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From "Shows How" to "Does": Simulation-Based Medical Emergency Training (MES) and Direct Observation of Procedural Skills (DOPS) in Dentistry: — A Systematic Review.

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ABSTRACT :

Background: While individual dentists rarely face medical emergencies, these events are common across the field. Surveys repeatedly show that both dentists and dental students often feel under-prepared to handle such situations. Simulation-based medical emergency training (MES) and Direct Observation of Procedural Skills (DOPS) represent the top two levels of Miller's pyramid—'shows how' and 'does'—but their combined evidence in dentistry has not yet been reviewed together.

Objectives: This review aims to systematically examine dental studies on (i) how MES affects knowledge, skills, confidence, retention, and team performance, and (ii) the feasibility, reliability, and educational impact of DOPS. It also proposes a combined MES–DOPS framework.

Methods: We searched PubMed/MEDLINE through 11 November 2026 using the PRISMA 2020 guidelines and two search terms (MES and DOPS). Eligible studies included dental students, trainees, dentists, hygienists, or dental teams. Outcomes were mapped to Kirkpatrick levels, and a narrative synthesis (SWiM) was used due to varied study designs and outcomes.

Results: Of 143 unique records, 36 studies were included (MES n = 21; DOPS n = 15), from 15 countries, published 2010–2026. Simulation-based assessments consistently exposed large baseline deficits (e.g., only 22% correct diagnosis in a robot-patient OSCE; 54% adequate chest compressions; <10% correct on 8 of 10 AED steps). Controlled studies showed large gains after MES (e.g., 146 vs 77 scenario points; 90.9 vs 61.2/128 OSCE points with 100% vs 0% pass rates). Skills decayed within 3 months in the only objective retention study. DOPS proved feasible and well-accepted, achieved good inter-rater agreement (Krippendorff α 0.92; ICC 0.86), improved procedural scores compared with conventional evaluation, and served as an effective scaffold for self- and peer-assessment. No dental study applied DOPS to emergency management, and none measured patient outcomes (Kirkpatrick level 4).

Conclusions: MES effectively builds emergency skills that dental curricula often miss, but skills need to be refreshed about every three months. DOPS is a practical, reliable, and feedback-focused tool for routine procedures. Combining both—using an 'E-DOPS' for simulated and real emergencies—is a logical next step that has not yet been tested.

Keywords: Medical emergencies; Simulation training; Direct observation of procedural skills; Dental education; Competency-based education; Patient safety.

Introduction

Every dental appointment combines an anxious patient, a vasoactive local anaesthetic, a supine posture and, increasingly, an older and medically compromised population. Emergencies are therefore an inherent occupational risk rather than a remote possibility. In a statewide survey of 620 German dentists, 57% reported up to three emergencies and 36% up to ten emergencies in a single year; vasovagal syncope was most common (1,238 cases), 42 life-threatening events were recorded, and the authors estimated one sudden cardiac arrest per 638,960 patients treated [1]. Allergic respiratory emergencies, though rarer, remain potentially lethal, with local anaesthetics, latex, chlorhexidine and methacrylates the commonest triggers [2].

Preparedness has not kept pace with the level of risk. In a survey of 267 dentists at Saudi university hospitals, 49.4% had managed a medical emergency, but only 34.5% felt competent in CPR, and 28.8% were confident using emergency drugs [3]. A 2026 survey of 400 dentists found that only 26% had good BLS/CPR knowledge; recent workshop attendance (OR 4.91) and previous emergency experience (OR 12.97) were the strongest predictors of good knowledge [4]. At the institutional level, a national survey of 26 Saudi dental colleges found that only 38.5% conducted mock emergency drills and just 34.6% of staff were familiar with emergency medications; no college rated itself as 'very well' prepared [5]. Data from U.S. dental schools also showed large differences in the time spent on emergency education [6]. The main issue is not awareness, but the lack of practiced, observable skills.

Two educational technologies address precisely this gap. Simulation-based medical emergency training (MES) reproduces rare, high-stakes events in a risk-free environment, using manikins, high-fidelity patient simulators (HFS), robot patients, vital-sign apps, role-play or in situ drills, and structured debriefing [7–9]. Direct Observation of Procedural Skills (DOPS) is a workplace-based assessment (WBA) in which a trained assessor observes a learner performing a real procedure, rates it against domain-specific descriptors, and gives immediate feedback [10–12]. In Miller's framework, MES targets the "shows how" level and DOPS the "does" level [13] (Figure 2). Evidence from medicine suggests that WBA tools are perceived as educationally valuable, although objective proof of performance change is limited [14,15].

There are reviews of MES in dentistry [7], and DOPS has been discussed for postgraduate dental training [11]. However, no review has examined both methods together or considered whether DOPS's assessment standards could be applied to emergency skills. This review addresses three main questions:

1.RQ1 – What is the effect of MES on the knowledge, skills, confidence, retention and team performance of dental learners and practitioners?

2.RQ2 – How feasible, reliable and educationally effective is DOPS in dental education?

3.RQ3 – What evidence exists for, and what would an integrated MES–DOPS model look like?

Materials and Methods

1 Protocol and reporting

This review followed the PRISMA 2020 guidelines [16]. Due to the wide variety of study designs and outcomes, we used a narrative synthesis based on the SWiM guideline [17]. The protocol was not registered in advance.

2 Eligibility criteria

Table 1. Eligibility criteria (PICOS).

