	Saudi Arabia	Cross-professional	National system case study	National CPD ecosystem	Accredited provider system and educator development	Regulatory redesign aligned accreditation standards with international practice and expanded the volume and diversity of accredited CPD.	More than 170 educators trained; 396 providers sought accreditation; accredited activities increased from 1,000 in 2002 to 10,500 in 2022.	Legacy standards; variable provider capacity; Leadership; accreditation reform; digital infrastructure; grants
Ali et al. 2025 [8]	International	Cross-professional	Systematic scoping review	17 studies from 1,562 screened records	Multiple CPD interventions	Most included studies reported positive patient-related outcomes, but heterogeneity and concentration in high-income settings limited certainty and transferability.	14 of 17 studies reported positive patient outcomes.	Heterogeneous outcomes; limited low-resource evidence; Intervention relevance; outcome measurement
Dentice et al. 2026 [9]	16 countries	Cross-professional	Systematic review	17 studies	E-learning	E-learning consistently improved perceived knowledge, confidence, attitudes and selected skills; evidence for sustained practice and patient outcomes was limited.	Nine quasi-experimental, six cross-sectional and two randomized studies; only four examined patient-care outcomes.	Self-report; inconsistent follow-up; digital implementation constraints; Flexible access; relevant design; interactive learning
Ifeoma et al. 2015 [10]	Nigeria	Medical Laboratory Sciences	Cross-sectional survey	135 respondents from 200 invited	Workshops; limited online learning	Attitudes were strongly positive, but recent participation and online use were low.	23.7% attended CPD in the preceding year; 7.5% used online CPD; 95.2% considered CPD essential; 93.8% reported lack of sponsorship.	Funding; sponsorship; staffing; weak policy; Professional recognition; institutional sponsorship
Horiuchi et al. 2016 [11]	Japan	Medical Laboratory Sciences	E-learning evaluation	Laboratory professionals using digital morphology software	Internet-based image morphology training	Digital competency software supported continuing morphology education and objective case-based assessment.	Performance was assessed through online image-classification exercises; study-specific effect estimates were not pooled.	Technology access; narrow technical scope; Immediate feedback; repeatable image sets; remote access
Gebregabher et al. 2023 [12]	Ethiopia	Medical Laboratory Sciences	National needs assessment	457 professionals	Requested formal and practical training	Priority needs included emerging technology, computer skills, medico-legal issues, microbiology, clinical chemistry,	96.9% worked in public-sector or training institutions.	Access; course availability; resource constraints; National needs assessment; role-relevant content

CONTINUING PROFESSIONAL DEVELOPMENT IN MEDICAL LABORATORY SCIENCES, DENTAL
ASSISTING, NURSING, AND HEALTH ADMINISTRATION

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/determinants
						molecular diagnostics, research and pathophysiology.		
Essuman et al. 2023 [13]	Ghana	Medical Laboratory Sciences	Online cross-sectional survey	316 professionals	Face-to-face, workshops and hands-on formats preferred	Quality systems, data interpretation/research, technical competence and management/leadership were the highest-priority domains.	Mean priority scores: quality management 80.59; pathophysiology/data interpretation/research 78.0; technical competence 73.97; management/leadership 72.82.	Cost; workload; timing; Hands-on delivery; supervisory relevance
Ndlovu et al. 2024 [14]	14 African countries	Medical Laboratory Sciences	Multicountry cross-sectional survey	283 respondents from 400 invited	National and regional CPD programs	Participation was low for more than half of respondents; awareness of national CPD activities was strongly associated with participation.	Response rate 70%; 54% had fewer than two trainings in two years; 70% knew of national CPD; association $p=0.0001$.	Personal, employer and environmental constraints; Program awareness; employer support; access
Negussie et al. 2025 [15]	Ethiopia	Medical Laboratory Sciences	Mixed-methods cross-sectional study	228 survey respondents plus institutional interviews	Formal CPD, licensing-linked education	Professionals valued CPD, but exposure was uneven and implementation barriers were substantial.	51% had never received CPD; nearly three-quarters considered it essential; 45.2% linked CPD to licence renewal and post-qualification skill development.	Finance; staff shortages; weak enforcement; limited local access; Regulatory linkage; employer support
Ndlovu et al. 2025 [16]	Africa	Medical Laboratory Sciences	Narrative review	African CPD literature and programs	Regional and national CPD programs	African laboratory CPD remained fragmented and required coordinated, tailored, continent-wide systems.	Comparable participation estimates were not pooled.	Fragmentation; funding; infrastructure; variable regulation; Coordination; regional platforms; tailored curricula
Ndlovu et al. 2026 [17]	Africa	Medical Laboratory Sciences	Program database evaluation	11,134 training records; 621 modular-course participants	ASLM Academy courses	The regional academy achieved substantial reach but repeated participation and certification completion varied.	69% of records were male; 39.3% were from East Africa; 48% were government employees; 89% completed one to four trainings; highest certification completion 56.7%.	Unequal regional uptake; limited repeated engagement; Regional platform; membership; modular structure
Shulman et al. 2011 [18]	United States	Dental Assisting	Multicentre pre/post evaluation	252 oral-health workers: 92 dentists, 123 hygienists, 37 dental assistants	Four-hour continuing education program	Knowledge improved immediately, but sustained behavior change was substantially lower than intended change.	Knowledge increased 22% ($p<0.001$); 80% intended to examine more children under 3, but 42% reported doing so at six months ($p<0.001$).	Intention-practice gap; mixed-profession reporting; Focused short course; follow-up
Haridi et al. 2016 [19]	Saudi Arabia	Dental Assisting	Cross-sectional survey	307 dental healthcare workers; 73.1% response	Infection-control training	High self-reported compliance was associated more strongly with institutional commitment and adequate training	86.3% knew standard-precaution guidance; 84.4% had infection-control training; 90.1% achieved high compliance.	Lower compliance risk among dental assistants and private-sector workers; Institutional

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/de terminants
						than with experience alone.	Institutional commitment OR 4.34; adequate training OR 3.51.	commitment; adequate training
Skapetis et al. 2022 [20]	Australia	Dental Assisting	Retrospective program evaluation	8,640 evaluations from 160 activities over eight years	Clinical and non-clinical CE	Dental assistants rated accuracy, relevance, knowledge gain and applicability more highly than dentists/specialists; clinical and non-clinical formats served different needs.	Role differences $p<0.001$; clinical CPD improved perceived knowledge $p=0.01$; non-clinical CE had higher overall scores $p=0.015$.	Self-report; dental-assistant denominator not consistently isolated; Role-tailored content; both clinical and non-clinical options
Albagi et al. 2023 [21]	Saudi Arabia	Dental Assisting	Cross-sectional knowledge and environmental sampling study	70 dental assistants and 60 dental-floss containers	Infection-control/ OSHA education	Substantial gaps in formal occupational-safety education were identified alongside environmental contamination risk.	41.4% had never heard of an OSHA course and 77.1% had never taken one.	Limited awareness and formal course exposure; Structured infection-control programs
Binassfour et al. 2024 [22]	Saudi Arabia	Dental Assisting	Cross-sectional educational needs study	Dental team members including dental assistants	Training on impression disinfection	Knowledge and practice variation across dental-team roles supported standardized interprofessional infection-prevention education.	Profession-specific numerical estimates were not consistently extractable for dental assistants.	Role variation; inconsistent protocols; Standardized team training; clear protocols
Kahraman et al. 2026 [23]	Türkiye	Dental Assisting	Cross-sectional survey	236 dentists, dental assistants and imaging technicians	Academic and in-service radiation training	Dental assistants and dentists had lower radiation-protection knowledge than imaging technicians; structured formal training was beneficial.	Between-group and training associations $p<0.01$; experience was not associated with knowledge ($p>0.05$).	Reliance on informal sources; uneven standardized training; Academic or formal in-service education
Breklemans et al. 2016 [24]	Netherlands	Nursing	Cross-sectional participation study	Registered nurses	Formal and informal CPD	Perceived importance, professional motives and enabling conditions predicted participation; research-related CPD was relatively weak.	Study-specific multivariable estimates were reported; no single internationally comparable participation rate.	Time; conditions; limited research orientation; Perceived relevance; motivation; supportive conditions
Hegland et al. 2017 [25]	International	Nursing	Systematic review and meta-analyses	15 randomized trials	Simulation-based training	Simulation improved knowledge and selected skills, although heterogeneity and certainty limitations were substantial.	Six studies yielded SMD -1.09 (95% CI -1.72 to -0.47); $I^2=85\%$; certainty low.	Heterogeneity; resource intensity; Repetition; feedback; realistic practice
Rouleau et al. 2019 [26]	International	Nursing	Umbrella review	22 systematic reviews from 12,906 records	E-learning	Evidence was most favorable for learner reaction, knowledge and skills; transfer to practice and patient outcomes	22 reviews included.	Variable course quality; limited downstream outcomes; Flexibility; multimedia; interactivity

