



Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com



Original Article

The impact of the COVID-19 epidemic on the utilization of dental services and attitudes of dental residents at the emergency department of a medical center in Taiwan



Ju-Hui Wu ^{a,b}, Min-Kang Lee ^a, Chen-Yi Lee ^{b,c},
Nien-Hsiang Chen ^a, Ying-Chun Lin ^{a,b}, Ker-Kong Chen ^{a,d},
Kun-Tsung Lee ^{a,b,**}, Je-Kang Du ^{a,d*}

^a Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan

^b Department of Oral Hygiene, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

^c Department of Medical Research, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan

^d School of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

Received 28 November 2020; Final revision received 26 December 2020

Available online 5 January 2021

KEYWORDS

COVID-19;
Epidemics;
Dental emergency treatment;
Dentists' attitude;
Personal protective equipment (PPE)

Abstract *Background/purpose:* Dental visits are a high risk activity during the COVID-19 pandemic. This study investigated the utilization of emergency dental services and clinical practical attitudes of dental residents in this period.

Materials and methods: Retrospective chart data from 13th November 2019 to 31st March 2020 in Kaohsiung Medical University Hospital, Taiwan were used. We obtained electronic medical records to review data from 515 patients who visited the emergency department with dental complaints and we contacted the 26 residents assigned to act as primary care providers to participate in this study.

Results: After the COVID-19 outbreak, 17% fewer patients had dental emergency utilization at a hospital emergency center relative to the previous period. A survey of residents also showed a decline in the number of patients. There were no significant differences of patients' problems and diagnoses between the two periods. After the COVID-19 outbreak, 61.5% of the residents were afraid of being infected by a patient's disease and the proportions of dentists wearing waterproof gowns, face shields, and surgical hair caps were 76.9%, 88.5%, and 76.3%, respectively. These variables increased significantly after the outbreak of COVID-19.

* Corresponding author. Department of Dentistry, Kaohsiung Medical University Hospital, No. 100, Shih-Chuan 1st Road, Kaohsiung, 80708, Taiwan. Fax: +886 7 3157 024.

** Corresponding author. Department of Oral Hygiene, College of Dental Medicine, Kaohsiung Medical University, No. 100, Shih-Chuan 1st Road, Kaohsiung, 80708, Taiwan.

E-mail addresses: denzellee63@gmail.com (K.-T. Lee), dujekang@gmail.com (J.-K. Du).

<https://doi.org/10.1016/j.jds.2020.12.012>

1991-7902/© 2021 Association for Dental Sciences of the Republic of China. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Conclusion: Despite the trend of a decreased number of patients, their utilization of dental emergency services seems to be similar before and after the COVID-19 outbreak, possibly related to strict hospital infection control policies and the relatively low number of COVID-19 confirmed patients internationally at that time.

© 2021 Association for Dental Sciences of the Republic of China. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

An Emergency Department (ED) visit is generally preceded by an urgent condition due to injury, accident, disaster, or disease that requires immediate medical management. Dental emergency services are an important and integral function of the medical care system. The American Dental Association (ADA) define dental emergencies as potentially life-threatening and requiring immediate treatment to stop ongoing tissue bleeding and alleviate severe pain or infection. Examples include uncontrolled bleeding, cellulitis or a diffuse soft tissue bacterial infection, and trauma involving facial bones. However, because the guidance may change as the Corona virus disease-2019 (COVID-19) pandemic progresses, dentists should use their professional judgment in determining a patient's need for urgent or emergency care.¹

Patients making emergency visits for dental care were classified as being traumatic, having non-traumatic origin, or other. Dental trauma conditions are jaw and alveolar bone fractures, displaced or avulsed teeth, fractured teeth, and soft tissue laceration. Non-traumatic dental conditions are pulp-related problems, periodontal-related problems, and odontogenic infection. Poor oral hygiene may lead patients with non-traumatic problems to require relief for acute pain and infection. The inability to access regular dental care may lead to care-seeking at a hospital ED.^{2,3} However, an outbreak of a respiratory disease^{4,5} also affects patients who are seeking care at a hospital ED.