Population	Undergraduate dental students, dental hygiene students, interns, postgraduate/dental core trainees, practising dentists, dental nurses and mixed dental teams	Exclusively medical, nursing, paramedic or non-health populations
Intervention / exposure	MES arm: any simulation used to train or assess management of medical emergencies (manikin, HFS, robot, app/screen-based, role-play, in situ). DOPS arm: DOPS or modified DOPS (self-, peer- or faculty-rated) used for teaching or assessment	Simulation of purely dental-technical procedures without an emergency component; WBA tools other than DOPS used alone
Comparator	Any (none, lecture-based teaching, conventional assessment, baseline)	—
Outcomes	Any Kirkpatrick level: reaction (1), attitudes/confidence (2a), knowledge/skills (2b), behaviour (3), patient/organisational results (4); psychometric properties of DOPS	—
Study design	Primary studies: RCTs, quasi-experimental, pre–post, cohort, cross-sectional with a simulation/DOPS component, qualitative and mixed methods	Reviews, editorials, letters, conference abstracts without data, records without an abstract
Other	English language; published to 11 November 2026	—

3 Information sources and search strategy

PubMed/MEDLINE was searched from inception to 11 November 2026 with two strategies (Table 2). Two supplementary targeted searches retrieved epidemiological surveys that were used for background and discussion only.

Table 2. Search strategies and yields (PubMed/MEDLINE, searched 11 November 2026).

A – MES	medical emergencies dental simulation training	107
B – DOPS	(DOPS[Title/Abstract] OR "direct observation of procedural skills"[Title/Abstract]) AND (dental OR dentistry OR dentist)	37
Supplementary	state-wide survey medical emergency management dental practices incidence; medical emergencies dental office incidence survey dentists syncope	2 (background only)

4 Study selection and data extraction

After removing duplicates, we screened titles and abstracts using the eligibility criteria, then reviewed potentially relevant records in detail. One reviewer handled screening and data extraction, using titles, abstracts, and bibliographic information. We used a set template to record the first author, year, country, study design, number of participants, intervention or method, comparator, assessment tool, main quantitative results, and Kirkpatrick level.

5 Appraisal of evidence

We classified each study by its design (randomised, non-randomised controlled, single-group pre–post or longitudinal, cross-sectional/observational, or descriptive/qualitative) and by the highest Kirkpatrick level it reached [18]. For each study, we noted main sources of bias, such as lack of a control group, self-reported outcomes, small single-centre samples, unblinded raters, or participant dropout. We then graded the certainty of each finding as moderate, low, or very low, based on the consistency, directness, and strength of the study designs.

6 Synthesis

We grouped studies by intervention (MES or DOPS) and then by outcome area. We reported whether effects were positive or negative and included effect sizes when available. We did not rely only on statistical significance to count results.

Results

1 Study selection

The two searches yielded 144 records (107 + 37); one duplicate was removed. Of 143 records screened, 83 were excluded as clearly irrelevant (non-dental simulation such as airway-device trials, nursing or trauma training, or unrelated dental education). Sixty reports were assessed in detail and 24 excluded: six reviews or narrative articles [2,7–9,11,12], five letters or records without abstract/data, four surveys without a simulation or DOPS component [4–6], and nine non-dental populations (including large DOPS validation studies in endoscopy and surgery [14,15,19] and a VR-based BLS trial assessed by DOPS [20]). Thirty-six studies were included: 21 in the MES arm and 15 in the DOPS arm (Figure 1).

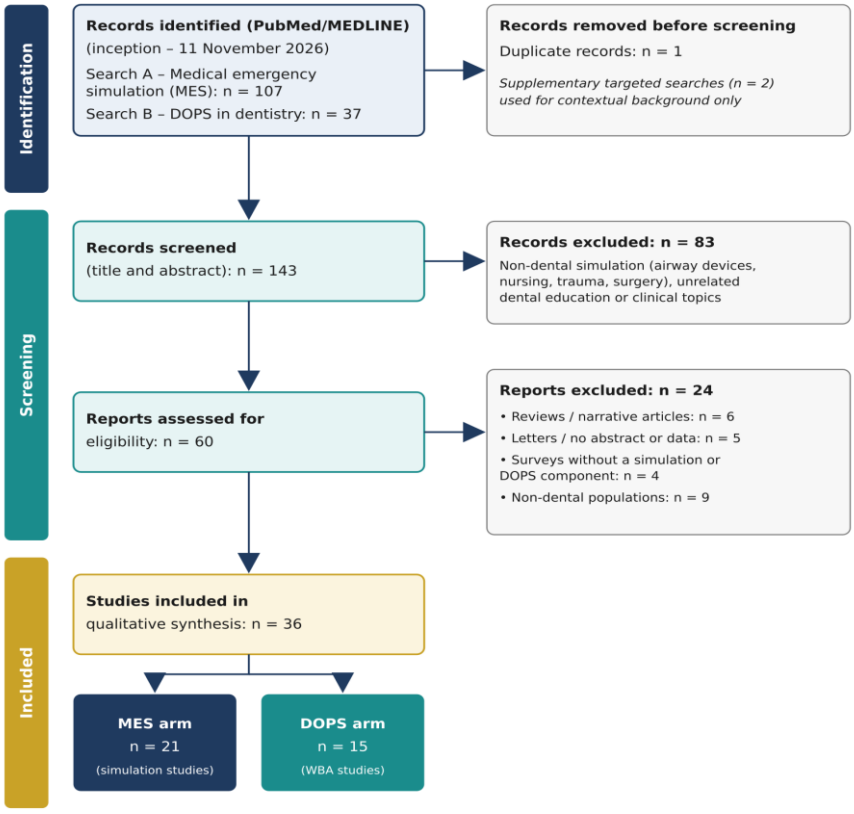


Figure 1. PRISMA 2020 flow diagram of study identification, screening and inclusion.

