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Original Article

Clinical Preparedness of Dental Students to Manage Medical Emergencies in Clinical Setting: A Cross-Sectional Study

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ABSTRACT

Background: Medical emergencies such as syncope, hypoglycemia, seizures, and anaphylaxis can occur unexpectedly during dental procedures, requiring prompt recognition and management to prevent serious outcomes. While theoretical knowledge of these events is typically included in undergraduate curricula, practical training and simulation are often limited in Pakistan, creating potential gaps in preparedness that may compromise patient safety and professional accountability. Objective: This study aimed to assess the clinical preparedness of dental students across Pakistan to manage medical emergencies, with a focus on their exposure, confidence, curriculum coverage, and perceived training needs. Methods: A cross-sectional observational study was conducted from July to August 2025 across multiple dental institutions. A validated, structured questionnaire was administered to third- and final-year students, house officers, and postgraduate trainees. Data from 193 participants were analyzed using SPSS version 22. Descriptive statistics summarized frequencies and proportions, while chi-square tests and odds ratios with confidence intervals evaluated associations between training exposure, academic stage, and confidence levels. Results: Syncope (48.7%) and hypoglycemia (37.8%) were the most frequently encountered emergencies. Awareness of syncope protocols was high (87%), yet confidence in managing seizures (42%), chest pain (23.8%), and anaphylaxis (16%) was low. Students receiving both theoretical and practical training reported significantly greater confidence (OR 2.93, 95% CI: 1.64–5.24, $p < 0.001$). Lack of confidence (56%) and fear of harming patients (62.7%) were the primary barriers, although 96.4% expressed willingness to attend hands-on workshops. Conclusion: Dental students in Pakistan demonstrate adequate theoretical awareness but limited clinical readiness to manage emergencies, particularly complex cases. Integration of structured simulation, BLS certification, and mandatory practical modules into dental curricula is essential to enhance competence and safeguard patient safety.

Keywords: Dental Education, Medical Emergencies, Clinical Preparedness, Simulation Training, Curriculum Reform.

INTRODUCTION

Dental practice frequently exposes clinicians to unforeseen medical emergencies that can rapidly escalate if not managed appropriately. Such events, including vasovagal syncope, hypoglycemia, seizures, asthma exacerbations, allergic reactions, and even anaphylaxis, may occur at any stage of dental procedures and demand immediate recognition and intervention to prevent serious morbidity or mortality (1). With the increasing prevalence of patients presenting with chronic illnesses and complex medical profiles in dental clinics, the risk of encountering medical emergencies has grown considerably, emphasizing the dual responsibility of dentists to provide both technical dental care and competent emergency management (2).

Globally, several studies have highlighted that while dental curricula address medical emergencies in theory, practical application through simulation and structured training is often limited. In high-income countries such as the United States and Australia, Basic Life Support (BLS) certification and mandatory simulation-based training modules have become an integral part of dental education, resulting in improved confidence and skill retention among dental students (3,4). Programs that incorporate role-play, mock drills, and hands-on workshops have been shown to significantly enhance preparedness, with students reporting higher confidence levels and better knowledge retention following these interventions (5). For instance, an Australian undergraduate training program reported confidence scores of nearly 4.7/5 after structured simulation-based learning (6). Similarly, short interventions in Saudi Arabia and Europe demonstrated that even one-day workshops could substantially improve preparedness and engagement (7). These findings underscore that competence in emergency management is not innate but can be effectively cultivated through repeated exposure and skill-based learning.

In contrast, the situation in Pakistan reveals a more concerning reality. Several cross-sectional surveys conducted in cities such as Karachi, Rawalpindi, and Islamabad indicate that a substantial proportion of dental students and early-career practitioners feel inadequately trained to manage emergencies in clinical practice (8,9). Many report reliance on theoretical knowledge alone, with limited

or no opportunities for supervised practical application. For example, recent multi-center studies highlight that fewer than 40% of final-year dental students received both theoretical and practical training, and the majority expressed low confidence in handling real-life emergencies such as seizures or cardiac events (10). The consequences of this gap extend beyond individual performance to patient safety, legal accountability, and the reputation of dental institutions. Inadequate responses to emergencies not only compromise outcomes but also risk malpractice allegations, highlighting the ethical and legal imperative for robust preparedness (11).