During dental treatment, transmission of infections could occur either through direct contact with blood, saliva, droplets, or aerosols, or through indirect contact with contaminated surfaces. In general, health care workers who do not follow proper infection control procedures while providing patient care are more susceptible to infectious diseases.⁶ Compliance with treatment guidelines is imperative to guide health care workers in treating and serving their patients.⁷

The Kaohsiung Medical University Hospital (KMUH) is the largest hospital in south Taiwan and has an emergency department (ED) that functions as one of the emergency medical centers and serves a wide geographic area in southern Taiwan. On 21st January 2020, the Taiwan Central Epidemic Command Center (CECC) officially reported the first COVID-19 case in Taiwan.⁸ The KMUH rapidly adopted several strategies to ensure safety in the hospital; the most important strategy was the establishment of quarantine stations at the entrances to the hospital. First, all people were requested to wear surgical masks, sanitize their hands, and have their body temperatures checked at a

quarantine station. Next, their travel, occupation, contact, and cluster histories (TOCC) were requested and recorded electronically. Those with a fever or high-risk marks in TOCC were not allowed to enter the hospital and were referred to an outdoor clinic or to the emergency department.⁹

Organized urgent dental care delivered by dental healthcare personnel in appropriate personal protective equipment such as gowns, gloves, masks and face shield with high-volume aspiration and other measures to reduce/avoid the production of droplets, splatter and aerosols by dental drills and saliva. However, there were no study to survey the difference of use scaling machines and high-speed handpieces for dental emergency treatment by dentists in personal protective equipment between before and after COVID-19. Therefore, this is the first study on the utilization of dental services, dental residents' attitude and practice at the emergency department for the COVID-19 pandemic. The study aimed to investigate the prevalence and characteristics of the patients who visits dental emergency, and also the rate of dental procedure with droplets and aerosols such as scaling machines and high-speed handpieces by dental residents, finally to evaluate the completeness of the personal protective equipment and dental residents' attitude toward dental emergency treatment.

Materials and methods

Study design and participants

A retrospective chart data review of patients with dental complaints who visited the KMU ED from 13th November 2019 to 31st March 2020 was conducted. KMU ED is a 24-h dental emergency hospital center in Kaohsiung. Electronic medical records were reviewed by a single dentist. A total of 515 ED patients with differential dental conditions as the principal diagnosis were extracted as the sample for the analysis. The test period of the COVID-19 epidemic was between 21st January and 31st March 2020. The control period of the pre-COVID-19 epidemic was between 13th November 2019 and 20th January 2020.

Electronic medical records

Electronic medical records data included age, gender, main problem, visit time and date, diagnosis, and procedure. The main problem was defined as the condition that is considered the clinically significant reason (trauma, pain, bleeding, swelling, or other reasons) for the patient's visit.

Table 1 Characteristics of dental emergency patients before and after COVID-19 epidemic.

Variables	n	Covid-19 (n, %)		χ^2	p-value
		before	after		
Total	515	281 (54.6)	234 (45.4) ^a	4.289	0.038
Gender					
Female	248 (48.2)	142 (50.5)	106 (45.3)	1.401	0.236
Male	267 (51.8)	139 (49.5)	128 (54.7)		
Age group					
≤ 18 years old	136 (26.4)	77 (27.4)	59 (25.2)	0.474	0.789
19–64 years old	291 (56.5)	155 (55.2)	136 (58.1)		
≥ 65 years old	88 (17.1)	49 (17.4)	39 (16.7)		
First-time visit in KMUH					
Yes	462 (89.7)	250 (89.0)	212 (90.6)	0.368	0.544
No	53 (10.3)	31 (11.0)	22 (9.4)		
Visiting time of the day					
12:00 am–8:00 am	98 (19.0)	54 (19.2)	44 (18.8)	0.366	0.833
9:00 am–5:00 pm	180 (35.0)	95 (33.8)	85 (36.3)		
5:00 pm–12:00 am	237 (46.0)	132 (47.0)	105 (44.9)		
Visiting day of the week					
Monday	63 (12.2)	34 (12.1)	29 (12.4)	10.464	0.106
Thursday	58 (11.3)	29 (10.3)	29 (12.4)		
Wednesday	69 (13.4)	39 (13.9)	30 (12.8)		
Tuesday	47 (9.1)	21 (7.5)	26 (11.1)		
Friday	70 (13.6)	32 (11.4)	38 (16.2)		
Saturday	94 (18.3)	51 (18.1)	43 (18.4)		
Sunday	114 (22.1)	75 (26.7)	39 (16.7)		

^a There were 30 cases (12.8%) that showed fever or high-risk findings in TOCC. After the outbreak of the COVID-19 epidemic, the proportion of patients decreased by 16.7% compared to before COVID-19.

The diagnosis categories were defined as traumatic, non-traumatic, and others. The traumatic category included soft tissue lacerations and tooth or alveolar bone fracture. The non-traumatic category included pulp-related problems, periodontal-related problems, and odontogenic infection. The category of others included post-operative complications and temporomandibular disorder disease, among other conditions. The treatment methods were divided into dental procedures with or without droplets and aerosols, medication only, or oral hygiene instruction.