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/terminants
						remained uncertain.		
King et al. 2021 [27]	International	Nursing	Rapid evidence review	Nursing CPD literature	Workplace, formal, online and self-directed learning	Self-motivation, relevance, workplace learning, leadership and a positive learning culture were recurrent enablers.	Comparable pooled participation data were not identified.	Workload; poor culture; low relevance; Leadership; workplace learning; motivation
Mlambo et al. 2021 [28]	International	Nursing	Metasynthesis	Qualitative studies	Multiple CPD formats	Nurses perceived CPD as important for current knowledge and skills, but staffing, funding, time and organizational support shaped access and application.	Qualitative synthesis; no pooled rate.	Staffing; workload; cost; study leave; Relevance; support; career development
Hakvoort et al. 2022 [29]	International	Nursing	Scoping review	60 papers from 2,673 records	Career-stage CPD	Influences differed for newly qualified nurses, experienced nurses and nurses pursuing advanced roles, while personal and contextual factors affected all groups.	60 papers included.	Access; resources; career-stage mismatch; Career-aligned learning; employer support
Wright et al. 2024 [30]	International	Nursing	Scoping review	19 papers	Advanced-practice continuing education, commonly online	Evidence concentrated in the United States and often assessed clinical competence rather than sustained service outcomes.	19 papers included.	Geographic concentration; variable outcome measures; Specialty focus; online access
Sharkiya et al. 2024 [31]	International	Nursing	Rapid review	14 studies; 1,204 nurses	Simulation	Simulation generally improved knowledge and skills; findings for confidence, behavior and clinical outcomes were mixed.	14 studies and 1,204 participants.	Cost; equipment; faculty time; Debriefing; realistic scenarios; repetition
Redwood et al. 2024 [32]	United Kingdom	Nursing	Qualitative study	Nurses involved in organizing, managing and budgeting CPD	Postgraduate and employer-supported CPD	Partnership working and alignment between workforce needs, funding and professional aspirations were central to engagement and retention.	Qualitative phase; no participation rate.	Budget pressure; release time; fragmented commissioning; Partnerships; retention goals; shared planning
Matandela et al. 2026 [33]	International	Nursing	Scoping review	Studies published 2000-2025	Multiple CPD formats	The review organized engagement around initiation, persistence and application, emphasizing	Comparable quantitative participation data were not identified.	Motivation-context mismatch; limited application support; Reflective

CONTINUING PROFESSIONAL DEVELOPMENT IN MEDICAL LABORATORY SCIENCES, DENTAL ASSISTING, NURSING, AND HEALTH ADMINISTRATION

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/deficiencies
						dispositions as well as context.		disposition; persistence; relevance
Ayeleke et al. 2019 [34]	International	Health Administration	Systematic review	Management and leadership development studies	Training and professional development	Programs improved selected management and leadership competencies, but evidence quality and outcome measurement were variable.	Heterogeneous studies; no pooled effect.	Short follow-up; self-report; weak evaluation designs; Experiential learning; organizational support
Kakemam et al. 2020 [35]	International	Health Administration	Scoping review	12 competency-framework studies	Competency-oriented management education	Seven broad domains were identified: evidence-informed decisions, operations/resources, healthcare environment, communication, leading people, change and professionalism.	12 studies included.	Framework variation; limited validation; Competency frameworks; role clarity
Ravaghi et al. 2021 [36]	International	Health Administration	Systematic review	9 studies	Hospital management training	Training improved planning, change management and leadership; technical management skills showed the clearest gains.	Nine studies included.	Small evidence base; limited objective outcomes; Practical technical content; leadership development
Nguyen et al. 2024 [37]	United States	Health Administration	Cross-sectional competency assessment	Nurse managers/healthcare leaders	Leadership-development needs assessment	Lowest confidence occurred in budgeting, annual reports, strategic planning, organizational performance and project planning.	Domain-level scores were reported; no common participation denominator.	Finance and strategy skill gaps; Targeted competency-based development
Barghi Shirazi et al. 2024 [38]	International	Health Administration	Systematic review	Studies from 1990-2021	Health-administration education and development	Future administrators require systems knowledge plus planning, leadership, finance, service management, communication, information management, HR, teamwork, crisis, innovation, policy and decision skills.	Narrative synthesis; no pooled rate.	Mismatch between curricula and service needs; Practical, skill-based, responsive education
Cheng et al. 2025 [39]	China	Health Administration	Pre/post program evaluation	Medical administrators in a three-phase program	Management and leadership development	Competency scores improved across several domains after a structured program grounded in a professional competency model.	Significant pre/post differences were reported; exact domain effects require local replication.	Single organization; no control group; Phased curriculum; competency model
Nexhip et al. 2025 [40]	Australia	Health Administration	Cross-sectional survey	72 health information management	Conferences, seminars,	Most participants valued CPD and attended general educational	70.8% agreed CPD was important; 72% attended a conference/seminar	Time; interest; relevance; movement outside HIM

Source	Country /region	Profession	Design	Sample	CPD format	Main outcome	Key numerical finding	Limitations/deficiencies
				nt graduates	webinars and professional-body CPD	events, but professional-body engagement remained incomplete.	/webinar; 57% had not joined professional-body CPD.	roles; Networking; continuous learning; skill development
Phillips et al. 2025 [41]	International	Health Administration	Umbrella review	86 reviews	Leadership development	Experiential and mixed methods, coaching, mentoring, longitudinal design, goals and 360-degree feedback were repeatedly supported, but patient and organizational outcomes were infrequently measured.	86 reviews included.	Self-report; short follow-up; limited downstream outcomes; Coaching; mentoring; longitudinal and experiential design
Oetjen et al. 2025 [42]	United States	Health Administration	Large program evaluation	2,297 managers; 189 completed all three components	Management curriculum with team dynamics and coaching	Participants reported high achievement of learning objectives and confidence, though completion of the full pathway was limited.	95% achieved core objectives; 97% recommended team-dynamics training; 93% reported psychological-safety gains; 97% reported coaching confidence.	Full-program completion; self-selection; Modular design; coaching; team focus

3.3 Medical Laboratory Sciences

Laboratory CPD combined technical updating, quality assurance, accreditation-related learning, research and data interpretation. Participation was inconsistent despite strong perceived value. In Nigeria, 32 of 135 respondents (23.7%) reported CPD participation in the preceding year and 10 of 135 (7.5%) used online CPD, although 95.2% considered CPD essential [10]. In a 14-country African survey, 153 of 283 respondents (54%) had completed fewer than two trainings in two years; 199 of 283 (70%) knew of national CPD activities, and awareness was strongly associated with participation ($p=0.0001$) [14]. In Ethiopia, 51% of 228 respondents had never received CPD [15]. These findings indicate a persistent gap between positive attitudes and practical access.

