

The readiness of New Zealand general dental practitioners for medical emergencies

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New Zealand Dental Journal 97: 81-86; 2001

SUMMARY

A risk of medical emergency accompanies every dental procedure, but little is known of general dental practitioners' readiness for such events. The few previous studies have shown that nearly all dentists have received training in medical emergencies at some time, most of this training being postgraduate. Up to 20 percent of dentists have reported feeling inadequately prepared for medical emergencies, and most are receptive to the idea of receiving further medical emergency-related training. We conducted a postal survey of 314 dentists concerning their readiness for, and experience of, medical emergencies within general dental practice; 199 dentists (63.4 percent) responded. Medical emergencies had occurred in 129 practices (65.2 percent) within the previous 10 years, at a mean rate of 2.0 events per 10,000 patients treated under local analgesia, other forms of pain control, or sedation. Vaso-vagal events had occurred in 121 (61.1 percent) practices within the previous year, the mean rate being 6.9 events per 10,000 patients treated using the same modes. More than half the respondents were dissatisfied with the training they had received for medical emergencies as undergraduate students, and 28 (14.1 percent) currently felt inadequately prepared for an emergency in practice. When asked how their preparedness could be improved, 165 (83.3 percent) opted for hands-on courses, 15 (7.5 percent) opted for lectures alone, and 5 (2.5 percent) opted for other courses alone. One in 20 felt no need for further training. Further training in the management of medical emergencies should be made available to New Zealand's dentists.

Medical emergencies in general dental practice are unpredictable, but fortunately uncommon¹. If a major medical emergency occurs in practice and the dentist is unprepared, the outcome can be disastrous². On the other hand, with adequate preparation through knowledge of the patient's medical history, having emergency-related drugs and equipment available, and having either knowledge or a written protocol to follow, a dentist can successfully manage most medical emergencies without assistance³. Information on the state of dentists' readiness for medical emergencies is of use because it can assist in identifying areas of weakness that require the profession's attention.

A literature search revealed one Australian⁴, three British^{1,5-8}, and three United States surveys⁹⁻¹² of medical emergencies in dental practice. Most of these surveys focused on dentists' skills in cardiopulmonary resuscitation (CPR). The 1997 Australian survey of 1,250 Australian general dentists obtained a 65 percent response. Almost two-thirds had undertaken CPR training since graduation, and almost half felt competent in CPR⁴. Dentists reported an

average of 3.3 emergency events (not including syncope) during the 10-year reference period.

A 1984 survey of 4,905 dentists (including specialists) in two southern US states (24.6 percent response) reported that 44 percent were comfortable with their current state of preparedness for emergencies, which had occurred at an average of 3.5 events (excluding syncope) per dentist during the 10-year period⁹. Nearly three-quarters reported having a staff member trained in CPR; in half of those practices the dentists also had CPR training¹⁰. Unpublished data on medical emergencies in another North American study were summarised in an article reviewing the management of medical emergencies: the 3,704 respondents (response rate not given) reported a mean of 2.6 medical emergencies (excluding syncope) over a 10-year period¹¹. A more recent North American study surveyed 736 paediatric dentists and received 359 replies (46.6 percent). One-third of respondents were not comfortable with their current state of emergency preparedness, and 91 percent felt they would benefit from more training for medical emergencies¹².

A 1999 survey^{1,5,6} of 1,500 British general dentists (74 percent response) reported that emergency events had occurred at an average of one every 4.5 practice years in England and Wales, and one every 3.6 years in Scotland. Most respondents possessed the drugs and equipment necessary to manage a medical emergency⁵. Virtually all had received training in medical emergencies at some time, most of this training occurring after graduation; one in five, however, felt inadequately prepared to manage a medical emergency⁶. A 1999 survey of 887 British general dentists (34 percent response) reported a much higher rate of medical emergencies (excluding syncope) than other studies have shown, at 0.7 cases per year⁷. In the most recent British study, 193 staff (82 percent response) of the University Dental Hospital of Manchester⁸, showed medical emergency events occurred more frequently in that dental hospital than in general practice, at 1.8 events per respondent per year. Nearly all respondents were receptive to the idea of further training.