Questionnaire development

The self-administered questionnaire for the residents included 28 items with close-ended response formats. A total of 30 residents were recorded, among whom 26 provided complete responses and were in the analysis (response rate: 86.7%).

Residents completed the questionnaire before and after the COVID-19 epidemic. The questionnaire included the basic demographic information of residents, standpoint of resident dentist, dental emergency treatment, and infection control guidelines (include personal protective equipment). The content adequacy of the questionnaire was examined by five expert dentists and item content validity index ranged from 0.8 to 1.

The standpoint included four items such as "I was afraid of being infected by patients", "The patients I encountered in need of emergency dental treatment", "I encountered dental emergency patients with no swelling and pain", and "There

were more than ten dental emergency cases when I'm on duty". The dental emergency treatment included three items such as "Avoid using scaling machine", "Avoid using high-speed hand pieces", and "Used medication for pain control". The infection control guidelines included seven items such as "Washing hands, before treatment", "Ask patients to use mouthwash, before treatment", "Wearing surgical masks", "Wearing gloves", "and Wearing waterproof gown", "Wearing face shield", and "Wearing surgical hair cap". The responses were 'always', 'usually', 'sometimes', 'seldom', and 'never'.

Statistical analysis

IBM SPSS 20 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The Chi-square test was used to compare the utilised emergency dental service before and after the COVID-19 epidemic regarding the demographic data, the reasons for seeking treatment, and principal diagnosis and management. Relevant variables were analysed using McNemar's test for the differences before and after the COVID-19 epidemic, the standpoint of the resident dentist, dental emergency treatment, and infection control guidelines. The p-value <0.05 was set as significant.

Ethics approval and consent to participate

This study was approved by the Institutional Review Board (IRB) of Kaohsiung Medical University Hospital (Letter No. KMHIRB-SV(I)-20200022). This study used an anonymous

Table 2 Utilization of dental emergency services before and after the COVID-19 epidemic.

Variables	n	Covid-19 (n, %)		χ^2	p-value
		before	After		
Chief complaints					
Trauma	284 (55.1)	144 (51.2)	140 (59.8)	7.564	0.109
Pain	147 (28.5)	92 (32.7)	55 (23.5)		
Bleeding	41 (8.0)	24 (8.5)	17 (7.3)		
Swelling	30 (5.8)	13 (4.6)	17 (7.3)		
Others	13 (2.5)	8 (2.8)	5 (2.1)		
Principal diagnosis					
Soft tissue lacerations	160 (31.1)	84 (29.9)	76 (32.5)	2.779	0.905
Tooth or alveolar bone fracture	120 (23.3)	63 (22.4)	57 (24.4)		
Pulp related problem	86 (16.7)	48 (17.1)	38 (16.2)		
Periodontal related problem	44 (8.5)	28 (10.0)	16 (6.8)		
Odontogenic infection	29 (5.6)	17 (6.0)	12 (5.1)		
Post-operative complication	21 (4.1)	10 (3.6)	11 (4.7)		
Temporomandibular disorder disease	15 (2.9)	9 (3.2)	6 (2.6)		
Others	40 (7.8)	22 (7.8)	18 (7.7)		
Diagnostic categories					
Traumatic ^a	280 (54.4)	147 (52.3)	133 (56.8)	1.482	0.345
Non-traumatic ^b	159 (30.9)	93 (33.1)	66 (28.2)		
Others ^c	76 (14.8)	41 (14.6)	35 (15.0)		
Treatment					
Dental procedure without droplets and aerosols	209 (40.6)	113 (40.2)	96 (41.0)	2.128	0.406
Dental procedure with droplets and aerosols	111 (21.6)	67 (23.8)	44 (18.8)		
Medication or oral hygiene instruction	195 (37.9)	101 (35.9)	94 (40.2)		
Follow up visit					
No	286 (55.5)	146 (52.0)	140 (59.8)	3.204	0.073
Yes	229 (44.5)	135 (48.0)	94 (40.2)		

^a Traumatic included soft tissue lacerations and tooth or alveolar bone fracture.

^b Non-traumatic included pulp-related problems, periodontal-related problems, and odontogenic infection.

^c Others included post-operative complications, temporomandibular disorder disease, and other diagnoses.

questionnaire, and the IRB determined that a waiver of informed consent was approved.