2 Characteristics of included studies

The 36 included studies were published between 2010 and 2026, with 14 (39%) published since 2023, showing that this area is growing quickly. Studies came from the USA (7), Saudi Arabia (3), the UK (5), Syria (4), Japan (3), Australia (2), China (2), India (2), Germany (2), and one each from France, Spain, Brazil, Egypt, Iran, and Taiwan. Participants included undergraduates, hygiene students, residents, core trainees, and qualified teams, with sample sizes from about 11 to 846. Only four studies were randomised. More details are in Table 3 (MES) and Table 4 (DOPS).

Table 3. Characteristics and principal findings of included MES studies (n = 21), in chronological order. K = highest Kirkpatrick level.

Newby 2010 [21]	Australia	Post-training survey	52 final-year UG	Interactive tutorial + realistic scenarios in students' own clinic	5-point Likert	Greater confidence 4.65 ± 0.48; prefer lecture to simulation 1.46 ± 0.74; simulation important 4.86 ± 0.35	2a
Tan 2011 [22]	USA	Descriptive	24 paediatric dental residents + assistants	Paediatric HPS in mock operatory: anaphylaxis, laryngospasm under sedation, overdose, arrhythmia; debrief	Survey	91.7% judged HPS a good learning tool and felt more confident for office crises	2a
Brooks-Buza 2011 [23]	USA	In-situ simulation exercise	Whole paediatric clinic team (faculty, residents, staff)	Two HFS scenarios run in a real patient room; facilitated debrief	Team/system observation	Vulnerabilities: communication, equipment availability, dosing errors, role assignment; led to mandatory simulation training	3
Tanzawa 2013 [24]	Japan	Cross-sectional OSCE	98 fifth-year UG	Robot patient OSCE after LA (vasovagal syncope; adrenaline hypersensitivity)	OSCE checklist	32% could not count pulse; 78% could not attach BP cuff/oximeter; correct diagnosis 22% (syncope 33%, adrenaline 8%)	2b
Kalsi 2013 [25]	UK	Pre–post survey	≤11 DF2 OMFS trainees	Four full-day courses: ALERT, simulated emergencies, case discussions	Rating scales, Likert	All perceived improvement in recognising critical illness, communication and resuscitation skills	2a
Bilich 2015 [26]	USA	Retrospective 4-yr cohort	114 dental hygiene students	HFS manikin emergency scenario in hygiene clinic	Faculty-rated performance	Effective for timely recognition, protocol use, kit use and follow-up; faculty calibration essential	2b
Breuer 2016 [27]	Germany	Scenario-based evaluation	30 final-year UG (15 teams)	ACLS manikin scenario (ERC 2010 guidelines)	Observation chart, video, manikin data	Only 33.3% of teams checked all vital functions; 54.1% of compressions adequate; 4 teams stopped CPR; AED used by 53.3%	2b
Rubin 2017 [28]	USA	Descriptive	14 GPR residents (78 questionnaires)	HFS team course with feedback and formal review	Questionnaire	Overall rating 4.91/5; course integrated into programme	1
Pinsky 2018 [29]	USA	Comparative	138 second-year UG; 18 retrained	Simulation-based emergencies rotation; equipment-location task	Checklist	Located ≥7/9 items: 10.1% vs 100% after targeted training; all items: 5.1% vs 72.2%	2b
Hadfield 2018 [30]	UK	Qualitative interviews	Sedation dentists and dental nurses	Centre-based and in-situ emergency simulation	Semi-structured interviews	Realistic, emotionally positive; in-situ sessions exposed flaws in drugs/equipment; self-reported changes in practice	3
Roy 2018 [31]	France	Prospective controlled	84 UG (42 sim, 42 control)	SimMan 3G HFS, 3 h; scenarios progressing to cardiac arrest	Scored test scenarios at 3 months, video	Median score 146 vs 77 ($P < .0001$); technical and non-technical skills improved	2b
Kishimoto 2018 [32]	Japan	Pre–post	51 dental providers	Low-cost vital-sign simulation app; syncope and anaphylaxis	Evaluation sheet, questionnaire	Syncope 7/9→9/9; anaphylaxis 8/12→12/12 ($P < .01$); confidence 14→56% and 6→42%	2b
De Mauro 2018 [33]	Brazil	Cross-sectional + manikin test	70 paediatric dentistry students	Child and infant CPR on manikins	Questionnaire + practical score	58% never BLS-trained; practical CPR inadequate in 73% (child) and 78% (infant); 17.1% felt prepared	2b
Manton 2021 [34]	USA	Controlled pilot	16 residents (8 vs 8)	Simulation curriculum replacing lectures	Recorded scenario OSCE, calibrated raters	90.9 vs 61.2/128 ($P = .0009$); pass rate 100% vs 0%	2b
Al-Sebaei 2023 [35]	Saudi Arabia	Repeated pre–post (4 yrs)	846 UG; 1,506 assessments	4-h module: lecture, 4 hands-on + 6 role-play stations	16-item MCQ; OSCE	MCQ 9.4 → 13.5; OSCE pass associated with number of module repetitions	2b

