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Original Article

# Analysis of adult dental emergencies at a medical center in southern Taiwan

Chiung-Lin Huang <sup>a</sup>, I-Jeng Yeh <sup>b,c,d</sup>, Ying-Chun Lin <sup>e,f</sup>,  
Chung-Fan Chiu <sup>a</sup>, Je-Kang Du <sup>e,g,h\*</sup>



<sup>a</sup> Division of Periodontics, Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan

<sup>b</sup> Department of Emergency Medicine, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>c</sup> Graduate Institute of Clinical Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>d</sup> School of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>e</sup> Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan

<sup>f</sup> Department of Oral Hygiene, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>g</sup> School of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>h</sup> Division of Prosthodontics, Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan

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## KEYWORDS

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Return rate

**Abstract** *Background/purpose:* The need for dental emergency (DE) services has increased in recent years. This study therefore investigated the characteristics of patients presenting with DEs in a medical center in southern Taiwan.

*Materials and methods:* This was a retrospective study of 1964 adult patients who presented with a DE at the Kaohsiung Medical University Hospital in 2018. Medical records providing age, sex, time, day, past visit history, chief complaint, diagnosis, and treatment were collected and analyzed.

*Results:* The results revealed that men constituted 52.4% of the patients with DEs, the average age was 45.6 years, and the age distribution peak was 20–29 years (26.5%). The peak period for the DE visit was between 17:00 and 24:00 (42.1%), and the peak day of the week was Sunday (27.4%), followed by Saturday (18.0%). The most common chief complaint was pain (49.8%), and the diagnoses were as follows: pulp-related problems (36.7%), periodontal-related problems (22.9%), trauma (22.2%), odontogenic infection (15.3%), postoperative complications (9.2%), and temporomandibular disorders (3.7%). Dental treatment and medication were

\* Corresponding author. Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung Medical University No. 100, Shih-Chuan 1st Road, Kaohsiung 807, Taiwan.

E-mail address: [dujekang@gmail.com](mailto:dujekang@gmail.com) (J.-K. Du).

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prescribed for 51.9% of the patients with DE. The rate of patients recommended for further dental treatment was 86.8%, and the actual return rate was 40.1%.

**Conclusion:** This study revealed that the top three reasons for adult DE visits were pulp-related problems, periodontal-related problems, and trauma. These results may be used as a reference for dentists who provide DE services.

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## Introduction

Acute dental symptoms, such as toothache and dental infection are common problems encountered by clinical dentists. When dental clinics are closed or the clinic dentist is unable to treat, patients must use dental emergency (DE) services.<sup>1,2</sup> In 2021, the American Dental Association proposed that DE services include the following: uncontrolled bleeding, cellulitis or a diffuse soft tissue bacterial infection with intra-oral or extra-oral swelling that potentially compromise the patient's airway, severe dental pain from pulpal inflammation, pericoronitis or third molar pain, postoperative complications, abscess, tooth fracture, dental trauma with avulsion or luxation, or other urgent dental care.<sup>3</sup> These conditions are usually unexpected and may threaten patient's life, making DE care an indispensable part of the medical system.

In the United States, the annual total number of DEs increased from 1.1 million in 1997–1998 to more than 2 million in 2007–2008.<sup>4</sup> Other studies have also demonstrated that the demand for DE services has increased in recent years.<sup>5–8</sup> Therefore, DE care is playing an increasing key role in the medical system. Through the analysis of DE data, the reasons and the treatment details can be clarified. Numerous studies in Europe and the United States have used DE epidemiological surveys to assess medical expenditure and workforce requirements.<sup>9–13</sup>

Kaohsiung Medical University Hospital (KMUH) is located in the center of Kaohsiung city, the largest city in southern Taiwan. It has been established for more than 60 years and has more than 1700 hospital beds. KMUH is a key medical center in southern Taiwan, providing emergency medical services 24 h a day, all year round. It is also a key medical institution for DE services.