Needs assessments emphasized quality-management systems, microbiology, clinical chemistry, molecular diagnostics, emerging technologies, computer skills, medico-legal issues, research, pathophysiology and data interpretation [12,13]. Ghanaian respondents rated quality-management systems highest, followed by pathophysiology/data interpretation/research, technical competence and management/leadership [13]. Face-to-face workshops and hands-on training were preferred, but digital platforms offered reach where travel and release time were constrained.

The ASLM Academy evaluation demonstrated the scalability of regional platforms: 11,134 training records were analyzed, but 89% represented only one to four trainings and the highest certification-course completion was 56.7% [17]. Regional uptake was unequal. The evidence supports blended systems that combine scalable digital modules with supervised practical work, proficiency testing, quality-improvement projects and local mentoring. Future laboratory CPD should explicitly address genomics, molecular diagnostics, automation, AI-assisted morphology and interpretation, point-of-care testing governance, biosafety, digital laboratory information systems and quality management.

3.4 Dental Assisting

Dental assisting had the smallest profession-specific evidence base. Dental assistants were often included within mixed dental teams, and outcomes were rarely reported separately. In a US multicentre study, only 37 of 252 participants were dental assistants. A four-hour course increased

overall knowledge by 22%, but the proportion reporting the intended practice at six months was 42% compared with 80% who initially intended to change, illustrating the difference between learning, intention and sustained behavior [18].

Infection prevention and occupational safety dominated the dental-assisting evidence. Among 307 dental healthcare workers in Hail, Saudi Arabia, 84.4% had received infection-control training and 90.1% achieved high self-reported compliance. Perceived institutional commitment (OR 4.34) and adequate training (OR 3.51) were stronger predictors than experience alone, and the authors highlighted the need to focus on dental assistants and private-sector workers [19]. In a separate study of 70 dental assistants, 41.4% had never heard of an Occupational Safety and Health Administration course and 77.1% had never taken one [21].

Program-evaluation data from Australia suggested that dental assistants rated educational accuracy, relevance, knowledge gain and applicability highly, with distinct value from both clinical and non-clinical content [20]. In Türkiye, structured academic or in-service radiation training was associated with better radiation-protection knowledge ($p < 0.01$), whereas experience alone was not [23]. Current and future CPD should therefore cover chairside skills, radiography, infection prevention, occupational safety and ergonomics, scope-of-practice changes, patient communication, legal responsibilities, digital workflows and expanded functions. Comparable profession-specific participation and completion rates were not identified beyond regulatory compliance and small mixed-team studies

3.5 Nursing

Nursing had the broadest and most mature evidence base. Reviews consistently described CPD as a product of both individual motivation and the learning environment. Perceived relevance, professional identity and career goals encouraged participation, while workload, staffing shortages, cost, limited study leave and weak managerial support restricted access [24,27–29,32,33]. Career stage also mattered: newly qualified nurses, experienced nurses and nurses pursuing advanced roles required different content, support and learning pathways [29].

Digital learning was common. An umbrella review of 22 reviews found the most consistent benefits for learner reaction, knowledge and skills, with limited evidence for transfer to routine practice or patient outcomes [26]. Cross-professional e-learning evidence reached a similar conclusion [9]. Online delivery improves flexibility and geographic access, but poorly designed asynchronous courses can produce isolation, low completion and superficial compliance. Interactive design, feedback, peer engagement and application tasks were recurrent facilitators.

Simulation was the most frequently evaluated experiential method. A 2017 meta-analysis of 15 randomized studies found a large pooled effect in six studies (SMD -1.09, 95% CI -1.72 to -0.47), but heterogeneity was high ($I^2 = 85\%$) and certainty was low [25]. A 2024 rapid review of 14 studies involving 1,204 nurses found generally positive knowledge and skill effects, with mixed findings for confidence, behavior and clinical outcomes [31]. Simulation is therefore useful for technical, team and safety competencies but requires skilled facilitation, debriefing, equipment and protected time.

Nursing regulations frequently combine minimum hours with participation and reflection. The United Kingdom NMC requires 35 hours in three years, including 20 participatory hours, within a broader revalidation process [48]. Australia requires at least 20 practice-relevant CPD hours annually [49]. The evidence supports moving beyond these minimums to individualized development plans linked to clinical assessment, evidence-based practice, digital nursing, telehealth, leadership, simulation, care coordination and AI-supported practice. Comparable global participation rates were not identified because definitions and regulatory cycles differed substantially.

3.6 Health Administration

Health-administration evidence was distributed across leadership development, management competency frameworks, health information management and professional credentialing. Reviews identified consistent domains: evidence-informed decision-making, operations and resource

management, health-system knowledge, communication, leading people, change management, professionalism, planning, finance, quality improvement, human resources, crisis management and policy [34–38].

Program evaluations suggested that structured, competency-based and longitudinal approaches were more promising than isolated lectures. A three-phase program for medical administrators in China produced significant pre/post improvements across several domains [39]. An umbrella review of 86 reviews supported experiential and mixed methods, coaching, mentoring, longitudinal design, explicit goals and 360-degree feedback, but found that patient and organizational outcomes were infrequently measured [41]. In a US program involving 2,297 managers, reported achievement and confidence were high, but only 189 participants completed all three components, demon

The Australian health information management survey provided rare participation data: 51 of 72 graduates (approximately 72%) had attended a conference, seminar or webinar, but 41 of 72 (57%) had not participated in a professional-body CPD activity [40]. Time, relevance, interest and movement into other roles limited engagement, while networking and skill development encouraged it. Future health-administration CPD should prioritize data analytics, informatics, AI governance, cybersecurity, strategic leadership, quality improvement, health economics, finance, workforce planning, crisis management and sustainability. Objective organizational metrics—such as safety, flow, cost, staff retention and implementation performance—should be incorporated into evaluation.

3.7 Comparison among professions and regulatory models

The professions shared core determinants but differed in how CPD was organized and evaluated. Laboratory evidence emphasized technical competence, quality systems and access; dental-assisting evidence emphasized infection prevention, radiation safety and role-specific practical skills; nursing evidence emphasized broad clinical competence, career-stage development, simulation and organizational culture; and health administration emphasized leadership, strategy, finance, data and system performance. Nursing and health administration had more review-level literature, while laboratory and dental-assisting evidence relied more heavily on cross-sectional studies and program evaluations.