Results

Patient characteristics

There were 515 patients' medical records, consisting of 248 females (48.2%) and 267 males (51.8%), that were included in the present study, and their demographic characteristics are listed in Table 1. Most patients who visited the ED were adults (aged 19–64 years) (56.5%), first time visit to KMUH (89.7%), visiting at night (5 pm–12 am) (46.0%), and on Sunday (22.1%). Significantly fewer patients (16.7% fewer) visited the dental emergency center during the COVID-19 epidemic period compared to before it (before: 281 vs. after: 234). After COVID-19, there were 30 cases (12.8%) with fever or high-risk findings in TOCC. No significant differences were shown in all the patient characteristics before and after COVID-19.

Reasons for emergency care, diagnosis and management

The comparison of the utilization of dental emergency services before and after COVID-19 are shown in Table 2. The most frequent chief complaint was trauma (55.1%),

followed by pain (28.5%), bleeding (8.0%), swelling (5.8%), and others (2.5%). The most frequent principal diagnosis was soft tissue lacerations (31.1%), followed by tooth or alveolar bone fracture (23.3%), and pulp-related problems (16.7%). The most frequent diagnostic category was traumatic problems (54.4%). The sequence and proportion of chief complaints for seeking emergency dental treatment were similar both before and after the COVID-19 epidemic ($p > 0.05$). The distribution ratio of principal diagnosis and diagnostic categories of emergency dental patients showed no significant differences either before or after the COVID-19 epidemic as well. Fig. 1 shows the distribution of treatment management where there were no significant differences either before or after the COVID-19 epidemic. The proportion of patients who needed a follow-up visit also showed no significant difference in their timeframes.

Table 3 shows the proportions of treatment management according to different diagnostic categories. The results showed no significant differences in treatment before and after the COVID-19 epidemic on traumatic, non-traumatic, and other diagnoses.

Standpoint of resident dentists, and dental emergency treatment

The average age of the dentists was 28.4 ± 1.7 years old, and 65.4% were female residents. Fig. 2 shows that after

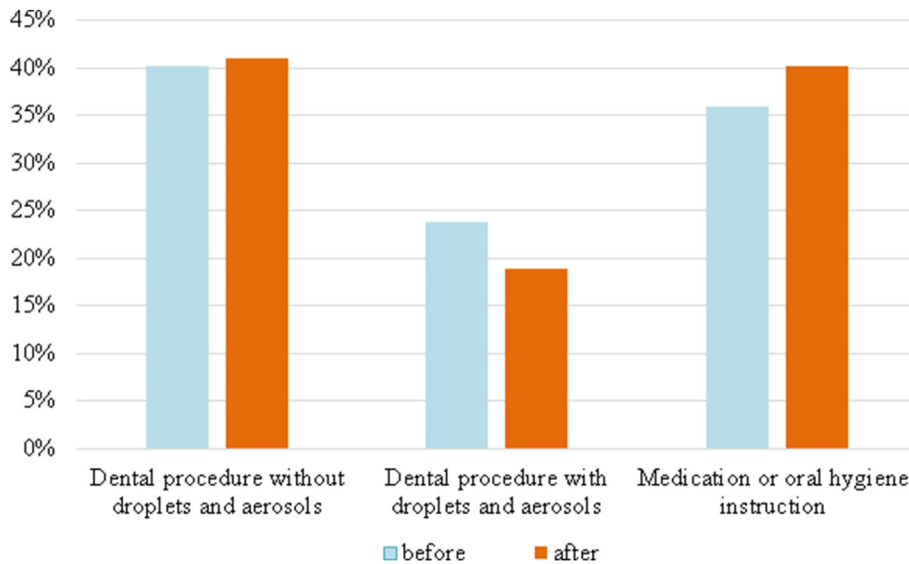


Figure 1 Dental emergency treatment for patients at before and after COVID-19. Note: there was no significant difference.

Table 3 The comparison of treatment management before and after COVID-19 epidemic according to diagnostic categories.

Diagnosis Categories	Variables	Covid-19 (n, %)		χ^2	p-value
		Before	After		
Traumatic ^a	Treatment			0.519	0.771
	Dental procedure without droplets and aerosols	77 (52.4)	73 (54.9)		
	Dental procedure with droplets and aerosols	28 (19.0)	21 (15.8)		
Non-traumatic ^b	Treatment			3.028	0.220
	Dental procedure without droplets and aerosols	20 (21.5)	11 (16.7)		
	Dental procedure with droplets and aerosols	38 (40.9)	21 (31.8)		
Others ^c	Treatment			0.101 ^d	0.750
	Dental procedure without droplets and aerosols	16 (39.0)	12 (34.3)		
	Dental procedure with droplets and aerosols	1 (2.4)	2 (5.7)		
	Medication or oral hygiene instruction	42 (28.6)	39 (29.3)		
	Medication or oral hygiene instruction	35 (37.6)	34 (51.5)		
	Medication or oral hygiene instruction	24 (58.5)	21 (60.0)		

^a Traumatic included soft tissue lacerations and tooth or alveolar bone fracture.

