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Emergency Medication Preparedness in Sudanese Dental Practice: Knowledge, Attitudes, Practices, and Systemic Barriers

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ABSTRACT

Background: Medical emergencies in dental practice, such as anaphylaxis or hypoglycemia, demand timely and competent intervention.
Objective: This study aimed to assess the knowledge, attitudes, and practices (KAP) of Sudanese dentists regarding emergency medications and identify barriers affecting their preparedness in clinical settings.
Methods: A descriptive cross-sectional study was conducted using an online survey targeting Sudanese dental practitioners from January to June 2024. A validated questionnaire was used to assess emergency preparedness among 413 participants, employing convenience sampling. Data were analyzed descriptively using SPSS version 25.0.
Results: Most of the respondents were female (59%), under 30 years old (66.8%), and dental interns (66.5%). While 70.5% reported receiving emergency training, only 30% demonstrated excellent knowledge, with notable gaps in identifying tachycardia (17.4% correct). Attitudes were largely neutral (66.3%), despite 83.5% strongly agreeing on the importance of emergency medications. In practice, 44.8% showed excellent performance, yet only 28.1% checked their emergency kits monthly. Medication availability varied, with aspirin (93.9%) and salbutamol (76.7%) commonly stocked, while hydrocortisone (35.7%) and glyceryl trinitrate (19.4%) were deficient.
Conclusion: Despite moderate levels of self-reported training, critical gaps persist in Sudanese dentists' knowledge, attitudes, and practice regarding emergency medications, as well as their availability in clinics. The predominance of early-career practitioners combined with systemic constraints highlights the urgent need for curriculum reforms, simulation-based training, and national policy interventions to strengthen emergency preparedness and safeguard vulnerable patients' resource-constrained settings.

Keywords: Dentists; Emergency Preparedness; Medication Shortage; Sudan; Syncope; Dental Education; Clinical Competence

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INTRODUCTION

Medical emergencies during dental procedures—such as anaphylaxis, hypoglycemia, syncope, and cardiac arrest — require immediate recognition and intervention to prevent fatal outcomes (1). Dentists, as primary healthcare providers, are often the first responders in such emergencies, particularly when treating medically compromised patients with conditions like diabetes or hypertension (2). However, studies from low- and middle-income countries (LMICs) reveal alarming gaps in preparedness. For example, in India, only 46.7% of dentists felt confident managing emergencies, and 82% lacked formal training (3). Similarly, in Zambia, just 25% of dental facilities stocked all essential emergency drugs (4), while in Malaysia, 32% of clinics lacked any emergency medications (5). These deficits are compounded by inconsistent training and systemic resource shortages (6, 7).

In Sudan, these challenges are exacerbated by political instability, economic sanctions, and healthcare system collapse (8). The country's reliance on imported pharmaceuticals leads to frequent stockouts of critical drugs like glyceryl trinitrate (available in only 19.4% of clinics in this study), mirroring trends in Jordan, where 86.7% of dentists reported needing additional emergency training (7). Dental emergencies are further complicated by Sudan's brain drain of medical personnel and fragmented training standards (9). While studies have assessed preparedness in Nigeria, Tanzania, and Egypt (2,10, 11), Sudan remains understudied despite its unique humanitarian crisis.

This study is the first to assess the knowledge, attitudes, and practices (KAP) of Sudanese dentists regarding emergency preparedness in the context of recurrent political, economic, and infrastructural crises. By evaluating the correlation between clinical experience and training and preparedness and identifying systemic barriers such as medication shortages and supply chain failures, this study fills a critical gap in the literature on dental emergency readiness in fragile health systems. While previous research in LMICs has highlighted similar issues, such as poor emergency knowledge among Nigerian dental students (12) and limited emergency kit availability in Indian clinics (13), this study uniquely contextualizes Sudan's challenges within both national instability and global trends. The findings are expected to inform national policy, support curriculum reform, and promote localized, low-resource solutions to enhance emergency response capacity and patient safety across the Sudanese dental care landscape.

METHODS

Study Design

This study employed a descriptive, cross-sectional design to assess the knowledge, attitudes, and practices (KAP) of Sudanese dental practitioners regarding emergency medication preparedness when managing medically compromised patients.

Study Area and Duration

The study was conducted across Sudan, utilizing online platforms to reach participants from diverse geographic locations, including urban and peripheral areas. Data collection took place over six months, from January to June 2024.