Table 5. Comparison of current CPD practices across the four professions

Profession	Regulatory pattern	Common delivery	Main barriers	Dominant competency focus
Medical Laboratory Sciences	Mandatory or credential-linked in many systems; variable national implementation	Hands-on workshops, regional academies, e-learning, proficiency and quality activities	Participation gaps, funding, staffing and geography	Technical competence, quality systems, molecular diagnostics, data interpretation and management
Dental Assisting	Highly jurisdiction-dependent; certification may be voluntary or regulatory registration mandatory	Chairside/infection-control courses, radiography, team training, online and in-person CE	Sparse profession-specific evidence; cost, employer support, role recognition and access	Infection prevention, radiography, digital dentistry, patient communication, expanded functions and occupational safety
Nursing	Commonly mandatory through annual renewal or multi-year revalidation	Online, participatory learning, workplace learning, simulation, specialty education and reflection	Workload, staff shortages, release time, funding and relevance	Clinical competence, evidence-based practice, safety, leadership, digital health, simulation and care coordination
Health	Often professional-	Leadership	Competing	Leadership,

Profession	Regulatory pattern	Common delivery	Main barriers	Dominant competency focus
Administration	credential or employer driven rather than universal statutory CPD	programs, coaching, mentoring, workshops, simulations, executive education and webinars	operational priorities, cost, relevance and limited outcome evaluation	governance, quality, finance, analytics, informatics, workforce and crisis management

Table 6. Selected mandatory CPD, revalidation or credential-maintenance requirements

Body	Profession/scope	Current requirement	Cycle	Model	Reference
Saudi Commission for Health Specialties (Saudi Arabia)	All registered health-practitioner categories	Re-registration requires 20 hours for technicians, 40 for specialists, 40 for pharmacists and 60 for physicians.	Registration cycle	Category-based mandatory hours linked to re-registration	[43]
ASCP Board of Certification	Medical Laboratory Scientist MLS(ASCP/ASCPi)	36 points in each three-year cycle: 8 discipline-specific, 1 laboratory/patient safety, 1 medical ethics and 26 related points.	3 years	Credential maintenance with specified content and audit	[44]
Health and Care Professions Council (United Kingdom)	Biomedical scientists	No fixed universal hour or point quota; continuous, varied, relevant CPD must be recorded and demonstrated if selected for audit.	Renewal cycle; random 2.5% audit	Outcome- and portfolio-based regulatory model	[45]
General Dental Council (United Kingdom)	Dental nurses	50 hours of verifiable CPD per five-year cycle, with at least 10 hours in each consecutive two-year period and annual declaration.	5 years	Mandatory hours plus personal development plan and reflection	[46]
Dental Assisting National Board (United States)	DANB certificants including CDA	Annual renewal requires continuing education, current CPR for most credentials and a renewal fee; CDA maintenance materials specify at least 12 CE credits annually.	1 year	Voluntary national certification maintenance	[47]
Nursing and Midwifery	Nurses, midwives and nursing	35 CPD hours per three-year	3 years	Revalidation combining	[48]

Body	Profession/scope	Current requirement	Cycle	Model	Reference
Council (United Kingdom)	associates	revalidation cycle, including at least 20 participatory hours, plus practice hours, feedback and reflection.		hours, participation, practice and reflection	
Nursing and Midwifery Board of Australia	Registered and enrolled nurses	Minimum 20 hours of CPD relevant to context of practice in each annual registration period; some endorsements require additional hours.	1 year	Annual mandatory practice-relevant hours	[49]
American College of Healthcare Executives	FACHE credential holders	36 healthcare-management CE credits in three years; at least 12 in-person, up to 24 virtual interactive and up to 12 qualifying credits or retake the examination.	3 years	Professional credential recertification plus volunteer requirements	[50]

Table 7. Reported participation, exposure and completion estimates

Source/population	Denominator	Estimate	Reference
Ifeoma et al., Nigeria, laboratory, 2015	135	32/135 (23.7%) attended CPD in preceding year; 10/135 (7.5%) used online CPD	[10]
Ndlovu et al., 14 African countries, laboratory, 2024	283	153/283 (54%) had fewer than two trainings in two years; 199/283 (70%) knew national CPD activities	[14]
Negussie et al., Ethiopia, laboratory, 2025	228	51% had never received CPD	[15]
ASLM Academy, Africa, laboratory, 2026	11,134 training records	89% had one to four trainings; highest certification completion 56.7%	[17]
Haridi et al., Saudi dental team, 2016	307	84.4% reported infection-control training; 90.1% high self-reported compliance	[19]
Albagieh et al., Saudi dental assistants, 2023	70	41.4% never heard of OSHA course; 77.1% never attended one	[21]

Source/population	Denominator	Estimate	Reference
GDC Enhanced CPD evaluation, UK dental professions	>2,800 survey plus administrative data	Almost 95% overall five-year compliance; 10-in-2 compliance was lower among dental nurses and technicians	[46]
Nexhip et al., Australian health information managers, 2025	72	72% attended conference/seminar/webinar; 57% had no professional-body CPD	[40]
Nursing	Varied	Comparable quantitative participation data were not identified because cycles and definitions differed.	[24,27–33]

3.8 Barriers and facilitators

Across the evidence, lack of time and workload were the most recurrent barriers, followed by cost, staff shortages, limited employer support, geographic access, scheduling, limited relevant courses and inconsistent recognition of learning. Digital access was both a solution and a source of inequity: online education reduced travel and scheduling burdens but required connectivity, equipment, digital literacy and course designs that sustained interaction. Family responsibilities and career-stage mismatch were prominent in nursing; sponsorship and local availability were prominent in laboratory studies; professional recognition and access to role-specific content were particularly important for dental assistants; and competing operational priorities were central for administrators.

Table 8. Recurrent barriers and facilitators to CPD participation

Determinant	Professions/settings most evident	Practical facilitator
Time, workload and staffing	All four; especially nursing and laboratory	Protected learning time; workload planning; backfill or cross-coverage
Cost and lack of sponsorship	Laboratory, nursing, dental assisting	Employer funding; scholarships; shared regional platforms; low-cost accredited online options
Limited relevance or role fit	All four	Needs assessment; competency mapping; profession- and career-stage tailoring
Geography and travel	Laboratory and rural services	Blended learning; mobile delivery; local skills hubs
Technology and internet access	All four	Device/connectivity support; low-bandwidth design; digital-literacy training
Weak employer or managerial support	All four	Manager accountability; development plans; mentoring; learning culture
Limited recognition/career benefit	Dental assisting, laboratory, nursing	Link CPD to scope, promotion, certification and career pathways
Fragmented regulation or provider quality	Laboratory and dental assisting	Accreditation standards; coordinated national or regional systems; audit and feedback
Difficulty translating learning to practice	All four	Application projects; coaching; simulation; audit cycles; post-course follow-up

3.9 Delivery methods and effectiveness

No single delivery format was superior in all contexts. Face-to-face workshops and hands-on sessions were valued for technical and procedural skills. Online learning improved reach and flexibility, particularly for knowledge-based content, but evidence for sustained practice change

remained limited [6,9,26]. Blended approaches combined digital preparation with practical application. Simulation was valuable for nursing, emergency response, team communication and high-risk skills but required resources and debriefing expertise [25,31]. Workplace learning, mentoring and coaching were repeatedly associated with application and organizational relevance [5,34,41,42].

Table 9. Common CPD delivery methods and reported effectiveness

Method	Main use	Evidence of value	Limitations
Face-to-face workshops	Laboratory, dental assisting, nursing, administration	Strong for interaction and focused knowledge; hands-on components support technical skills	Travel, release time and cost
Online asynchronous learning/MOOCs	All four	Scalable and flexible; generally improves knowledge, confidence and selected skills	Attrition, limited interaction and weak evidence for sustained practice/patient outcomes
Live virtual/interactive learning	All four	Improves access while retaining peer interaction; recognized in some credential systems	Scheduling, connectivity and facilitation quality
Blended learning	All four	Combines scalable content with practice, feedback and assessment	Requires coordination and local resources
Simulation	Nursing; dental radiography/emergencies; administration crisis exercises	Improves knowledge and procedural/team skills; enables safe rehearsal	Cost, equipment, faculty time and heterogeneous outcome evidence
Workplace learning/quality projects	All four	High contextual relevance and potential for practice change	May be undocumented; dependent on culture and supervision
Mentoring/coaching	Nursing and administration; applicable to all	Supports reflection, leadership and transfer of learning	Mentor capacity and consistency
Certification/recertification portfolios	Laboratory, dental assisting, nursing, administration	Creates accountability and structured documentation	May incentivize credit accumulation rather than outcomes

3.10 Outcomes of CPD

Knowledge, confidence, attitudes and perceived competence were the most frequently reported outcomes. Objective knowledge gains were demonstrated in dental education and simulation studies, and structured management programs showed pre/post competency improvement [18,25,39]. However, self-reported outcomes predominated. The cross-professional patient-outcome review found positive patient-related findings in 14 of 17 studies, but the interventions, outcomes and settings were heterogeneous [8]. The 2026 e-learning review found only four studies assessing patient safety, care quality, satisfaction or infection outcomes [9].