Despite recognition of these challenges, structured simulation-based modules remain largely absent from the majority of dental curricula in Pakistan. The emphasis continues to be skewed toward theoretical instruction, leaving students ill-prepared to translate knowledge into practice during high-pressure clinical scenarios. This mismatch between curricular design and practical demands contributes to hesitation, lack of confidence, and fear of patient harm among dental trainees, all of which have been reported as significant barriers to effective emergency management (12). Given that emergencies, though infrequent, occur in nearly every dental setting with syncope and drug-related reactions being most common the absence of systematic preparedness training poses a tangible risk to patient safety and professional standards (13).

The existing literature thus demonstrates a clear gap between global best practices and local training approaches. While international data confirms the effectiveness of simulation-based education and mandatory BLS certification, the Pakistani context reveals persistent reliance on theory with limited practical reinforcement. This study seeks to address this knowledge gap by assessing the clinical preparedness of dental students across Pakistan in managing medical emergencies. Specifically, it aims to evaluate their exposure to emergencies, familiarity with standard protocols, confidence in handling critical events, and perceptions of curricular adequacy. By identifying weaknesses and training needs, this research intends to generate evidence that can support curriculum reform and inform national policy development in dental education. The central research question is whether dental students in Pakistan are sufficiently prepared, both theoretically and practically, to manage medical emergencies during clinical practice, and which areas of training require priority to enhance patient safety and professional competence.

MATERIAL AND METHODS

This investigation was designed as a cross-sectional observational study with the primary aim of evaluating the preparedness of dental students to manage medical emergencies in clinical practice. The design was selected because it allows for the assessment of knowledge, exposure, and self-reported competence at a single point in time, which is particularly appropriate when exploring educational gaps and variations across student cohorts (14). The study was conducted across multiple dental institutions in Pakistan, including both public and private sector colleges, with data collection spanning from July to August 2025 to ensure adequate representation and variability in responses.

Participants included undergraduate students in their third and final years of Bachelor of Dental Surgery (BDS), house officers who had recently completed their undergraduate training, and postgraduate trainees actively engaged in clinical rotations. Inclusion criteria required that students and trainees be directly involved in clinical care of patients during the study period. Exclusion criteria comprised preclinical students, individuals on academic leave, and those unwilling to provide informed consent. A convenience sampling approach was employed, and eligible participants were invited through institutional notices and personal communication. Prior to participation, each individual was informed of the study objectives and assured of the voluntary nature of involvement, confidentiality of responses, and their right to withdraw at any time without consequence. Consent was obtained electronically before the survey could be accessed.

Data collection was conducted through a structured, self-administered questionnaire. The instrument was developed following an extensive review of existing literature and previous validated tools assessing emergency preparedness in dental education (15,16). The initial version underwent pilot testing with 40 students to assess clarity, content validity, and internal consistency. Adjustments were made based on feedback before full dissemination.

The final questionnaire included sections on demographic information, prior exposure to emergencies, awareness of standard clinical protocols, self-rated confidence levels, curriculum coverage, and perceptions of barriers and training needs. Key variables were operationalized as follows: exposure was defined as having witnessed or managed an emergency on a dental chair; awareness was defined as knowledge of standard protocols such as Trendelenburg positioning for syncope; and confidence was measured on a 5-point Likert scale ranging from very low to very high. Perceived barriers included lack of confidence, knowledge, equipment, or fear of harming the patient.