The current literature of DE cases in southern Taiwan is limited. This study analyzed the trends, demographics, and conditions of DE visits at KMUH in southern Taiwan. Because the age distribution of DE patients is wide, and the prevalence of diseases varies in different age groups. For example, the prevalence of severe forms of periodontitis increases with age.<sup>14–17</sup> However, caries constituted the most common reason for pediatric DE presentation comprising close to 43% of total visits in Canada.<sup>18</sup> The existing literature of Taiwan doesn't analyze the data of adult and pediatric DE cases separately.<sup>7,20–24</sup> This study was aimed to analyze the adult DE data by eliminating the possible impact of pediatric DE cases. The results may be used as a reference for the future allocation of medical resources.

## Materials and methods

This was a retrospective study. The patients were aged  $\geq 20$  years and visited the KMUH emergency department in 2018, and their visits were classified as either a DE or they required a consultation for emergency dental care or evaluation. A total of 1964 patients were included. The following information was collected and analyzed.

### Patient demographics

Age and sex. We followed Cohen<sup>19</sup> and Kuo<sup>7</sup> in dividing adult patients into seven age subgroups of 10 years each: 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and  $\geq 80$ .

### The time and day of a patient's DE presentation

We followed Kuo<sup>7</sup> in dividing DE visit time into three subgroups: 0:00–08:00, 08:00–17:00, and 17:00–24:00. The day of the week of the DE visit was divided into seven subgroups (Monday–Sunday) and a further two subgroups (holidays and nonholidays). Holidays are defined as the weekend (Saturday and Sunday) and national holidays.

### Past visit history

Based on their medical records, patients were divided into three groups as follows: new patients visiting KMUH for the first time, established KMUH patients with a first dental visit, and established patients who had received dental treatment at KMUH before.

### Chief complaints

These were divided into six groups: trauma, pain, swelling, bleeding, fever, and other causes. Because multiple chief complaints may exist, the sum is greater than 100%.

### Diagnosis

DE diagnoses were divided into two groups: trauma and nontrauma. The trauma group had four subgroups: soft tissue injury (cheek, lips, etc.), tooth and alveolar bone fracture or displacement (avulsion, luxation, etc.), maxillofacial bone fracture, and other trauma. The nontrauma group was divided into six subgroups: periodontal-related problems (including gingivitis, periodontitis, periodontal abscess, pericoronitis, peri-implantitis, and periodontal

destruction caused by root fracture), pulp-related problems (including caries, pulpitis, pulp necrosis, apical periodontitis, and periapical abscess), odontogenic infection (such as cellulitis), postoperative complications (such as postextractive or postoperative pain, bleeding, or swelling), temporomandibular disorders (pain or dislocation), and other nontrauma-related conditions. More than one condition may be diagnosed, thus the sum is greater than 100%.

### Treatments method

This was divided into two groups, with treatment and without treatment (either treatment was not needed or the patient refused treatment). The with-treatment group had 3 subgroups: dental treatment, medication, and a combination of dental treatment and medication. Dental treatment included periodontal emergency treatment, endodontic emergency treatment, suture, fixation, hemostasis, incision and drainage, and other treatments (including multiple treatments).

### Follow-up visit

Whether a return visit was necessary was evaluated by the emergency department dentist, and the return visit rate was calculated according to whether the patient returned on schedule.

### Statistical analysis

Stata 13.1 (Stata Corp LLC, College Station, TX, USA) was used for statistical analysis. The medical records included data on age, sex, time, day, past visit history, chief complaint, diagnosis, and treatment method, which were recorded and analyzed. Statistical quantitative analyses were conducted using Microsoft Excel formulas. Percentages were used to express the distribution of study variables.

### Ethics approval and consent to participate

The study was approved by the Institutional Review Board of Kaohsiung Medical University Hospital [KMUHIRB-E(1) 20200222]. Meanwhile, informed consent is not required to this retrospective study.

## Results

### Patient demographics

Patient demographics are presented in [Table 1](#). In 2018, KMUH had 1964 patients with DEs, of whom 1029 (52.4%) were male, and 935 (47.6%) were female. The average age of the patients was 45.6 years. The 20-29-year-old age group had the highest visit rate (26.5%), followed by the 30-39-year-old age group (18.2%). 690 (35.1%) patients were new to KMUH, 900 (45.8%) were KMUH patients with a first dental visit, and 374 (19.0%) were established patients who had received dental treatment at KMUH before.