Study Population

Licensed dental professionals (general dentists, interns, or specialists) working in public and private dental facilities across Sudan at the time of data collection who provided informed consent for participation were included in the study. We excluded dental professionals not in active practice during the study period and incomplete or duplicated responses.

Sample Size and Sampling Technique

A non-probability convenience sampling method was adopted due to the practical constraints of conducting research in Sudan's fragmented and unstable dental healthcare infrastructure. This approach was considered feasible and ethically acceptable given the lack of a comprehensive national dental registry, limited interconnectivity between professional networks, and ongoing civil and economic disruptions affecting access to dental facilities. A total of 413 dental practitioners who met the eligibility criteria were included in the final analysis.

Data Collection Tool

A structured, closed-ended questionnaire was used to collect data. The tool was adapted from Malamed's 2020 emergency preparedness framework (1), widely recognized in dental emergency literature, and further modified to reflect local Sudanese healthcare contexts. The questionnaire underwent

content validation by a panel of three academic experts in dental public health and medical emergency response. Items were reviewed for cultural relevance, clarity, and contextual accuracy. A pilot study involving 30 respondents was conducted, and necessary adjustments were made to enhance reliability and internal consistency. The final version comprised four sections: demographic and professional data, knowledge of emergency medications, attitudes toward emergency preparedness, practice behavior, and medication availability. The survey was distributed electronically via professional associations, institutional mailing lists, and social media platforms (e.g., WhatsApp and Facebook) commonly used by Sudanese dental professionals.

Data Analysis

Data were entered, cleaned, and analyzed using IBM SPSS Statistics version 25.0. Descriptive statistics—including frequencies, percentages, means, and standard deviations—were used to summarize findings. Cross-tabulations were performed to observe trends across experience levels and practice settings.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of Al-Fajr College for Medical Sciences and Technology (Approval Ref: AFC/IRB/2024-07). The IRB approval ensured that the study adhered to Sudan's 2024 National Guidelines for Medical and Health Research Ethics, aligning with international principles of autonomy, beneficence, and confidentiality. Participation was voluntary, and electronic informed consent was obtained from all participants before initiating the survey. No personally identifiable information was collected. Data were stored on encrypted, password-protected servers accessible only to the principal investigators.

RESULTS

A total of 413 Sudanese dental practitioners participated in this descriptive cross-sectional study assessing emergency preparedness for managing medically compromised patients. The results are structured into four domains: demographics, knowledge, attitudes, and practices, including medication availability.

Demographic Characteristics

Participants were predominantly female (59.0%), under the age of 30 years (66.8%), and in early stages of their careers: 63.2% had less than five years of clinical experience. Most respondents were dental interns (66.5%) (Table 1).

Table 1: Demographic Characteristics of the Study Participants, (n=413)

Characteristic	Frequency	Percentage
Gender		
Female	241	59.0%
Male	172	41%
Age Group		
<30 years	276	66.8%
30–40 years	115	27.8%
>40 years	22	5.3%
Years of Experience		
Less than 5 years	261	63.2%
5-10 years	146	35.3%
More than 10 years	6	1.5%
Professional Status		
Dental Intern	275	66.5%
General Practitioner	96	23.2%
Specialist/Consultant	42	10.3%

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Training and Level of Knowledge about Emergency Management

Out of the 413 participants, 70.5% reported receiving emergency management training. When their knowledge about emergency management was examined, 58.1% showed good knowledge, 30% excellent, and and11.9% had poor knowledge (Table 2).

Table 2: The distribution of the study population according to training and the level of knowledge about emergency management, (n=314)

Characteristic	Frequency	Percent (%)
Received training		
Yes	291	70.5
No	122	29.5
The level of knowledge about emergency management		
Poor	49	11.9
Good	240	58.1
Excellent	124	30.0
Total	413	100.0

Selected Knowledge Questions and Participants' Responses Showing the Gap

Although 70.5% of participants reported receiving prior emergency training, only 30.0% demonstrated excellent knowledge. A critical gap was noted in the recognition of tachycardia, with just 17.4% correctly identifying heart rates ≥100 bpm as tachycardia, posing a risk for delayed diagnosis and intervention in cardiac emergencies. Furthermore, 19.9% misdiagnosed anaphylaxis as asthma, potentially compromising acute management in allergic reactions (Table 3).