To minimize bias, anonymity was maintained throughout the data collection process, and no identifiable information was requested. Response bias was further reduced by ensuring that participation was voluntary and independent of academic evaluation. Confounding was addressed in the analysis phase by stratifying results according to year of study and clinical experience, thereby examining whether training level influenced preparedness outcomes. The pilot-tested questionnaire enhanced content validity, while the use of multiple institutions improved generalizability.

The final sample comprised 193 valid responses. A sample size of approximately 190 was targeted based on an assumed prevalence of 50% for adequate preparedness, a 95% confidence level, and a 7% margin of error, which provided sufficient statistical power to detect meaningful differences across groups (17).

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 22. Descriptive statistics were used to summarize frequencies and proportions for categorical variables, while means and standard deviations were reported for continuous

measures. Associations between preparedness outcomes and independent variables such as level of education and prior exposure were explored using chi-square tests for categorical comparisons and independent t-tests or ANOVA where appropriate. Subgroup analyses were conducted by academic year to identify patterns across training levels. Missing data were minimal, and cases with incomplete responses for key variables were excluded listwise to avoid introducing bias. Adjustments for potential confounders, including gender and academic stage, were performed in multivariable analyses to isolate independent associations.

Ethical approval was obtained from the Research Ethics Committee of Liaquat University of Medical and Health Sciences under reference number LUMHS REC 985. All procedures were conducted in accordance with institutional and national ethical standards, and data protection protocols were observed to maintain participant confidentiality. Electronic records were stored in password-protected files accessible only to the research team. To enhance reproducibility, the questionnaire, coding framework, and statistical analysis plan were standardized and archived, allowing replication of study procedures by independent investigators.

RESULTS

A total of 193 valid responses were analyzed, with 98 (50.8%) females and 95 (49.2%) males, showing a balanced gender distribution. Most respondents were third-year BDS students (63.7%), followed by final-year students (17.6%), house officers (13%), and postgraduates (5.7%). Detailed participant characteristics are presented in Table 1.

Table 1. Demographic and Educational Characteristics of Participants (N = 193)

Variable	Frequency (n)	Percent (%)	Statistical Comparison	p-value
Gender (Male vs Female)	95 / 98	49.2 / 50.8	$\chi^2(1) = 0.02$	0.89
Year of Study				<0.001*
– 3rd Year BDS	123	63.7	Ref	–
– Final Year BDS	34	17.6	OR 1.42 (95% CI: 0.72–2.81)	0.31
– House Officer	25	13.0	OR 2.16 (95% CI: 0.94–4.93)	0.07
– Postgraduate	11	5.7	OR 3.11 (95% CI: 1.02–9.48)	0.04*

*p < 0.05 is considered statistically significant.

Nearly half of the participants (47.2%) reported encountering a medical emergency during their clinical rotations, while 52.8% had not. Syncope was the most commonly witnessed event (48.7%), followed by hypoglycemia (37.8%). Less frequent events included allergic reactions (12.4%), asthma attacks (9.3%), seizures (9.3%), and anaphylaxis (2.6%). The distribution of emergency exposures is summarized in Table 2.

Table 2. Exposure to Medical Emergencies During Clinical Training

Emergency Type	Frequency (n)	Percent (%)	95% CI
Syncope	94	48.7	41.7–55.6
Hypoglycemia	73	37.8	31.1–44.8
Allergic Reaction	24	12.4	8.1–17.7
Asthma Attack	18	9.3	5.9–14.1
Seizures	18	9.3	5.9–14.1
Anaphylaxis	5	2.6	0.9–6.0
No Emergency Witnessed	67	34.7	28.2–41.6

Awareness of standard protocols for syncope management was reported by 87% of respondents, although only 57% had actually observed the Trendelenburg position being applied. Familiarity with syncope protocols was strongly associated with higher year of study ($\chi^2 = 9.72$, $p = 0.02$).