^b Non-traumatic included pulp-related problems, periodontal-related problems, and odontogenic infection.

^c Others include post-operative complication, temporomandibular disorder disease, and other diagnoses.

^d The number of patients who accept dental procedure with droplets and aerosols was only three; therefore, this subgroup was excluded from the Chi-square test.

the COVID-19 epidemic, the residents who reported they were always afraid of being infected by a patient’s disease significantly increased compared to before COVID-19. Residents encountered dental emergency patients without swelling, and instances of having more than ten dental emergency residents on duty significantly decreased ($p < 0.05$). We also found that 53.8% of resident dentists avoided using a scaling machine or high-speed hand pieces for treatment ($p < 0.001$) (Table 4).

Personal protective equipment for infection control

The 100% of the dentists wearing surgical masks and gloves before and after the COVID-19 epidemic. After the COVID-

19 epidemic the proportions of dentists wearing waterproof gowns (76.9%), face shields (88.5%), surgical hair caps (76.9%) had significantly increased compared to before the COVID-19 outbreak ($p < 0.001$). However, there were no differences of dentists washing hands and ask patients to use mouthwash before treatment between before and after periods of COVID-19 (Table 4).

Discussion

On 8th July 2020 the COVID-19 epidemic in Taiwan included 449 positive cases, with 7 deaths and 438 who had recovered. Taiwan’s government learned from its 2003 SARS experience and established a public health response mechanism for enabling rapid actions for the

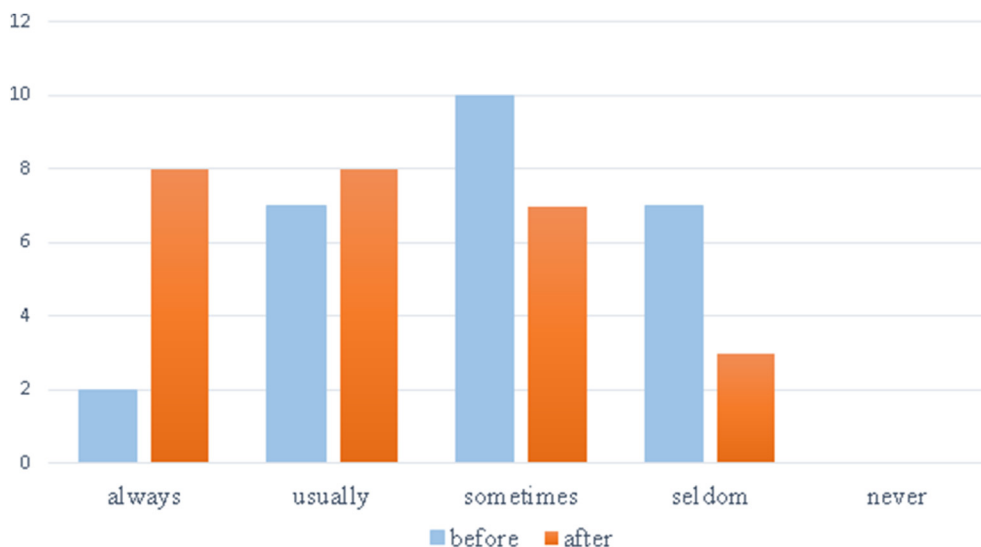


Figure 2 The number of resident dentists afraid of being infected by patients at before and after COVID-19. Note: * p -value < 0.05 .

next crisis. The Taiwan CECC has rapidly produced and implemented a list of at least 124 action items as part of this response.¹⁰ These policies not only affect people's daily lives but also outdoor activities. They also affected the patient who did not have an urgent problem to seek dental treatment in the hospital. To confine the spread of disease outbreak, the CECC recommended that dentists should postpone dental treatment when patients had a fever or respiratory symptoms. Therefore, the dental residents found that patients without swelling and pain seeking dental emergency services decreased significantly ($p < 0.05$). In this study the number of dental emergency patients was reduced by 17% after the COVID-19 epidemic. This finding was similar to previous studies after the impact of the severe acute respiratory syndrome (SARS) in 2003, when ED volumes decreased by 10%–12% in Toronto.¹¹ In 2020, the overall ED volumes reduced by 38%, reflecting the impact of the COVID-19 epidemic⁵ in China.