Table 3: Selected Knowledge Questions and Participants' Responses (n = 314)

Question	Correct Answer	Frequency	Percentage (%)
Tachycardia: HR ≥100 bpm	Tachycardia	72	17.4
Most frequent dental emergency	Syncope	381	92.3
Dyspnea, wheezing, cyanosis – diagnosis	Anaphylaxis	324	78.5
First-line treatment of hypoglycemia in a conscious patient	Oral glucose	398	96.4

Attitudes toward Emergency Preparedness

The overall attitude toward emergency preparedness among respondents was as follows: 9.2% had a fair attitude, 66.3% were neutral, and 24.5% had a good attitude. Although the majority of respondents held a neutral attitude (66.3%), a significant proportion (83.5%) strongly agreed that emergency medications are essential in dental practice. This contrast suggests a cognitive dissonance between recognizing the importance of emergency preparedness and possessing the confidence or readiness to act accordingly (Table 4).

Table 4: The study population's responses to the Attitude-related Statements, (n=314)

Statement	Strongly Agree (%)	Neutral (%)	Strongly Disagree (%)
Emergency medications are essential for all dentists	83.5	1.5	0.0
Emergencies frequently occur in dental settings	11.6	42.6	0.5
Clinics are well-equipped with emergency medications	40.2	18.9	1.7

Practices of the Study Participants

Among the 413 participants, 44.8% demonstrated an excellent level of practice, while 39.7% were rated as good. A smaller proportion showed moderate (3.1%) or acceptable (10.9%) levels of practice. Only 1.5% of respondents were classified as having a poor level of practice. These findings indicate that the majority of participants possessed either good or excellent practical competencies in emergency management. Table 5 depicts that despite 44.8% claiming excellent preparedness, only 28.1% of participants inspected their emergency kits monthly. Notably, 83.1% routinely obtained comprehensive medical histories, a critical preventive measure.

Table 5: The Study Participants' Responses to the Practice-related Statements, (n=314)

Statement	Response	Frequency	Percent (%)
I learned about emergency medications by myself	Always	131	31.7
	Often	56	13.6
	Sometime	141	34.1
	Rarely	69	16.7
	Never	16	3.9
I check for emergency medications in the clinic	Always	174	42.1
	Often	129	31.2
	Sometime	71	17.2
	Rarely	32	7.7
	Never	7	1.7
I take a history from the patients before the dental intervention.	Always	343	83.1
	Often	35	8.5
	Sometime	22	5.3
	Rarely	8	1.9
	Never	5	1.2
I consult seniors about emergencies	Always	212	51.3
	Often	88	21.3
	Sometime	42	10.2
	Rarely	62	15.0
	Never	9	2.2
At any time, prepare the emergency box:	Immediately, when the clinic opens	355	86.0
	After the emergency case came	58	14.0
How many times per year check the storage and label the expiration date?	on month	116	28.1
	6 months	176	42.6
	3 month	121	29.3

Medication Availability in the Clinics

Emergency medication availability varied widely. Table 5 shows the list of emergency medications available in the dental clinic. Aspirin (93.9%) and salbutamol (76.7%) were commonly available. In contrast, hydrocortisone (35.7%) and glyceryl trinitrate (GTN) (19.4%)—both listed in the World Health Organization's essential medicines for emergency care were significantly understocked (Table 6). This falls below WHO-recommended thresholds, which suggest universal clinic-level availability for managing cardiac and allergic conditions (14).

Table 6: The list of selected Emergency Medications Available in Clinics according to the study participants, (n = 314)

The medication	Frequency	Percent
Midazolam	252	80.25
Adrenalin	201	64.01
Antihistamine	92	29.29
D50	174	55.41
Aspirin	295	93.94
Salbutamol	241	76.75
Hydrocortisone	112	35.66
Glyceryl trinitrate	61	19.42
O2 Cylinder	177	56.36
Atropine	34	10.82
Diazepam	53	16.87
Normal Saline	223	71.01
Total	314	100.00

Key Inconsistencies and Clinical Implications

- **Training vs. Competence:** Although over two-thirds (70.5%) had received training, only 30.0% demonstrated excellent knowledge, and fewer than half (44.8%) showed excellent practice behavior.
- **Knowledge Gaps:** Failure to correctly identify tachycardia (17.4%) and anaphylaxis (19.9%) increases the risk of delayed or inappropriate treatment during acute episodes.
- **Resource Constraints:** The low availability of GTN (19.4%)—critical for angina and cardiac emergencies—underscores systemic supply chain failures when compared to WHO's emergency drug guidelines (14).
- **Attitudinal Mismatch:** The high acknowledgment of the necessity for emergency medications (83.5%) contrasts sharply with neutral or indifferent attitudes toward actual clinic preparedness (66.3% neutral responses), reflecting a readiness-perception gap that could compromise clinical safety.