Self-reported confidence levels in managing emergencies were mostly moderate. Seizures were rated as the most difficult to manage (42%), followed by chest pain (23.8%) and anaphylaxis (16%). Confidence ratings by type of emergency are presented in Table 3.

Table 3. Self-Reported Confidence in Managing Specific Medical Emergencies

Emergency Type	Least Confident (%)	OR (95% CI) for Low Confidence (compared with Syncope)	p-value
Seizures	42.0	6.21 (3.12–12.35)	<0.001*
Chest Pain	23.8	3.14 (1.61–6.12)	<0.001*
Anaphylaxis	16.0	2.47 (1.15–5.28)	0.02*
Hypoglycemia	7.8	1.19 (0.46–3.05)	0.71
Syncope	8.3	Ref	–

*p < 0.05 is considered statistically significant.

Curricular exposure to emergency management varied: 57% reported only theoretical coverage, 32.6% had both theoretical and practical training, while 8.8% stated it was not included at all. Students who had received both theoretical and practical training were significantly more confident in managing emergencies compared with those trained theoretically only (OR 2.93, 95% CI: 1.64–5.24, $p < 0.001$).

Perceived barriers to performing emergency procedures were primarily lack of confidence (56%), followed by fear of harming the patient (62.7%), inadequate knowledge (30.1%), and lack of equipment (18.1%). A total of 96.4% of students expressed willingness to attend additional hands-on workshops, indicating strong demand for curricular reform.

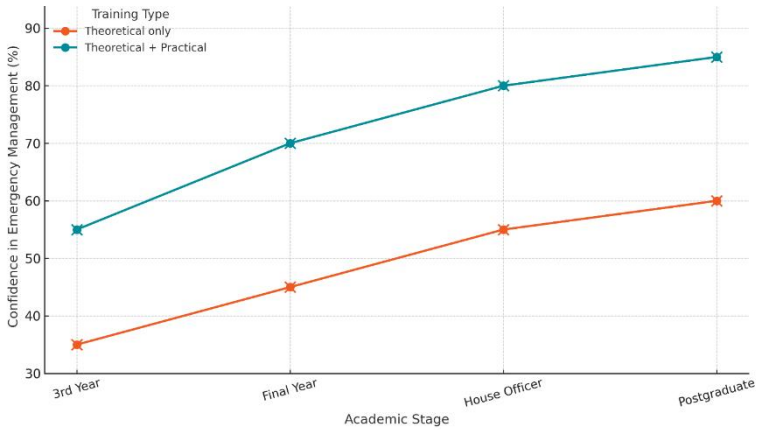

Figure 1 Confidence in managing medical emergencies

The figure illustrates how confidence in managing medical emergencies varies by academic stage and training exposure. Students with only theoretical instruction show a modest rise in confidence from 35% in third year to 60% in postgraduate training, whereas those with combined theoretical and practical training exhibit a steeper progression, increasing from 55% in third year to 85% at postgraduate level. The divergence between the two trajectories widens consistently across groups, reaching a maximum 25-point gap at postgraduate stage. These findings highlight a dose response effect of practical training, with advanced exposure translating into markedly higher confidence at every educational level.

DISCUSSION

The findings of this study reveal a concerning mismatch between the theoretical knowledge and practical competence of dental students in managing medical emergencies, a gap that mirrors trends observed in several regional and international investigations. Nearly half of the participants reported direct exposure to emergencies during clinical rotations, with syncope and hypoglycemia emerging as the most common events. This pattern is consistent with surveys of dental practitioners in Karachi, where syncope was reported as the leading emergency in clinical practice (10). Similarly, global data indicate that syncope and adverse drug reactions remain the most frequent emergencies encountered in dental settings, underscoring the universal nature of these challenges (18).