Kishimoto 2024 [36]	Japan	Longitudinal (0, 3, 6, 12 m)	39 dental residents	App-based scenarios: syncope, anaphylaxis, hyperventilation, ACS	Checklist, confidence survey	Skills and correct diagnosis fell significantly by 3 months; refresher at ~3 months recommended	2b
Cameron 2025 [37]	UK	Qualitative	OMFS dental core trainees	One-day HFS emergency course	Thematic analysis	Themes: realism, safe environment, community of practice; multidisciplinary debrief valued	2a
Alawaji 2026 [38]	Saudi Arabia	Pre–post, 9–11 m follow-up	34 senior UG (20 followed)	Social-cognitive-theory-based HFS scenarios, CPR refresher	Validated self-efficacy and capability scales	Capability +4.7, self-efficacy +41.4 points; no significant decline at 9–11 months	2b
Zachar 2026 [39]	Australia	Post-training survey	306 UG	Interactive medical-emergency simulation	Self-report	61.8% initially not/slightly confident → 71.6% fairly/completely confident; 97.6% felt more prepared	2a
Tayebi-Hillali 2026 [40]	Spain	Two-phase simulation study	81 final-year UG	Manikin cardiac arrest with semi-automated AED	10-item checklist, time to shock	<10% correct on 8/10 items; modified instructions improved key steps; time to shock 143 → 116 s	2b
Glowski 2026 [41]	USA	Randomised mixed-methods	110 UG in 12 teams	Reflection-through-action (PARSE pause) vs standard simulation	Expert-rated TS/NTS; epistemic network analysis	No difference on conventional scores; stronger diagnosis–plan–action linkage in reflective teams	2b

ACS, acute coronary syndrome; AED, automated external defibrillator; ALERT, Acute Life-threatening Events Recognition and Treatment; DF2, second-year dental foundation trainee; GPR, general practice residency; HFS/HPS, high-fidelity/human patient simulator; LA, local anaesthesia; NTS/TS, non-technical/technical skills; OMFS, oral and maxillofacial surgery; UG, undergraduate.

Table 4. Characteristics and principal findings of included DOPS studies (n = 15), in chronological order.

Tricio 2015 [42]	UK	Prospective pilot	10 Y2 (phantom head) + 16 Y5	Two modified peer-DOPS forms; immediate peer feedback	Generalisability	161 peer-DOPS; G = 0.62 (6 encounters) and 0.67 (7 encounters); positive perceptions	2b
Tricio 2016 [43]	UK	Prospective cohort	86 final-year (68 used peer-DOPS)	Peer-DOPS + feedback + self-reflection over one year	Participants vs non-participants	576 forms; ≥10 encounters → exam grades d = 0.74, critical reflection d = 1.41	2b
Singh 2017 [44]	India	Pilot implementation	15 UG; 4 faculty; 42 periodontal procedures	Generic DOPS form adapted to periodontics	Feasibility survey	Faculty comfort 3.95/5; student satisfaction 4.19/5; 83% wanted DOPS in other clinics	1
Khalifa 2018 [45]	Egypt	Inter-rater reliability	76 UG (complete dentures)	DOPS integrated into prosthodontic exam: occlusal plane, VDO, centric relation	Bland–Altman; Krippendorff α	Close rater agreement (OPO LoA 0.73/–0.78); centric relation α = 0.92	2b
Rawekar 2020 [46]	India	Institutional implementation	PG learners (medical, dental, ayurveda, nursing)	Mini-CEX and/or DOPS, six encounters per semester	Semester trend; perceptions	Scores improved semester-on-semester; satisfactory acceptance by students and faculty	2b
Liu 2021 [47]	Taiwan	8-yr retrospective	69 PG trainees	DOPS for complicated extraction (self vs faculty)	Self–faculty comparison	Faculty scores > self-scores; high performers under-rated most; >40% self-rated "poor" despite adequate performance	2b
Alfakhry 2022a [48]	Syria	Prospective pilot	16 UG (restorative)	Self-DOPS + rubric, 4 encounters with training	Self–faculty bias	Bias 0.77 → 0.21 (d = 0.64); disconfirming dimensions 39.7% → 26.9%	2b
Alfakhry 2022b [49]	Syria	Prospective pilot	16 Y5 (restorative)	Peer-DOPS + rubric, 3 encounters	Peer–faculty gap	Over-estimation fell each encounter; gap reduced (d = 0.67)	2b
Alfakhry 2023 [50]	Syria	Quasi-experiment	32 Y5 (operative)	Self-DOPS, 5 encounters + feedback/feed-forward	Self–teacher deviation	Deviation decreased (P = .064, α = .10); identification of improvement areas P = .011	2b