Practice behavior and organizational outcomes were less consistently evaluated. The dental study in young-child oral health demonstrated that immediate intention substantially exceeded behavior reported six months later [18]. Leadership-development reviews found limited evidence linking training to patient or organizational outcomes [34,41]. These findings support a staged evaluation model: learner reaction and participation; knowledge and skills; observed competence; practice behavior; service or organizational performance; and patient outcomes. Attendance should be treated as exposure, not effectiveness.

3.11 Current and emerging competency priorities

Frequency of major CPD priorities coded in profession-specific sources

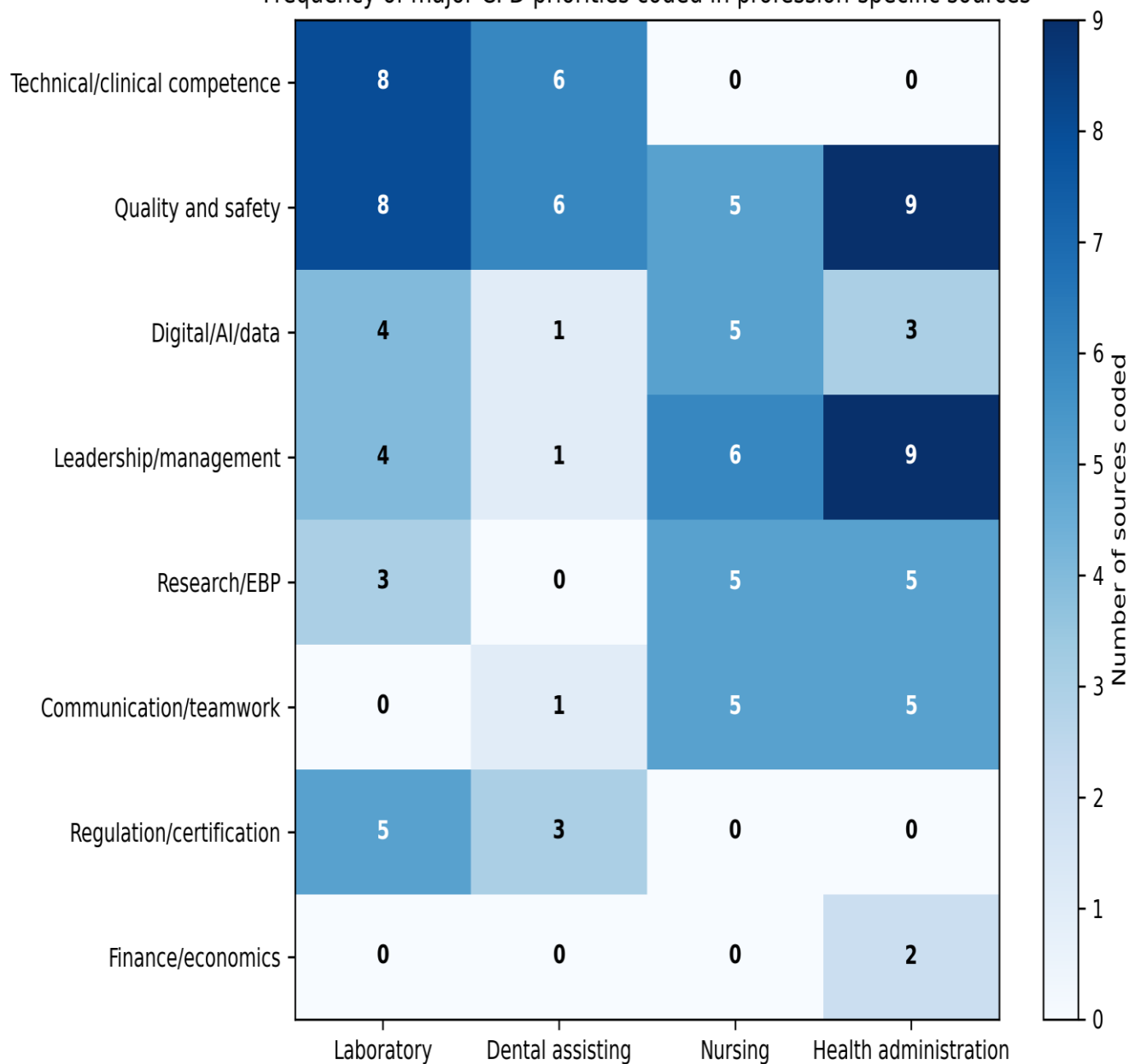


Figure 5. Comparative matrix of major CPD priorities across the four professions.

Table 10. Current and emerging competency needs by profession

Profession	Current priorities	Emerging priorities
Medical Laboratory Sciences	Quality systems; technical competence; biosafety; interpretation	Genomics; molecular diagnostics; automation; AI-assisted morphology/diagnostics; data interpretation; digital laboratory systems; point-of-care governance
Dental Assisting	Chairside support; infection prevention; radiography; occupational safety; communication	Digital dentistry; expanded functions; technology-assisted care; ergonomics; legal responsibilities; standardized radiation safety
Nursing	Clinical competence; evidence-based practice; patient safety; specialty skills; simulation	Digital nursing; telehealth; advanced assessment; AI-supported practice; care coordination; leadership and change management
Health Administration	Leadership; governance; quality improvement; finance; HR; strategy	Health informatics; data analytics; AI governance; cybersecurity; workforce planning; crisis management; sustainability
Shared	Communication; teamwork; ethics; patient safety; quality improvement	Digital literacy; research literacy; leadership; change management; equity; outcomes evaluation

3.12 Multidisciplinary CPD framework

The synthesis supported a multidisciplinary framework in which individual motivation and learning needs interact with professional requirements, employer support and learning methods. Competency development then produces professional, patient, service and organizational outcomes, which should feed back into future learning plans and CPD investment. The framework retains profession-specific competencies while providing a common architecture for governance, needs assessment, protected time, delivery, assessment and evaluation

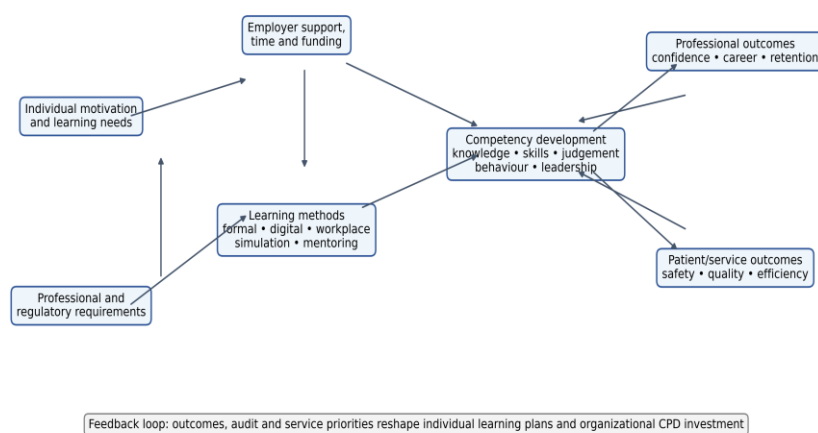


Figure 2. Proposed multidisciplinary CPD framework.