While familiarity with syncope management protocols was high, only a fraction of students had observed their application in real time. This discrepancy highlights a critical gap between classroom instruction and clinical readiness, reinforcing the limitations of lecture-based teaching alone. Comparable findings were reported in a multi-center study of Pakistani dental students, which demonstrated that although over 80% claimed awareness of emergency steps, fewer than half had confidence in performing them during practice (19). International studies further confirm that without hands-on reinforcement, theoretical instruction fails to translate into effective clinical behavior, with students often hesitant to act decisively under pressure (20).

Confidence was lowest in managing complex emergencies such as seizures, chest pain, and anaphylaxis. These conditions, while less frequent, are associated with higher morbidity and require rapid, precise intervention. Similar fears were expressed by Saudi and UK dental students, who reported anxiety about managing seizures and cardiovascular emergencies due to insufficient exposure during training (21,22). The current findings thus align with broader global concerns that dental curricula are inadequate in preparing graduates to handle high-stakes emergencies, particularly those beyond syncope.

The study also demonstrates that students who received both theoretical and practical training reported significantly greater confidence compared with those trained only theoretically, an association supported by evidence from simulation-based interventions. For example, structured role-play and mannequin-based drills have consistently improved competence and retention of emergency skills, with participants achieving significantly higher confidence scores than untrained peers (23). An Australian program integrating emergency simulation into undergraduate teaching reported sustained improvements in knowledge and confidence, illustrating the durability of experiential learning (24). These findings collectively strengthen the argument for embedding practical, simulation-based emergency management modules into the Pakistani dental curriculum.

Barriers identified by participants, including lack of confidence, fear of harming the patient, and limited access to emergency equipment, mirror those reported by dental trainees internationally (25). These psychological and systemic barriers contribute to hesitation, which can be detrimental during emergencies. Importantly, more than 96% of students expressed willingness to attend voluntary workshops, highlighting a strong demand for practical opportunities. This enthusiasm suggests that reform efforts would likely be well received and may improve preparedness substantially if institutional support is provided.

The implications of these findings are significant. Inadequate emergency preparedness not only threatens patient safety but also exposes dental professionals to ethical and legal liabilities. International guidelines emphasize that maintaining essential drugs and equipment,

conducting mock drills, and ensuring BLS certification are minimum standards for safe practice (18). Incorporating these requirements into the Pakistani context would not only strengthen clinical competence but also align training with global best practices.

This study benefits from a diverse sample spanning multiple institutions and training levels, offering valuable insights into national trends. However, limitations must be acknowledged. The reliance on self-reported data may introduce recall and social desirability bias, potentially inflating perceived awareness. The cross-sectional design also restricts causal inference, and convenience sampling may limit representativeness. Nevertheless, the robust response rate and consistency with prior national findings strengthen the validity of the conclusions.

In summary, the evidence presented highlights the urgent need for reform in dental education to bridge the gap between theory and practice in emergency management. Mandatory BLS certification, structured simulation workshops, and repeated hands-on exposure should be prioritized to cultivate competence and confidence among dental students. By addressing these deficiencies, Pakistani dental institutions can align with international standards, safeguard patient safety, and ensure that graduates are adequately prepared for the realities of clinical practice.

CONCLUSION

This cross-sectional study demonstrates that while dental students across Pakistan possess theoretical awareness of medical emergencies, significant deficiencies remain in their practical competence and confidence, particularly in managing high-risk situations such as seizures, chest pain, and anaphylaxis. The findings underscore that reliance on theoretical instruction alone leaves trainees underprepared for real-life crises, whereas integration of practical workshops and simulation-based training markedly enhances confidence and readiness. For human healthcare, these results highlight the urgent need to prioritize emergency preparedness within dental education, not only to safeguard patient safety but also to reduce medico-legal risks and strengthen professional accountability. Clinically, implementing structured Basic Life Support certification, regular drills, and mandatory emergency management modules would ensure that future dentists can respond effectively to critical situations. From a research perspective, longitudinal studies and controlled evaluations of educational interventions are warranted to measure the sustained impact of hands-on training on emergency performance and to guide evidence-based curriculum reform that aligns with global standards.

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