The distribution ratio of principal diagnosis of emergency dental patients were the same value before and after the COVID-19 epidemic. More than half (52.3%–56.8%) of dental emergencies before and after the COVID-19 epidemic were caused by trauma. However, this finding was different in China, where non-traumatic problems (dental pulpal or periapical lesion) were the main reason (44.7%) for dental emergencies.⁵ In Missouri, dental caries accounted for 20.4% and pulpitis or periapical abscess accounted for 14.8% of the main reasons for emergency visits.¹² In Croatia, the most common diagnosis was face and jaw abscesses (27.3%).¹³ A previous study about dental emergencies conducted in a medical center's hospital found that 20.9% of dental emergencies were caused from trauma and 46.7% came from pulp or periodontal related problems in Taiwan.¹⁴ Also, 47.1% of paediatric dental emergencies were caused from trauma in 2012–2013.¹⁵ The aforementioned results revealed that dental trauma was the most frequent cause of emergency care in Taiwan and has gradually increased.

The reason for the decrease in non-traumatic diagnosis cases may be due to the Taiwan National Health Insurance (NHI) and the high density of dentists in Taiwan. The NHI provided almost all medical care in Taiwan and the coverage rate was 96.16% of the whole population of 23 million people in 2000, rising to 99% by the end of 2004.¹⁶ For dental services, total reimbursements increased significantly while the number of visits per patient remained steady in both hospitals and clinics after the adoption of global budgeting.¹⁷ By the end of the 20th century, there were an average of 6.05 dentists per 10,000 people in Taiwan,¹⁸ similar to developed countries such as the United States, Australia, Canada, and France. Over 68% of WHO Member States report having fewer than five dentists per 10,000 population.¹⁹

If the patient has urgent medical needs, dentists need to wear protective equipment and reduce the use of a dental headpiece or ultrasonic instruments. The clinical environment could be contaminated from droplets of aerosol produced after dental treatment.²⁰ In addition to establishing quarantine stations at its entrances to check patients' conditions, the KMHU provided personal protective equipment, including facial masks, gloves, gowns, and hair caps, to protect skin and eyes from infected blood or secretions. Hand hygiene has been considered the most critical measure for reducing the risk of transmitting microorganisms to patients.²¹ Resident dentists avoided using scaling machines or high-speed hand pieces for treatment at a rate of 53.8%. This rate is similar to that of Turkish dentists (49.95%) who avoided performing aerosol-forming procedures as much as possible.²² In this study, all dentists (100%) wore personal protective equipment including masks and gloves to prevent the transmission of diseases, with 88.5% always or usually washing their hands before treatment. The survey of Turkish dentists also demonstrated similar results of more frequent hand washing (96.88%), wearing gloves (96.58%), and wearing a mask (85.90%). A survey of Jordanian dentists²³ indicated that 92.9% of dentists wore personal protective equipment such as masks, gloves, and

Table 4 Distribution of the residents' relevant variables before and after the outbreak of the COVID-19 epidemic.

Items	Covid-19 (n, %)		p-value
	Before	after	
Standpoint of resident dentist			
1. I was afraid of being infected by patients			
Always/usually	9 (34.6)	16 (61.5)	0.039
Sometimes/Seldom/never	17 (65.4)	10 (38.5)	
2. The patients I encountered in need of emergency dental treatment			
Always/usually	7 (26.9)	14 (53.9)	0.065
Sometimes/Seldom/never	19 (73.1)	12 (46.1)	
3. I encountered dental emergency patients with no swelling and pain			
Always/usually	8 (30.8)	0 (0.0)	<0.001
Sometimes/Seldom/never	18 (69.2)	26 (100.0)	
4. There were more than ten dental emergency cases when I'm on duty			
Always/usually	7 (26.9)	0 (0.0)	0.015
Sometimes/Seldom/never	19 (73.1)	26 (100.0)	
Dental emergency treatment			
1. Avoid using scaling machine			
Always/usually	4 (15.4)	14 (53.8)	<0.001
Sometimes/Seldom/never	22 (84.6)	12 (46.2)	
2. Avoid using high-speed hand pieces			
Always/usually	4 (15.4)	14 (53.8)	<0.001
Sometimes/Seldom/never	22 (84.6)	12 (46.2)	
3. Used medication for pain control			
Always/usually	9 (34.6)	13 (50.0)	0.289
Sometimes/Seldom/never	17 (65.4)	13 (50.0)	
Infection control guidelines (include personal protective equipment)			
1. Washing hands, before treatment			
Always/usually	22 (84.6)	23 (88.5)	0.317
Sometimes/Seldom/never	4 (15.4)	3 (11.5)	
2. Ask patients to use mouthwash, before treatment			
Always/usually	19 (73.0)	18 (69.2)	0.654
Sometimes/Seldom/never	7 (27.0)	8 (30.8)	
3. Wearing surgical masks			
Always/usually	26 (100.0)	26 (100.0)	—
Sometimes/Seldom/never	0 (0.0)	0 (0.0)	
4. Wearing gloves			
Always/usually	26 (100.0)	26 (100.0)	—
Sometimes/Seldom/never	0 (0.0)	0 (0.0)	
5. Wearing waterproof gown			
Always/usually	6 (23.1)	20 (76.9)	<0.001
Sometimes/Seldom/never	20 (76.9)	6 (23.1)	
6. Wearing face shield			
Always/usually	9 (34.6)	23 (88.5)	<0.001
Sometimes/Seldom/never	17 (65.4)	3 (11.5)	
7. Wearing surgical hair cap			
Always/usually	8 (30.8)	20 (76.9)	<0.001
Sometimes/Seldom/never	18 (69.2)	6 (23.1)	