4. Discussion

This review identified a shared CPD problem across four distinct professions: professionals generally value learning, but participation, relevance and application depend heavily on organizational and regulatory conditions. Time, workload, staffing, cost and employer support repeatedly shaped access. These factors are not peripheral; they determine whether mandatory requirements become meaningful professional development or a compliance exercise. Systems that require credits without protecting learning time may transfer the burden to individual workers and widen inequity between well-resourced and under-resourced settings.

The evidence base was uneven. Nursing had the largest number of reviews and the widest range of delivery and outcome studies. This likely reflects the size of the nursing workforce, longstanding regulatory CPD requirements, strong nursing-education research infrastructure and the proximity of nursing practice to measurable clinical outcomes. Laboratory evidence was increasingly quantitative but concentrated in African settings and emphasized participation barriers and technical needs. Dental-assisting evidence remained sparse, frequently mixed with other dental professions and often focused on infection control or radiation safety rather than comprehensive CPD systems. Health-administration evidence was substantial in leadership and competency development but less often framed as CPD participation or linked to objective organizational outcomes.

The comparison of regulatory systems showed that hours and credits are not equivalent to competence. SCFHS uses category-based hours for re-registration [43]; ASCP BOC combines a three-year point total with discipline, safety and ethics requirements [44]; HCPC requires a continuous and relevant portfolio without a universal hour quota [45]; GDC and DANB maintain profession-specific dental requirements [46,47]; NMC combines hours with participatory learning, reflection and practice evidence [48]; NMBA uses annual practice-relevant hours [49]; and ACHE combines management education with credential and volunteer requirements [50]. These systems reflect different purposes—legal registration, credential maintenance or professional recognition—and should not be ranked by total hours alone.

Digital education was a major cross-professional development. Online and mobile formats can reduce travel, extend access to rural workers and support rapid dissemination of new guidance. MOOCs and e-learning reviews documented large reach and generally positive knowledge and confidence outcomes [6,9]. Yet digital delivery can reproduce inequity when connectivity, devices, protected time or digital literacy are inadequate. It can also encourage passive completion when courses lack interaction, application and feedback. A stronger design combines concise digital content with case discussion, simulation, supervised practice, quality-improvement work or coaching.

Simulation and experiential learning are especially relevant where errors are high consequence or opportunities for practice are limited. Nursing simulation evidence supports knowledge and skill benefits but remains heterogeneous [25,31]. Similar principles can be applied to laboratory incident response, dental radiography and medical emergencies, and health-administration crisis or command-center exercises. Simulation should not be treated as technology alone; scenario relevance, facilitation and debriefing determine learning value.

The outcome evidence reinforces a hierarchy problem. Reaction and self-reported confidence are easy to collect and commonly positive. Knowledge tests and skill assessments provide stronger evidence but may still fail to demonstrate routine application. The oral-health study showed an intention-practice gap at six months [18], and leadership reviews found sparse patient and organizational outcomes [34,41]. Even the cross-professional patient-outcome review, while reporting positive findings in 14 of 17 studies, emphasized heterogeneity [8]. CPD evaluation should therefore predefine a plausible pathway from learning to competence, behavior and service outcome, rather than assuming that attendance causes improvement.

Equity requires deliberate attention. Rural and lower-resource workers may have fewer accredited programs, higher travel costs and greater staffing constraints. Dental assistants may have less professional autonomy or employer sponsorship than dentists. Nurses with family responsibilities or inflexible shifts may be disadvantaged by fixed scheduling. Laboratory professionals in under-resourced systems may face limited local courses and weak regulatory implementation. Administrators may prioritize immediate operational demands over development. Protected time, funded access, low-bandwidth digital options, local learning hubs and recognition within career pathways are therefore equity interventions as well as educational strategies.

Military and large integrated health systems could use the multidisciplinary framework to coordinate shared competencies—patient safety, communication, quality improvement, ethics, digital literacy and emergency management—while maintaining separate technical pathways. Shared governance can reduce duplication and support interprofessional exercises, but profession-specific assessment remains essential. The evidence does not establish that one central model is universally superior; rather, it supports common infrastructure with role-specific curricula, assessment and supervision.

This review also has important limitations. It used a rapid single-reviewer workflow and did not include authenticated searches of Scopus, Web of Science, CINAHL or ERIC. Relevant non-English and non-indexed sources may have been missed. The included evidence used different definitions of CPD, participation and completion, preventing pooled estimates. Many outcomes were self-reported, and dental-assistant results were often not separately extractable. Regulatory requirements can change and were current only to the stated access date. These limitations mean that the review maps the evidence and supports system design but should not be interpreted as a definitive comparative effectiveness analysis.

5. Evidence gaps and research priorities

Table 11. Evidence gaps and recommended research priorities

Gap	Why it matters	Research priority
Dental-assistant-specific participation and outcomes	Mixed dental-team data obscure the profession.	Use dental-assistant denominators, role-specific outcomes and longitudinal follow-up.
Comparable participation definitions	Studies use different windows and thresholds.	Develop core definitions for exposure, completion, active participation and application.
Objective practice and patient outcomes	Self-report dominates.	Use observed competence, audit data, safety indicators, patient experience and service metrics.
Health-administration organizational outcomes	Leadership programs rarely link to system performance.	Measure implementation, quality, workforce, financial and flow outcomes using comparison groups where feasible.
Low- and middle-income evidence	Evidence is geographically uneven and resources differ.	Evaluate scalable, low-bandwidth, locally facilitated and employer-supported models.
Digital and AI-enabled CPD	Rapid adoption exceeds evaluation.	Assess adaptive learning, AI tutoring, data privacy, bias, digital equity and transfer to practice.
Cost-effectiveness	Costs and opportunity costs are infrequently reported.	Include provider cost, staff release, travel, technology and downstream value.
Regulatory model effectiveness	Hours, points, portfolios and revalidation are rarely compared.	Compare compliance, learning quality, equity and practice outcomes across regulatory models.
Sustained effects	Follow-up is often immediate or short.	Use 6- to 24-month follow-up and document decay, reinforcement and practice change.

6. Future CPD needs

Medical Laboratory Sciences. Programs should integrate genomics, molecular diagnostics, automation, AI-assisted diagnostics, data interpretation, quality management and point-of-care testing governance. Technical modules should be paired with proficiency assessment, incident review and supervised application. Leadership, research literacy and communication with clinical teams are necessary as laboratory professionals increasingly interpret and govern complex diagnostic data.

Dental Assisting. Priority areas include digital dentistry, dental radiography, expanded functions where permitted, patient communication, occupational ergonomics, infection prevention, legal responsibilities and technology-assisted care. Regulators and educators should build profession-specific evidence rather than extrapolating from dentists. Training should be accessible to assistants in private and small-practice settings and linked to recognized career pathways.

Nursing. Future CPD should address advanced clinical assessment, digital nursing, telehealth, leadership, evidence-based practice, simulation, care coordination and AI-supported clinical practice. Career-stage pathways are needed for newly qualified, experienced and advanced-practice nurses. Evaluation should move beyond confidence to observed competence, practice change and patient safety.

Health Administration. Priority domains include informatics, data analytics, AI governance, strategic leadership, quality improvement, health economics, workforce planning, crisis management, cybersecurity and sustainability. Programs should use real organizational projects, coaching and longitudinal follow-up, with explicit measurement of implementation and organizational performance.

Shared competencies. Communication, interprofessional teamwork, digital literacy, leadership, patient safety, ethics, quality improvement, research literacy and change management should form a common CPD foundation. Shared modules can support integrated practice, but technical assessment and scope-of-practice requirements must remain profession specific.

7. Recommendations

Recommendations were classified by implementation horizon and stakeholder. Short-term actions can be initiated within 12 months, medium-term actions within one to three years and long-term actions over three to five years. The priorities are intended to be adaptable to hospitals, laboratories, dental clinics, nursing services, health-administration departments, universities, professional bodies and regulators.