**Table 1** Demographic data of patients with dental emergencies (DE) (N = 1964).

	N	%
Sex		
Female	935	47.6
Male	1029	52.4
Mean	45.6	—
Age		
20–29 years	520	26.5
30–39 years	357	18.2
40–49 years	304	15.5
50–59 years	283	14.4
60–69 years	278	14.2
70–79 years	135	6.9
≥ 80 years	87	4.4
Past visit history		
New patients for the first time	690	35.1
Established patients with a first dental visit	900	45.8
Established patients with dental treatment before	374	19.0
The time of the DE visit		
0:00–08:00	472	24.0
08:00–17:00	666	33.9
17:00–24:00	826	42.1
The day of the week of the DE visit		
Monday	224	11.4
Tuesday	212	10.8
Wednesday	211	10.7
Thursday	204	10.4
Friday	220	11.2
Saturday	354	18.0
Sunday	539	27.4
Weekend and holidays		
No	958	48.8
Yes	1006	51.2

[Fig. 1](#) presents the DE visits by time of day. The peak time period for DE visits was 17:00–24:00 (42.1%). The peak day of the week was Sunday (539 patients, 27.4%), followed by Saturday (354 patients, 18.0%), and the percentage for Monday to Friday was between 10.4% and 11.4% ([Table 1](#)). The nonholiday DE visit rates were 42.0% for 17:00–24:00, 28.2% for 08:00–17:00, and 27.0% for 0:00–08:00. The holiday DE visit rates were 41.0% for 17:00–24:00, 38.6% for 08:00–17:00, and 20.5% of 0:00–08:00 ([Fig. 2](#)).

### Reasons for emergency care and diagnosis

As presented in [Table 2](#), approximate half the patients' chief complaints were pain (979 patients, 49.8%), followed by swelling (470 patients, 23.9%) and trauma (436 patients, 22.2%). The highest percentage of diagnoses were for pulp-related problems (720 patients, 36.7%), followed by periodontal-related problems (450 patients, 22.9%), trauma (436 patients, 22.2%), odontogenic infection (301 patients, 15.3%), postoperative complications (180 patients, 9.2%), temporomandibular disorders (72 patients, 3.7%), and other reasons (108 patients, 5.5%).