Dabaghi Tabriz 2024 [51]	Iran	Randomised quasi-experiment	60 UG (30/30)	DOPS ×3 for fluoride, fissure sealant, health education	Traditional evaluation	Higher scores in all three skills (P < .001); high student and faculty satisfaction	2b
Alfakhry 2024 [52]	Syria	Mixed-methods quasi-experiment	32 UG (operative)	Self-assessment-modified DOPS, 5 encounters	Zimmerman SRL framework	84.4% strongly agreed self-assessment useful; benefit across forethought, performance and reflection	2a
Baabdullah 2025 [53]	Saudi Arabia	Curriculum report	OMFS trainees	6-week arts-and-humanities facial-analysis course; DOPS among outcome tools	Multiple tools	Preliminary gains in observation, recall, reasoning and empathy	2b
Huang 2025 [54]	China	RCT	58 fourth-year UG	Blended PBL/CBL/seminar chairside teaching; DOPS + Mini-CEX outcomes	Lecture-based teaching	Higher pre-op preparation (7.24 vs 6.14), standardised steps (7.10 vs 6.34), post-op care (7.07 vs 6.24); no difference in technique	2b
Weimer 2026 [55]	Germany	Prospective quasi-experiment	64 UG (21 at 3 m) + physicians	Blended head-and-neck ultrasound curriculum; DOPS at post-test	Certified physicians	DOPS performance not different from physicians (P = .59); domain-specific gaps	2b
Wu 2026 [56]	China	Randomised mixed-methods	40 Y5 (oral surgery)	Microskill stepwise extraction model; modified DOPS by two blinded examiners	Apprenticeship teaching; ICC	ICC 0.86; 94.6 vs 88.3 (d = 1.19); narrower score range (87–100 vs 75–96)	2b

CBL, case-based learning; ICC, intraclass correlation coefficient; LoA, limits of agreement; Mini-CEX, mini-clinical evaluation exercise; OPO, occlusal plane orientation; PBL, problem-based learning; PG, postgraduate; SRL, self-regulated learning; VDO, vertical dimension of occlusion; Y2/Y5, year 2/year 5.

3 MES arm: synthesis of findings

1 Simulation reveals the size of the competence gap

Simulation assessments consistently revealed skill gaps that written exams missed. For example, in a robot-patient OSCE, 78% of fifth-year students could not attach a sphygmomanometer or pulse oximeter, and only 22% made the correct diagnosis; just 8% recognized adrenaline hypersensitivity [24]. In an ACLS scenario, only a third of teams checked response, breathing, and circulation, and only 54% of chest compressions were adequate [27]. About three-quarters of postgraduate students performed paediatric CPR inadequately [33]; fewer than 10% of final-year students completed eight out of ten AED steps correctly [40]; and only 10% of second-year students could find seven of nine emergency items in their clinic [29]. In-situ team simulations also uncovered communication failures, missing equipment, dosing errors, and unclear roles that had gone unnoticed in daily practice [23].

2 Effect on skills and knowledge (Kirkpatrick 2b)

All three controlled studies showed that simulation led to much better results. Students who had three hours of high-fidelity simulation scored a median of 146 points on test scenarios three months later, compared to 77 points, with improvements in both technical and non-technical skills [31]. Residents who completed a simulation program averaged 90.9 out of 128 OSCE points, while controls averaged 61.2; all intervention participants passed, but none in the control group did [34]. Targeted training improved equipment-location success from 5% to 72% [29]. Uncontrolled pre–post studies found similar results: a low-cost vital-sign app raised scores for syncope and anaphylaxis to the maximum [32]; a four-hour role-play module increased MCQ scores from 9.4 to 13.5 among 846 students, and OSCE pass rates improved with more repetitions [35]; and high-fidelity simulation worked well for dental hygiene students when faculty were properly trained [26]. Even low-cost methods like apps, role-play, and clearer AED prompts [40] led to significant improvements, showing that high cost is not necessary.

3 Confidence and self-efficacy (Kirkpatrick 1–2a)

All studies that measured reaction or confidence found very positive results [21,22,25,28,37,39]. In the largest group, 61.8% of 306 students felt little or no confidence before training, but after training, 71.6% felt fairly or completely confident, and 97.6% felt more prepared [39]. One study using social cognitive theory reported a 41-point increase in self-efficacy [38]. These results are important because low confidence can prevent action in real emergencies, but self-reported confidence does not prove actual competence.

4 Retention and skill decay

There is limited and mixed evidence about how long skills last. In the only study with repeated objective tests, scores for anaphylaxis checklists and diagnosis of syncope, hyperventilation, and acute coronary syndrome dropped significantly at 3, 6, and 12 months after training. The authors suggested a refresher at about three months [36]. In contrast, self-rated ability and self-efficacy did not decline 9–11 months after a theory-based course [38], and one controlled study found continued improvement at three months [31]. The difference between objective and self-reported results is important: confidence can outlast actual skills.

5 Teams, systems and reasoning (Kirkpatrick 3)

Three studies looked at effects beyond individual learners. In-situ simulation found hidden system problems and led to changes in the organization [23]. Sedation practitioners reported real changes in their practice, especially after in-situ sessions [30]. A randomised study showed that a structured pause for

reflection during simulation helped teams more closely connect diagnosis to action, even though standard checklists did not show a difference [41]. Trainees appreciated realistic scenarios, multidisciplinary debriefing, and peer observation [37].

DOPS arm: synthesis of findings

1 Feasibility and acceptability

DOPS was practical to use in undergraduate periodontics, community dentistry, restorative and operative dentistry, oral surgery, prosthodontics, and postgraduate programs. In the first Indian dental pilot, faculty rated the format as non-intrusive (3.95/5), students were satisfied (4.19/5), and 83% wanted it used in other clinical postings [44]. An Indian program that combined Mini-CEX and DOPS showed steady score improvement and good acceptance [46]. Both students and faculty were also satisfied in Iran [51] and in peer-DOPS programs in the UK [42].