Table 12. Recommended actions by stakeholder and time horizon

Horizon	Stakeholder	Action
Short term	Professionals	Create an annual needs-based learning plan; document workplace learning and reflection; select activities linked to scope and service priorities.
Short term	Healthcare organizations	Provide protected learning time, transparent funding criteria and low-bandwidth online access; map mandatory training separately from developmental CPD.
Short term	Managers and professional leads	Use competency-gap assessment; ensure dental-assistant and laboratory staff receive role-specific opportunities; identify mentors and local facilitators.
Short term	Educators/providers	State measurable outcomes; use active learning, cases, feedback and application tasks; report completion and

Horizon	Stakeholder	Action
		profession-specific denominators.
Medium term	Organizations and regulators	Adopt a common CPD data structure linking learning need, activity, competence assessment, practice application and outcome.
Medium term	Universities/training providers	Build blended micro-credentials in digital health, quality, leadership, research literacy and profession-specific emerging technologies.
Medium term	Licensing/credentialing bodies	Balance minimum participation requirements with reflection, practice relevance, ethics/safety content and proportionate audit.
Medium term	Policymakers	Fund rural access, local skills hubs, digital infrastructure and workforce backfill; monitor equity by profession, setting and geography.
Long term	Health systems	Develop interoperable CPD portfolios and multidisciplinary academies with profession-specific assessment pathways.
Long term	Researchers/funders	Support comparative studies of hour-based, portfolio and outcomes-based systems; require objective service and patient outcomes where appropriate.
Long term	All stakeholders	Establish national core outcome sets for CPD participation, competence, behavior, service quality, workforce outcomes and equity.

8. Implications for practice and policy

For practice, CPD should be embedded in workforce planning rather than added after workload decisions are made. Protected time, supervisor support and application opportunities are necessary if learning is expected to change care or operations. For policy, accreditation and renewal systems should distinguish minimum compliance from meaningful development and should collect data that permit assessment of equity and outcomes. For education, program design should begin with competence and service need, use the least restrictive effective delivery mode, and include follow-up. For research, future studies should report profession-specific denominators, delivery intensity, completion, objective outcomes and context.

9. Strengths and limitations

Strengths include explicit separation of dental assisting from dentistry; inclusion of empirical, review, program and regulatory evidence; current verification of selected requirements to July 2026; preservation of numerators and denominators where available; and generation of figures from the charted dataset. Limitations include the rapid single-reviewer design, lack of authenticated subscription-database searches, possible omission of non-English and grey literature, heterogeneous terminology and outcomes, and frequent reliance on self-report. The manuscript should undergo librarian replication of the search and independent second-reviewer validation before submission to a journal requiring fully duplicated systematic-review procedures.

10. Conclusion

CPD is widely valued across medical laboratory sciences, dental assisting, nursing and health administration, but participation and effectiveness depend on time, staffing, funding, access, relevance, employer support and regulatory design. Nursing has the broadest evidence; dental-assisting evidence is limited and often not separately reported; laboratory evidence highlights access and technical-quality needs; and health-administration evidence emphasizes leadership and system competencies. Online and simulation-based learning can extend access and improve knowledge or skills, but attendance and confidence should not be mistaken for sustained practice or improved outcomes. The most important strategic shift is from attendance-based CPD to needs-based, competency- and outcomes-oriented systems supported by protected learning time, employer investment, equitable access, objective assessment and feedback from patient, service and organizational performance.

Declarations

Ethics statement: Ethical approval was not required because the review used published and publicly accessible information and involved no participants or identifiable private data.

Funding: This research received no external funding.

Conflict of interest: The authors declare no conflicts of interest.

Data availability: No new primary participant-level data were collected.

Abbreviations

ACHE, American College of Healthcare Executives; AI, artificial intelligence; ASCP BOC, American Society for Clinical Pathology Board of Certification; CE, continuing education; CPD, continuing professional development; DANB, Dental Assisting National Board; GDC, General Dental Council; HCPC, Health and Care Professions Council; JBI, Joanna Briggs Institute; MLS, medical laboratory scientist; NMC, Nursing and Midwifery Council; NMBA, Nursing and Midwifery Board of Australia; PCC, Population–Concept–Context; PRISMA-ScR, Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews; SCFHS, Saudi Commission for Health Specialties.

References

1. World Health Organization. Global competency and outcomes framework for universal health coverage. Geneva: WHO; 2022.

2. Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI Manual for Evidence Synthesis. Adelaide: JBI; 2024.
3. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Scoping reviews. In: Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI Manual for Evidence Synthesis. JBI; 2024. doi:10.46658/JBIMES-24-09.
4. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018;169(7):467-473. doi:10.7326/M18-0850.
5. Manley K, Martin A, Jackson C, Wright T. A realist synthesis of effective continuing professional development (CPD): a case study of healthcare practitioners' CPD. *Nurse Educ Today*. 2018;69:134-141. doi:10.1016/j.nedt.2018.07.010. PMID:30059819.
6. Longhini J, Rossetini G, Palese A. Massive open online courses for nurses' and healthcare professionals' continuous education: a scoping review. *Int Nurs Rev*. 2021;68(1):108-121. doi:10.1111/inr.12649. PMID:33855697.
7. McMahon GT, Alnasser M, Alzouman H, Aldakhil L, Ababtain A. Transforming continuing professional development for healthcare professionals to meet national goals in Saudi Arabia. *J CME*. 2024;13(1):2378617. doi:10.1080/28338073.2024.2378617. PMID:39011066.
8. Ali S, et al. Impact of continuing professional development on patient outcomes: a systematic scoping review. *BMC Med Educ*. 2025;25:1284. doi:10.1186/s12909-025-07883-4. PMID:41039533.
9. Dentice S, Moreal C, Chiappinotto S, et al. Professional and patient care outcomes of e-learning in healthcare continuing education: a systematic review. *Nurse Educ Pract*. 2026;94:104866. doi:10.1016/j.nepr.2026.104866. PMID:42190409.
10. Ifeoma EA, Rebecca EF, Ezekiel OO, et al. A cross-sectional study of the knowledge and attitude of medical laboratory personnel regarding continuing professional development. *Niger Med J*. 2015;56(6):425-428. doi:10.4103/0300-1652.171617.
11. Horiuchi Y, et al. The efficacy of an internet-based e-learning system using the CellaVision Competency Software for continuing professional development. *Clin Chem Lab Med*. 2016;54(4):e127-e131. doi:10.1515/cclm-2015-0641. PMID:26479345.
12. Gebregzabher T, et al. Continuing professional development training needs assessment for medical laboratory professionals in Ethiopia. *Hum Resour Health*. 2023;21:47. doi:10.1186/s12960-023-00837-1. PMID:37340429.
13. Essuman MA, Addy NA, Essien-Baidoo S, et al. Self-reported continuing professional development needs of medical laboratory professionals in Ghana. *Hum Resour Health*. 2023;21:74. doi:10.1186/s12960-023-00859-9. PMID:37700340.
14. Ndlovu N, Mataka A, Lombard C, Erasmus RT, Zemlin AE. Survey and situation analysis of factors affecting participation in CPD programs of laboratory professionals in Africa. *Am J Clin Pathol*. 2024;161(4):360-368. doi:10.1093/ajcp/aqad154. PMID:38035716.
15. Negussie A, Sisay A, Shibabaw A, et al. Perceptions, attitudes, and challenges regarding continuing professional development among Ethiopian medical laboratory professionals: a mixed-methods study. *BMC Med Educ*. 2025;25:1049. doi:10.1186/s12909-025-07633-6. PMID:40660176.
16. Ndlovu N, et al. Narrative review: continuous professional development training programmes in Africa and their limitations. *Afr J Lab Med*. 2025;14(1):2602. doi:10.4102/ajlm.v14i1.2602. PMID:40470129.
17. Ndlovu N, et al. Improving laboratory continuous professional development training in Africa: the ASLM Academy experience. *Trop Med Int Health*. 2026;31(7):895-904. doi:10.1111/tmi.70134. PMID:41877398.
18. Shulman ER, Howard WG, Sharps G, Wearden S. The impact of a continuing education oral health program on providing services for young children by dentists, dental hygienists and dental assistants. *J Dent Hyg*. 2011;85(3):220-228. PMID:21888779.