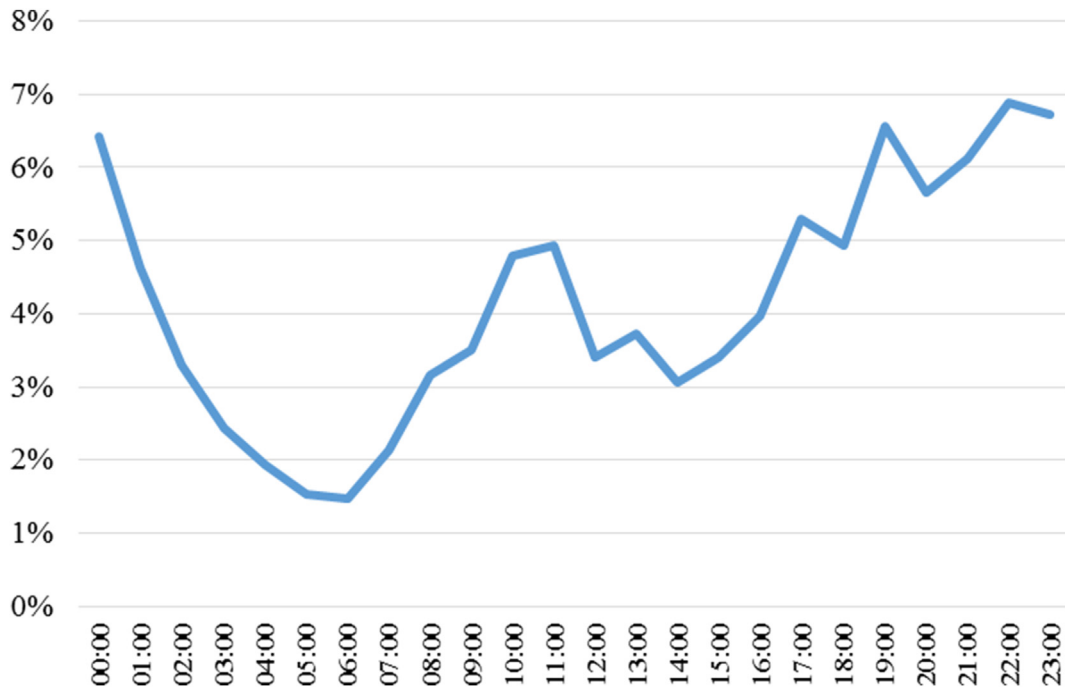


Figure 1 The dental emergency visits by time of day.

### Management

After the dentist's assessment, 1832 (93.3%) patients received treatment, 457 (23.3%) patients received only dental treatment, 356 (18.1%) patients received only medication, and 1019 (51.9%) patients received a combination of dental treatment and medication. Emergency department dentists recommended that 1705 (86.8%) patients return for further treatment, but only 683 patients returned, for a return rate of 40.1% (Table 2).

### Discussion

The limit of this study is that only adults were included, making the results less compatible to compare with the limited DE literature of Taiwan, which included both adult and pediatric cases. However, the demographic distribution of patients was similar to other medical centers in Taiwan.<sup>7,20–24</sup> More than half the patients with DEs at KMHU were men (52.4%), and the age group with the highest rate was 20–29 years. The average age was 45.6 years, which

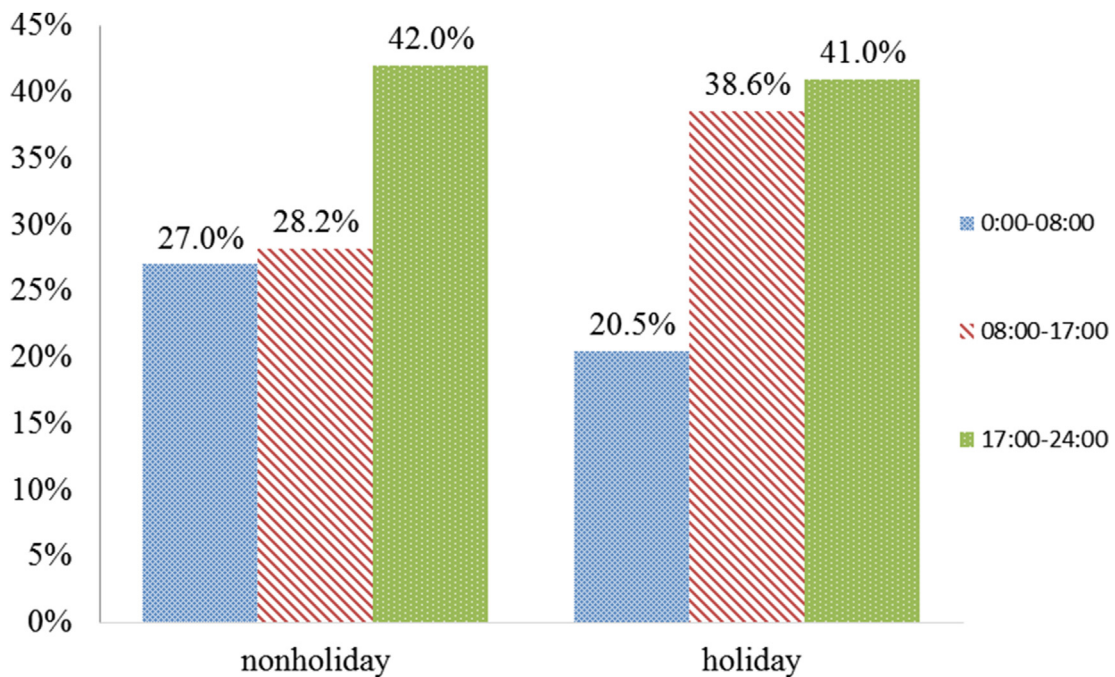


Figure 2 Dental emergency visit rates of holidays and nonholidays.