2 Educational impact on performance

Four comparative studies showed that DOPS improved procedural performance. Repeated DOPS led to much higher scores than traditional evaluations for fluoride application, fissure sealing, and health education [51]. Students who completed 10 or more peer-DOPS sessions performed better than those who did not on major exams ($d = 0.74$) and in critical reflection ($d = 1.41$) [43]. When DOPS was used to measure outcomes, a stepwise microskill model for extractions outperformed apprenticeship teaching ($d = 1.19$) and had less score variation [56]. Blended chairside teaching improved DOPS scores for preparation, standardisation, and post-operative care, but not for technique [54]. DOPS was also accurate enough to compare dental students with physicians in ultrasound skills [55].

3 Reliability

Inter-rater agreement was strong where measured: Krippendorff's α was 0.92 for centric relation registration, with tight Bland–Altman limits for occlusal plane and vertical dimension in a prosthodontic exam [45], and the ICC was 0.86 for modified DOPS in oral surgery [56]. Peer-DOPS generalisability coefficients (0.62–0.67 after 6–7 sessions) were just below the 0.70 standard [42]. Large non-dental datasets help explain this: in over 10,000 gastroscopy DOPS, trainee skill explained only 31% of score differences, with 43% due to case variation and 18% to assessor subjectivity; three assessments by three assessors were needed to reach 0.70 reliability [19].

4 DOPS as a scaffold for self- and peer-assessment

A unique aspect of dentistry is the use of DOPS forms with rubrics to support self-regulated learning. In a series of Syrian studies, structured self-DOPS reduced the gap between self and faculty ratings from 0.77 to 0.21 [48], and peer–faculty differences got smaller with each session [49]. Students became better at identifying their own areas for improvement [50], and reported benefits throughout all stages of Zimmerman's self-regulated learning cycle [52]. On the other hand, an eight-year review of postgraduate extraction DOPS found that the best trainees often rated themselves lowest, with over 40% calling themselves 'poor' even when they performed well [47].

5 Certainty of evidence

Table 5 gives an overview of the direction and certainty of each main finding. Most studies provided evidence at Kirkpatrick level 2; three reached level 3, and none reached level 4. The main limitations were single-group designs, self-reported outcomes, small sample sizes from single institutions, and the lack of blinding.

Table 5. Summary of findings and certainty of evidence.

MES – baseline competence deficit revealed by simulation	6	Consistent: large deficits in recognition, monitoring, CPR, AED and equipment use	Moderate	Consistent, objective measures; cross-sectional
MES – short-term skills/knowledge gain	7	Consistently positive; large effects in 3 controlled studies	Low–moderate	Few controls, small samples, mostly unblinded
MES – confidence/self-efficacy	8	Consistently positive	Low	Self-report; no control groups
MES – retention over time	3	Inconsistent: objective decline by 3 m vs stable self-report	Very low	Few studies, attrition, mixed measures
MES – team/system performance	3	Positive; latent hazards identified	Low	Qualitative/descriptive designs
DOPS – feasibility/acceptability	5	Consistently positive	Moderate	Consistent across settings and countries
DOPS – procedural performance	4	Positive ($d \approx 0.7–1.2$)	Low	Three randomised (one quasi-randomised)
DOPS – reliability	3	Good inter-rater agreement; G slightly < 0.70 for peer-DOPS	Low	Single-centre, few raters
DOPS – self/peer calibration	5	Positive; bias reduced with training	Low	Small samples, one research group dominant
Patient outcomes (Kirkpatrick 4)	0	Not studied in dentistry	—	Evidence gap

6 Convergence of MES and DOPS

None of the dental studies included used DOPS to assess how medical emergencies were managed, either simulated or real. However, several MES studies used direct-observation checklists, scoring grids, or recorded OSCEs that are similar in structure to DOPS [24,27,31,34,40]. A non-dental randomised crossover trial also used DOPS to track BLS skills from baseline to three months after both traditional and virtual-reality training [20]. So, the method exists, but it has not yet been applied in dentistry.

Discussion

1 Principal findings and their importance

This review is the first to combine dental evidence on two complementary competency-based tools. The main takeaway is that dental graduates should not be considered competent in emergencies just because they attended lectures or have BLS certificates. When actual performance was observed in simulations, most learners missed key steps [24,27,33,40]. MES helps close this gap in the short term, often with large improvements and at low cost [31,32,34,35]. DOPS adds structured observation and immediate feedback, turning occasional supervision into documented, formative assessment [43,44,51].

Each tool is important because it covers what the other cannot. Emergencies are too rare and risky to learn during real patient care, so they need to be practiced in simulation. Routine procedures happen every day but are rarely observed in a structured way, so workplace-based assessment is needed. On Miller's pyramid, MES strengthens the 'shows how' level for rare, serious events, while DOPS checks the 'does' level for common procedures (Figure 2) [13].