Note: p-value is from McNemar's test.

goggles, and 96.2% of them frequently cleaned their hands, but 74% did not ask patients to rinse their mouths with antibacterial mouthwash before dental treatment. In the

same study, 94% of the participants reported the practice of washing their hands with soap and water or sanitizer before the treatment of patients.²⁴ In this study, 61.5% of resident

dentists were afraid of being infected by a patient's disease compared to other reports showing 87% of participants were afraid of getting infected with COVID-19 from either a patient or a co-worker.²⁴

Before and after the COVID-19 outbreak, there was no significant statistical difference in the reasons for patients seeking dental emergency treatment, principal diagnosis, and management. There was also no significant statistical difference in the dental emergency treatment with different diagnosis category. Whether it was a traumatic or non-traumatic dental condition, the same trend of decline was shown. While almost all resident dentists were afraid of being infected by a patient's disease in the COVID-19 epidemic and avoided the use of dental hand pieces to produce droplets and aerosol, they still provided dental care for the presenting problem. They also followed standard treatment guidelines that were implemented before the COVID-19 outbreak regarding the use of dental hand pieces.

Well-trained and experienced teams of officials recognized the crisis immediately and activated emergency management measures to fight against the emerging outbreak. The faster the infection curve rises, the quicker the health care system becomes overloaded due to an inadequate treatment capacity. According to the COVID-19 experience in Italy, there was a very high mortality rate there (12.63%) compared with the reported rate in Taiwan (1.55%) and more than 13,000 health care workers were affected.²⁵ Taiwan is looking forward to avoiding this situation by "flattening the curve" of the pandemic, i.e. preventing and delaying the spread of the virus so that large portions of the population can get rid of the illness at the same time. A slower infection rate leads to reduced stress on the health care system and decreased hospital visits.

The number of dental emergency patients was decreased after the COVID-19 outbreak. However, the proportions of chief complaints, principal diagnosis, diagnostic categories, and treatment of patients was no difference before and after the COVID-19, and the reason may be related to strict hospital infection control policy and relatively low number of COVID-19 confirmed patient internationally. Residents wear personal protective equipment in accordance with the policy in the COVID-19 epidemic. Even though residents fear being infected, they still follow the standard treatment guidelines to provide essential care according to the actual symptoms. Dentists should be updated the information of infection control guidelines and following these for the COVID-19 prevention. The main limitation of this study was that the data were only from a regional survey and it used a small sample size under this limited space-time background.

Declaration of competing interest

The authors have no conflict of interest to declare.

Acknowledgements

This research was supported in part by Kaohsiung Medical University Hospital with grant no. KMUH-C09 to Ju-Hui Wu.

The funding organization had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