DISCUSSION

Due to observed gaps in clinical pharmacology courses during their studies, fourth and fifth level dental students as well as those in their internship year lack the information and abilities necessary to prescribe emergency medications used in the field of dentistry (15). This study reveals critical gaps in emergency preparedness among Sudanese dentists, contextualized within Sudan's healthcare crisis and aligned with global LMIC challenges. Below, we dissect these findings through four lenses: (9) demographic trends, (7) knowledge-training mismatches, (8) systemic barriers, and (2) actionable solutions.

The predominance of young, female dentists in our sample (66.8% aged <30 years; 59.0% female) mirrors trends in Tanzania (11) but contrasts with male-dominated cohorts in Saudi Arabia (16) and Pakistan (6). This demographic profile—largely early-career practitioners—may exacerbate preparedness gaps, as Fernandes et al. (3) demonstrated that inexperienced dentists in India were 53% less confident in handling emergencies. Similarly, Okoh and Efimueh (12) found Nigerian dental students lacked emergency management skills due to curricular deficiencies. These parallels suggest that Sudan's workforce demographics intersect with training inadequacies to heighten risks during emergencies.

Despite 70.5% of respondents reporting prior emergency training, only 30% exhibited excellent knowledge. This dissonance echoes global patterns. Tariq et al. (6) reported that 53.1% of Pakistani dentists felt unprepared for emergencies despite training, and Kumarswami et al. (13) noted that only 6.6% of Indian dentists could administer IV medications.

Specific knowledge deficits like misidentifying tachycardia (17.4%) or anaphylaxis (19.9%) align with Majambo et al. (7)'s findings in Zambia, where 54% of practitioners encountered emergencies but lacked diagnostic skills. These gaps underscore the inadequacy of didactic training alone; simulation-based programs, as successfully piloted in Rwanda (16), are urgently needed.

The scarcity of essential drugs (e.g., GTN: 19.4%; hydrocortisone: 35.7%) reflects Sudan's reliance on imported pharmaceuticals, disrupted by sanctions and civil unrest (8, 9). This crisis is not unique. Ramli et al. (5) found 32.3% of Malaysian clinics lacked any emergency drugs. Al Ghanam and Khawalde (7) reported that only 18.9% of Jordanian clinics stocked GTN.

Such shortages violate WHO guidelines (14) and correlate with poor outcomes. For example, ElZoghby et al. (2) linked Egypt's low adrenaline availability to delayed anaphylaxis management. Sudan's additional challenges, power outages, and internet failures demand context-specific solutions that prioritize stable supply chains, offline training modules, and low-resource emergency preparedness protocols to ensure timely and effective patient care.

Recommendations: Bridging Gaps in Sudan's Context

1. Regulatory Reforms

Competency-based training should be mandated through annual certifications, such as Basic Life Support (BLS), tied to license renewal. This approach has been proposed by Ogunbodede et al. (10) for Nigeria. Additionally, emergency kits should be standardized following the WHO's essential medicines list (14) and enforced via routine clinic inspections. Evidence from Majambo et al. (4) showed this raised compliance by 40% in Zambia.

2. Educational Interventions

Simulation training should be adopted, following the model used in Rwanda (17), where hands-on drills improved emergency response times by 58%. To address infrastructural limitations, mobile-based e-learning platforms should be employed, as tested in Ghana (18), to circumvent internet instability.

3. Systemic Solutions

Sudan should explore a partnership with East African manufacturers, as suggested by Deng et al. (18), to reduce dependence on imported emergency drugs. Moreover, establishing telemedicine networks could offer critical support to rural dental practitioners, similar to successful implementations in Pakistan reported by Tariq et al. (6).

CONCLUSION

Sudan's emergency preparedness crisis is a microcosm of broader LMIC challenges, amplified by political instability. Our findings, aligning with evidence from India (3), Zambia (4), and Jordan (7), call for multisectoral action. By integrating regulatory mandates, simulation training, and localized supply chains, Sudan can mitigate risks for its young dental workforce and medically compromised patients.

Conflict of Interest

The authors declare that there is no conflict of interest.

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