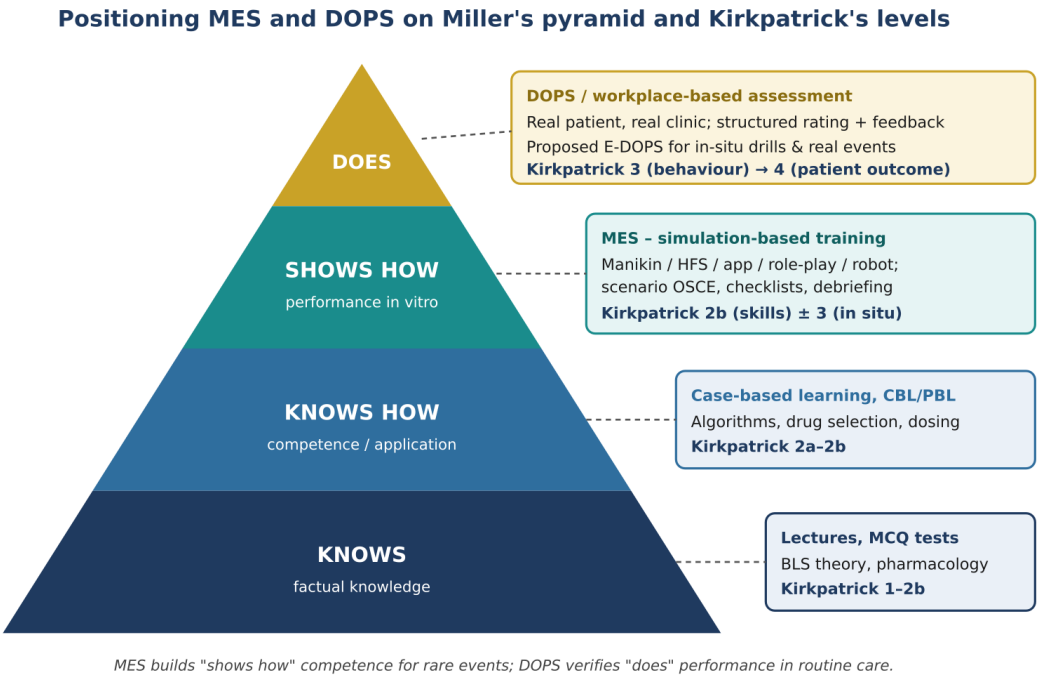


Figure 2. MES and DOPS mapped to Miller's pyramid of clinical competence and to Kirkpatrick's levels of training evaluation.

2 Skill decay and the case for scheduled refreshers

The drop in skills observed within three months [36] aligns with findings from other resuscitation studies and suggests that a single course in the final year is insufficient. The fact that confidence stayed high even when actual skills were not measured [38] is a warning: feeling confident without practice can lead to missed emergencies or unsafe actions. Repeated practice helps—OSCE pass rates improved with each extra module [35], and recent workshop attendance strongly predicted knowledge among dentists [4]. A reasonable approach is to schedule short refreshers about every three months during clinical years, with yearly in-situ drills after that.

3 Why DOPS works — and its caveats

DOPS appears to work more as a tool for feedback than just for measurement. Its benefits were most obvious when sessions were repeated (at least 10 peer sessions [43]; three repetitions [51]) and when learners were trained to use the rubric [48,49]. Reliability can be achieved for clear steps such as centric relation recording [45], but a single DOPS is not enough for important decisions: medical data show that several assessors and sessions are needed [19], and confusion about whether DOPS is formative or summative can reduce acceptance [15]. The wider WBA literature also warns that positive opinions have not yet been matched by clear evidence of practice change [14]. Faculty development is essential, not optional [44,47].rd an integrated MES–DOPS model ("E-DOPS")

Bringing together both types of evidence points to a cyclical model (Figure 3) in which emergency simulations are assessed using a DOPS-style tool, called E-DOPS, rather than ad hoc checklists or satisfaction surveys. E-DOPS would keep the main features of DOPS—direct observation, domain-based ratings, immediate feedback, repeated sessions, and self- and peer-rating—while focusing on the skills that simulation studies have shown to be lacking.

Table 6 suggests a set of domains for future validation.