19. Haridi HK, Al-Ammar AS, Al-Mansour MI. Compliance with infection control standard precautions guidelines: a survey among dental healthcare workers in Hail Region, Saudi Arabia. *J Infect Prev.* 2016;17(6):268-276. doi:10.1177/1757177416645344. PMID:28989490.
20. Skapetis T, Cheema S, El Mustapha M. Evaluation of clinical versus non-clinical continuing education in terms of preferences and value for oral healthcare workers. *Med Educ Online.* 2022;27(1):2125630. doi:10.1080/10872981.2022.2125630. PMID:36124488.
21. Albagieh H, Alsenani M, Alshehri M, et al. Knowledge and awareness assessment of cross-contamination of dental floss containers in King Saud University dental hospital clinics. *Saudi Dent J.* 2023;35(1):90-94. doi:10.1016/j.sdentj.2022.12.014. PMID:36817032.
22. Binassfour MA, et al. Knowledge and practices regarding dental impression disinfection among dental healthcare workers. *BMC Med Educ.* 2024;24:246. doi:10.1186/s12909-024-05238-z. PMID:38448923.
23. Kahraman EN, Bayrı B, Ulu Ö, et al. Radiation protection knowledge and training needs among dental healthcare workers in Turkey. *Int J Occup Saf Ergon.* 2026 Mar 11:1-7. doi:10.1080/10803548.2026.2638072. PMID:41812078.
24. Brekelmans G, et al. Factors influencing nurse participation in continuing professional development activities: survey findings. *Nurse Educ Today.* 2016;40:13-19. doi:10.1016/j.nedt.2016.01.028. PMID:27125144.
25. Hegland PA, Aarlie H, Strømme H, Jamtvedt G. Simulation-based training for nurses: systematic review and meta-analysis. *Nurse Educ Today.* 2017. doi:10.1016/j.nedt.2017.04.004. PMID:28456053.
26. Rouleau G, Gagnon MP, Côté J, Payne-Gagnon J, Hudson E, Dubois CA. Effects of e-learning in a continuing education context on nursing care: systematic review of systematic reviews. *J Med Internet Res.* 2019;21:e15118. doi:10.2196/15118. PMID:31579016.
27. King R, Taylor B, Talpur A, et al. Factors that optimise the impact of continuing professional development in nursing: a rapid evidence review. *Nurse Educ Today.* 2021;98:104652. doi:10.1016/j.nedt.2020.104652. PMID:33190952.
28. Mlambo M, Silén C, McGrath C. Lifelong learning and nurses' continuing professional development, a metasynthesis of the literature. *BMC Nurs.* 2021;20:62. doi:10.1186/s12912-021-00579-2. PMID:33853599.
29. Hakvoort L, Dikken J, Cramer-Kruit J, Molendijk-van Nieuwenhuyzen K, van der Schaaf M, Schuurmans M. Factors that influence continuing professional development over a nursing career: a scoping review. *Nurse Educ Pract.* 2022;65:103481. doi:10.1016/j.nepr.2022.103481. PMID:36327594.
30. Wright K, et al. Continuing education for advanced practice nurses: a scoping review. *J Adv Nurs.* 2024;80(8):3037-3058. doi:10.1111/jan.15911. PMID:37902130.
31. Sharkiya SH, et al. Simulation-based continuing education for nurses: a rapid review. *J Contin Educ Nurs.* 2024;55(9):433-441. doi:10.3928/00220124-20240529-01. PMID:38836635.
32. Redwood T, Ward A, Ali T, O'Dell C, Poole C, Rebaudo D. Continued professional development provision for nurses: a qualitative exploration. *Heliyon.* 2024;10(12):e32582. doi:10.1016/j.heliyon.2024.e32582. PMID:38948029.
33. Matandela M, Muswede NJ, Matahela VE. Understanding nurses' dispositions for continuing professional development: a scoping review. *Nurse Educ Pract.* 2026;93:104834.
34. Ayeleke RO, Dunham A, North N, Wallis K. The impact of training and professional development on health management and leadership competence: a mixed methods systematic review. *J Health Organ Manag.* 2019;33(4):354-379. doi:10.1108/JHOM-11-2018-0338. PMID:31282815.

35. Kakemam E, et al. Leadership and management competencies for hospital managers: a scoping review. *J Healthc Leadersh.* 2020;12:59-68. doi:10.2147/JHL.S265825. PMID:32801985.
36. Ravaghi H, et al. Effectiveness of training and educational programs for hospital managers: a systematic review. *Health Serv Manage Res.* 2021;34(2):113-126. doi:10.1177/0951484820971460. PMID:33143488.
37. Nguyen T, et al. Leadership competency development needs among healthcare managers. *J Nurs Adm.* 2024;54(6):347-352. doi:10.1097/NNA.0000000000001437. PMID:38743811.
38. Barghi Shirazi F, Soleimani Movahed M, Moslehi S, Barzegar Rahatlou M, Seyedin H. Knowledge and skills needed for future health administrators: a systematic review. *Iran J Public Health.* 2024;53(5):1021-1032. doi:10.18502/ijph.v53i5.15582.
39. Cheng S, He F, Su X, Liu Y, Cheung M, Mah AP. Impact of competency training on medical administrators: an evaluation of medical management and leadership development programme. *BMJ Lead.* 2025;9(3):281-285. doi:10.1136/leader-2024-001115. PMID:39667824.
40. Nexhip A, Riley M, Robinson K. Health information managers' engagement in continuing professional development. *Health Inf Manag.* 2025. doi:10.1177/18333583251378960. PMID:41020386.
41. Phillipson J, et al. What works in healthcare leadership development: an umbrella review. *BMJ Lead.* 2025;9(4):349-359. doi:10.1136/leader-2025-001269. PMID:40527607.
42. Oetjen D, et al. Evaluation of a comprehensive healthcare management development program. *J Healthc Leadersh.* 2025;17:649-664. doi:10.2147/JHL.S528912. PMID:41220490.
43. Saudi Commission for Health Specialties. Professional re-registration requirements. Riyadh: SCFHS; accessed 1 Jul 2026.
44. American Society for Clinical Pathology Board of Certification. Medical Laboratory Scientist MLS credential maintenance program requirements. Chicago: ASCP BOC; accessed 1 Jul 2026.
45. Health and Care Professions Council. Standards of continuing professional development and biomedical scientist requirements. London: HCPC; accessed 1 Jul 2026.
46. General Dental Council. Enhanced continuing professional development guidance for dental care professionals. London: GDC; accessed 1 Jul 2026.
47. Dental Assisting National Board. Maintain certification and continuing education requirements. Chicago: DANB; accessed 1 Jul 2026.
48. Nursing and Midwifery Council. Revalidation: continuing professional development requirements. London: NMC; accessed 1 Jul 2026.
49. Nursing and Midwifery Board of Australia. Continuing professional development registration standard and 2026 renewal guidance. Melbourne: NMBA; accessed 1 Jul 2026.
50. American College of Healthcare Executives. Maintain or recertify the FACHE credential. Chicago: ACHE; accessed 1 Jul 2026.