**Table 2** The chief complaint, diagnosis, and treatment of patients with dental emergencies (DE) (N = 1964).

	N	%
<b>Chief complaint</b>		
Pain	979	49.8
Swelling	470	23.9
Trauma	436	22.2
Bleeding	209	10.6
Fever	12	0.6
Other causes	109	5.5
<b>Diagnosis</b>		
Trauma-related	436	22.2
Soft tissue injury	230	11.7
Tooth and alveolar bone fracture or displacement	277	14.1
Maxillofacial bone fracture	26	1.3
Other trauma	22	1.1
Nontrauma-related	1528	77.8
Pulp-related problems	720	36.7
Periodontal-related problems	450	22.9
Odontogenic infection	301	15.3
Postoperative complications	180	9.2
Temporomandibular disorders	72	3.7
Other condition	108	5.5
<b>Treatment</b>		
Without treatment	132	6.7
With treatment	1832	93.3
<b>Treatment method</b>		
Dental treatment	457	23.3
Medication	356	18.1
Combination of dental treatment and medication	1019	51.9
<b>Dental treatment</b>		
Periodontal emergency treatment	482	24.5
Endodontic emergency treatment	306	15.6
Suture	193	9.8
Fixation	91	4.6
Hemostasis	184	9.4
Incision and drainage	51	2.6
<b>Need for return</b>		
Yes	1705	86.8
No	259	13.2
Return for follow-up (N = 1705)	683	40.1

was higher than other studies (25.7–39.0 years old).<sup>7,20–24</sup> This is because the cases included were limited to adults over the age of 20. Consistent with our study, Kim et al. stated that in South Korea, the number of male patients with DEs was higher, and adult age group with the highest rate was 20–29 years.<sup>25</sup> This may be because men pay less attention to oral health,<sup>26</sup> which may lead to more unexpected DEs. Patients aged 20–29 are often either still in college or recently graduated, and the time they can visit a dentist on weekdays may be more limited. This younger age group may have less experience and understanding of dental symptoms, resulting in less sense of dental illness, which could explain why they don't seek help until the symptoms are severe. However, this requires further clarification.

The peak period for DE visits was from 22:00 to 24:00, and the rate of DE visits at 04:00–07:00 was relatively low. Bae et al. stated that the peak period of Koreans for DE was 21:00 to 24:00, and the number of patients who visited was relatively low, which is consistent with our study.<sup>8</sup> Studies have revealed that the public seldom seeks DE service late at night or early in the morning.<sup>20,22,23</sup> This may be related to the patient's perception that to visit a clinic rather than an emergency department they only need to endure the pain for a few more hours. The rate of visits on weekends was higher than weekdays.<sup>7,20–22,24</sup> If national holidays are included in the calculations for weekends, the DE visit rate is 51.2%, indicating that the public has more DE needs on holidays, which may be related to the lack of availability of dental clinics on weekend and holidays.

In this study, 81.0% of DE patients had never accepted treatment at the KMHU dental outpatient department, and 35.1% of patients were visiting KMHU for the first time. Chou et al. revealed that 74.0% of DE patients had never visited a hospital dental department.<sup>22</sup> Chiu et al. demonstrated that 84.0% of patients with DEs were visiting the hospital for the first time.<sup>24</sup> Based on these results, we speculate that people prefer to seek dental treatment in clinics with acute dental problems. They visit the hospital for DEs mainly on holidays, or when referred by a clinical dentist. Lewis et al. noted that in the United States, up to 73% of emergency patients received treatment through DE referrals.<sup>27</sup> This may be related to the high emergency medical fees or the insurance system.

The reasons of DE visits can be divided into trauma and nontrauma factors.<sup>26,28</sup> The study by Bae et al. revealed that in Korea, up to 66% of patients with DEs had dental trauma.<sup>8</sup> In Taiwan, Wang et al. stated that the rate of traumatic DEs was 50.7%,<sup>23</sup> and Chou et al. revealed that 31% of DEs were trauma;<sup>22</sup> trauma was the most common reason for a DE in both studies. However, the proportion of KMHU DEs related to trauma was 22.2%, which is similar to the study (20.9%) of Lin et al.,<sup>15</sup> but higher than the 7.5–10.3% of other hospitals,<sup>7,21,24</sup> indicating that the percentage of trauma-related DE may vary greatly between regions.