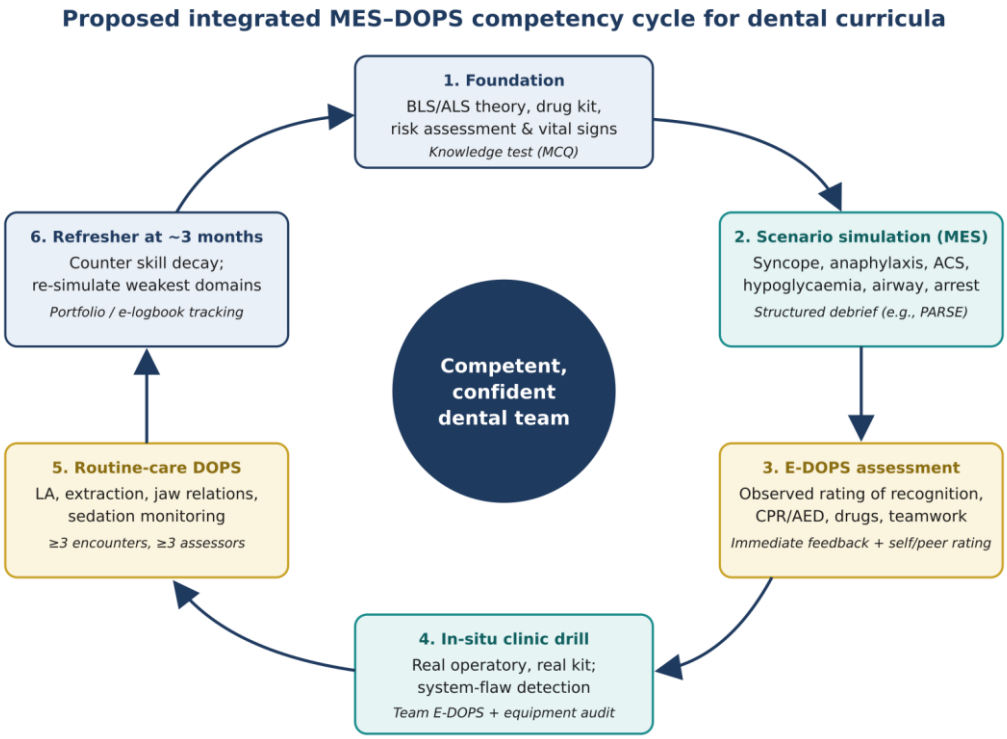


Figure 3. Proposed integrated MES–DOPS competency cycle. E-DOPS: emergency-adapted direct observation of procedural skills.

Table 6. Proposed E-DOPS domains, each rated on the conventional six-point DOPS scale (1–2 below expectations; 3 borderline; 4 meets expectations; 5–6 above expectations) with free-text feedback.

1. Pre-treatment risk assessment	Medical history and medication review; baseline pulse, BP, SpO_2 recorded; ASA status; emergency kit checked	Monitor attachment failures [24]; baseline vital signs rarely mandated [5]
2. Recognition and diagnosis	Systematic ABCDE assessment; correct working diagnosis; differentiates syncope, anaphylaxis, hypoglycaemia, ACS	Correct diagnosis 22% [24]; vital-function checks 33% [27]
3. Call for help and role allocation	Stops treatment, summons help, activates EMS/code, assigns roles	Role confusion and communication failure [23]
4. Positioning, airway and oxygen	Appropriate positioning; airway opening; oxygen delivery; suction/foreign-body management	Bag-valve-mask and airway errors [27]
5. Drugs: choice, dose, route	Selects emergency drug per current national guideline; checks dose/route; documents time	Dosing errors [23]; low drug confidence [3]
6. CPR and AED	Compression depth/rate, minimal interruptions; correct AED pad placement, safety check, time to shock	Compressions adequate 54% [27]; AED steps <10% [40]
7. Equipment and environment	Locates and uses kit, oxygen, AED without delay	Equipment location 10% [29]
8. Non-technical skills	Closed-loop communication, situational awareness, leadership, structured handover	NTS gains with simulation [31,39,41]
Global	Overall judgement, strengths, development points, agreed action plan	Self-assessment bias [47,48]

5 Relevance to prosthodontics and to the Indian context

Prosthodontic practice involves several emergency risk factors: patients are often older, have multiple health issues, and take many medications; appointments for implant surgery and full-mouth rehabilitation are long; and some procedures, like impression-making, carry risks of aspiration and airway problems. The only prosthodontic DOPS study in this review showed excellent reliability for jaw-relation recording [45], suggesting that prosthodontic departments could pilot both routine DOPS (such as border moulding, jaw relations, try-in) and E-DOPS. The two Indian studies confirm

that DOPS is practical in current clinical postings and postgraduate programs [44,46]. No Indian dental MES study met the inclusion criteria, highlighting a clear opportunity for postgraduate research.

6 Strengths and limitations

Strengths of this review include its dual-arm design, clear mapping to the Miller and Kirkpatrick frameworks, transparent reporting of search methods and results, and the translation of findings into a testable framework. However, there are important limitations to consider. Only one database was searched, so studies found only in Scopus, Web of Science, Embase, ERIC, or regional journals (especially Iranian and Indian DOPS studies) may be missing. Screening and data extraction were performed by one reviewer using titles, abstracts, and metadata, not in duplicate from full texts, thereby raising the risk of errors. The protocol was not registered. Most included studies were small, uncontrolled, and relied on self-reported outcomes; there may be publication bias toward positive results, and certainty was graded informally rather than using a validated tool such as MERSQI.

7 Implications for research

- •Randomised or cluster-randomised trials comparing MES with lecture-based teaching using blinded, objective scenario scores.
- •Development and validation of E-DOPS: content validity (Delphi), inter-rater reliability, generalisability (number of encounters and assessors) and relationship to OSCE scores.
- •Longitudinal studies of retention at 3, 6 and 12 months comparing different refresher intervals.
- •Translational outcomes: in situ drill performance, real-event audits, time to defibrillation, and patient outcomes (Kirkpatrick 3–4).
- •Multicentre Indian studies of MES and DOPS within undergraduate and postgraduate prosthodontic curricula.

Conclusion

Within the limitations of this review, the following conclusions can be drawn:

1. 1.Simulation-based assessment consistently shows that dental learners have substantial, previously hidden deficits in recognising and managing medical emergencies.
2. 2.MES produces large short-term gains in skills and confidence, is achievable with low-cost modalities, and should be a mandatory, repeated component of dental curricula.
3. 3.Emergency skills decay within months; refresher simulation at approximately three-month intervals and periodic in-situ drills are warranted.
4. 4.DOPS is feasible, acceptable and reliable for defined dental procedures, improves procedural performance when repeated, and is a powerful scaffold for self- and peer-assessment.
5. 5.Integrating the two — an emergency-adapted DOPS applied to simulated and in-situ events — is a logical and currently untested strategy to carry emergency competence from "shows how" to "does".

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