References

- Solana Kimber. *ADA develops guidance on dental emergency, nonemergency care*. 2020. <https://www.ada.org/en/publications/ada-news/2020-archive/march/ada-develops-guidance-on-dental-emergency-nonemergency-care>. [Accessed 4 May 2020].
- Kim PC, Zhou W, McCoy SJ, et al. Factors associated with preventable emergency department visits for nontraumatic dental conditions in the U.S. *Int J Environ Res Publ Health* 2019;16:3671–9.
- Tomar SL, Carden DL, Dodd VJ, Catalanotto FA, Herndon JB. Trends in dental-related use of hospital emergency departments in Florida. *J Publ Health Dent* 2016;76:249–57.
- Quinonez C, Gibson D, Jokovic A, Locker D. Emergency department visits for dental care of nontraumatic origin. *Community Dent Oral Epidemiol* 2009;37:366–71.
- Guo H, Zhou Y, Liu X, Tan J. The impact of the COVID-19 epidemic on the utilization of emergency dental services. *J Dent Sci* 2020;15:564–7.
- de Souza RA, Namen Jr FM, Galan J, Vieira C, Sedano OH. Infection control measures among senior dental students in Rio de Janeiro State, Brazil. *J Publ Health Dent* 2006;66:282–4.
- Jain M, Sawla L, Mathur A, et al. Knowledge, attitude and practice towards droplet and airborne isolation precautions among dental health care professionals in India. *Med Oral Patol Oral Cir Bucal* 2010;15:e957–61.
- Taiwan Centers for Disease Control. *COVID-19 dashboard*. 2020. https://www.cdc.gov.tw/Category/ListContent/EmXemht4IT-IRAPrAnyG9A?uaid=6oHuoqzW9e_onW0AaMEemg. [Accessed 4 May 2020].
- Juang SF, Chiang HC, Tsai MJ, Huang MK. Integrated hospital quarantine system against COVID-19. *Kaohsiung J Med Sci* 2020;36:380–1.
- Wang CJ, Ng CY, Brook HR. Response to COVID-19 in Taiwan: big data analytics, new technology, and proactive testing. *J Formos Med Assoc* 2020;323:1341–2.
- Schull MJ, Stukel TA, Vermeulen MJ, et al. Effect of widespread restrictions on the use of hospital services during an outbreak of severe acute respiratory syndrome. *CMAJ* 2007;176:1827–32.
- Hong L, Ahmed A, McCunniff M, et al. Secular trends in hospital emergency department visits for dental care in Kansas City, Missouri, 2001-2006. *Publ Health Rep* 2011;126:210–9.
- Balenovic A, Fazlic A, Mihecić M, Hoch A, Radujkovic V. Sociodemographic determinants and common reasons for visiting the emergency dental service in the city of Zagreb. *Acta Stomatol Croat* 2019;53:247–54.
- Lin YT, Tsai AI, Chen JCM, Chang YL, Huang PY. A retrospective analysis of dental emergencies presenting to a medical center in Taiwan. *Taiwan J Oral Maxillofac Surg* 2016;27:101–10.
- Jung CP, Tsai AI, Chen CM. A 2-year retrospective study of pediatric dental emergency visits at a hospital emergency center in Taiwan. *Biomed J* 2016;39:207–13.
- Cheng TM. Taiwan's new national health insurance program: genesis and experience so far. *Health Aff (Millwood)* 2003;22:61–76.
- Lin C, Chao H. Use of selected ambulatory dental services in Taiwan before and after global budgeting: a longitudinal study to identify trends in hospital and clinic-based services. *BMC Health Serv Res* 2012;12:339–47.

18. Huang LY, Huang B. The impact of the global budget system on dynamics of dental manpower and utilization of dental services. *Dent Res J (Isfahan)* 2016;13:132–8.
19. World Health Data Platform. *Dentists (per 10 000 population)*. 2020. [https://www.who.int/data/gho/data/indicators/indicator-details/GHO/dentists-\(per-10-000-population\)](https://www.who.int/data/gho/data/indicators/indicator-details/GHO/dentists-(per-10-000-population)). [Accessed 5 May 2020].
20. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. *J Dent Res* 2020;99:481–7.
21. Larson EL, Early E, Cloonan P, Sugrue S, Parides M. An organizational climate intervention associated with increased hand-washing and decreased nosocomial infections. *Behav Med* 2000;26:14–22.
22. Duruk G, Gümüşboğa ZŞ, Çolak C. Investigation of Turkish dentists' clinical attitudes and behaviors towards the COVID-19 pandemic: a survey study. *Braz Oral Res* 2020;34:e054.
23. Khader Y, Nsour MA, Al-Batayneh OB, et al. Dentists' awareness, perception, and attitude regarding COVID-19 and infection control: cross-sectional study among Jordanian dentists. *JMIR Publ Health Surveill* 2020;6:e18798.
24. Ahmed MA, Jouhar R, Ahmed N, et al. Fear and practice modifications among dentists to combat novel coronavirus disease (COVID-19) outbreak. *Int J Environ Res Publ Health* 2020;17:2821.
25. Izzetti R, Nisi M, Gabriele M, Graziani F. COVID-19 transmission in dental practice: brief review of preventive measures in Italy. *J Dent Res* 2020;99:1030–8.