Nontrauma-related DEs include dental caries,<sup>29</sup> pulp disease,<sup>29,30</sup> periapical abscess,<sup>31</sup> gum or periodontal disease,<sup>29,32</sup> cellulitis.<sup>29,33</sup> Patients with pericoronitis, apical periodontitis, pulpitis, and periodontitis usually have toothache, prompting them to seek a DE.<sup>28,34</sup> Pain is a common complaint for DEs;<sup>7,22,23</sup> in this study, half the patients visited the hospital because of pain. Pulp-related disease (36.7%) was the main DE diagnosis at KMHU and also at other hospitals (24.5–44.0%).<sup>7,20,21,24</sup> At Taipei Veterans General Hospital and Tri-Service General Hospital,<sup>22,23</sup> the percentage of DEs of pulp-related diseases was the highest nontrauma-related condition in each study, demonstrating that pulp-related diseases are a fairly common DE primary diagnosis. This may be associated with the severe pain caused by these diseases.

Lyu et al.<sup>35</sup> noted that 12.3% of DEs were related to periodontitis and another 15.8% to pericoronitis. At KMHU, 22.9% of patients with DEs were diagnosed with periodontal disease. This is the second most common diagnosis for nontraumatic conditions in this study. Lin et al.<sup>20</sup> revealed that 22.2% of patients with DEs were diagnosed with periodontal disease. In this study, pulp-related and

periodontal-related diseases ranked in the top two DE diagnoses at KMUH, and several studies achieved similar results.<sup>7,20,24</sup>

In this study, 15.3% of patients requested a DE due to infection, lower percentage than study of Chen et al. (30%).<sup>21</sup> Chen classified 351 patients with periodontal and apical abscesses into infection subgroups; however, we classified periodontal abscess as a periodontal disease and apical abscess as a pulp-related disease, leading to different results.

The percentage of DEs related to postoperative complications in this study was 9.2%, whereas percentages in other studies have varied from 5.4% to 15.2%.<sup>7,20–23</sup> Temporomandibular disorders included pain and dislocation, with 72 patients (3.7%) seeking a DE in this study. The percentages of other studies are different (0.1–4.5%).<sup>7,20–22,24</sup>

As described above, the DE patients in this study was limited to adults. In the study of Jung et al.<sup>36</sup> pediatric DE in the medical center of northern Taiwan were predominantly related to trauma (47.1%) and pulp pain (29.9%). Therefore, the result of this study may underestimate the actual rate of DE due to trauma-related or pulp-related problems if all DE cases were included.

The rate of patients who accepted treatment was 93.3%. More than half the patients were treated with a combination of dental treatment and medicine (antibiotics, nonsteroidal anti-inflammatory drugs, analgesics, etc.). KMUH DE differed from that of hospitals in northern Taiwan, which used medicine in more than half the DE cases.<sup>21,22</sup> Because most patients with DEs only received an initial treatment or alleviated the symptoms, the majority still required dental treatment in the outpatient department. 1705 (86.8%) patients were advised to return for follow-up and further treatment. The actual return rate of patients suggested to visit the KMUH dental outpatient department was 40.1%, which is similar to the study of Chou et al.<sup>22</sup> The past data had shown that 23.5%–27.2% of all DE patients will return.<sup>7,21–24</sup> The result of this study showed that adult DE patients have a higher rate of return, which may indicate that DE patients under 20 years prefer dental clinics. Whether this result is related to the parent's need to work or less accessibility to medical centers for younger group is unknown.

Whether the dental treatment was completed after the initial visit, thus avoiding further DE visits remains unclear. Further studies are necessary to determine dental treatment completion rate of patients with DEs.

In conclusion, the study revealed that the top three causes of DE visits were pulp-related problems, periodontal-related problems, and trauma. Although some of the results are consistent with the available literature, differences exist. This may be because of differences in the geographic location of the hospital, the demographics of the people in the region, or medical habits. The results of this study may be used as a reference for dentists providing DE services and for allocating the limited emergency health resources.

## Declaration of competing interest

The authors declare no conflict of interest related to this study.

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