Although overseas studies provide useful background data, no information is available on the occurrence of, and dentists' readiness for, medical emergencies in New Zealand dental practice. This study was designed to obtain information on the incidence of medical emergencies in dental practice, dentists' perceived readiness for such events, and whether dentists follow the recommendations of the New Zealand Dental Association's Code of Practice for Emergencies in the Dental Practice¹³.

METHODS

Ethical approval for the study was obtained from the University of Otago's Ethics Committee. The postal survey method was used, and an original sample of 450 dentists

was randomly selected from the electronic database of the Dental Council of New Zealand. Dentists who did not meet the eligibility criterion of being in general practice were excluded from the sample. This gave a final sample of 314 practising general dentists; a self-report questionnaire, a covering letter, and reply-paid envelope were sent to each. No consent form *per se* was used, as return of a completed questionnaire implied consent. The first mail-out was in mid-December 2000, and was followed by a second mail-out to those who had not responded within 1 month. As an incentive to increase the response rate, all respondents were entered into a draw for their choice of a book token or music voucher to the value of \$100.

To reduce the possibility of recall bias, experience of medical emergencies among the dentists was limited to the past 10 years for all events except hyperventilation and vaso-vagal episodes, which were limited to the previous year. Dentists were asked to estimate the number of patients they treat in a typical week using local analgesia, general anaesthesia, intravenous sedation, or oral or other sedation. They were asked to describe any medical emergencies that had occurred in their practices, and the treatment they had provided.

To help determine their readiness to deal with medical emergencies in practice, dentists were asked to rate their confidence in the use of any emergency-related equipment and drugs available in their practices, the list of items being derived from the New Zealand Dental Association's guidelines¹⁵. Additional questions were asked about previous training received in medical emergencies; these explored overall confidence in managing such events.

Data were analysed using the Statistical Package for the Social Sciences (SPSS). For a small number of items, extreme outliers were recoded to the next highest value for that variable.

The level of statistical significance was set at $P < 0.05$. Analysis of variance (for continuous dependent variables) and Chi-square tests (for categorical dependent variables) were used to test the statistical significance of observed associations.

RESULTS

Response rate

Completed questionnaires were received from 199 dentists (63.4 percent), of whom 86.9 percent were graduates of the University of Otago; 5.5 percent had graduated in Britain; 1.5 percent had graduated in each of Iraq, South Africa, and Australia; the remainder had received their dental education elsewhere. Approximately 75 percent of respondents were male. The number of years spent in general dental practice ranged from 1 to 59 (mean, 20; standard deviation, 11). Subsequent analyses omit the data from one dentist who had a postgraduate qualification in anaesthetics, and who regularly administered general anaesthesia. All respondents reported treating patients using local analgesia (mean, 53 per week; sd, 29); 111 dentists (56.1 percent) used various forms of sedation (mean, 1.6 per week; sd, 3.4); and 20 dentists (10.1 percent) reported treating patients under general anaesthesia. Recent graduates tended to treat patients using sedation more often ($P < 0.05$). Three dentists did not specify the number of patients they treated per week, and six dentists did not specify what equipment or drugs they had available for medical emergencies.

Occurrence of medical emergencies in practice

The incidence of medical emergencies occurring in the practices is presented in Table I. Excluding vaso-vagal and

hyperventilative episodes, 129 respondents (65 percent) reported at least one medical emergency in their practice in the last 10 years. Overall, the mean number of events was 4.5 per dentist (sd, 7.8) during the 10-year period. Just over half the respondents reported more than one emergency event in their practices in that time. Dentists who did not report using sedation for any patients reported fewer emergency events (mean, 2.2; sd, 2.8) than those who did use it (mean, 6.2; sd, 9.6; $P < 0.05$).

TABLE I – Reported incidence of medical emergencies occurring in general dental practice.

Emergency event	Number of dentists reporting episode during a 1-year period (%)	Mean number of events per reporting dentist (range)
Faints	120 (61.1)	2.8 (1-15)
Hyperventilation	55 (27.8)	2.9 (1-30)
	Number of dentists experiencing event during a 10-year period (%)	Mean number of events per reporting dentist (range)
Angina	29 (14.6)	1.7 (1-5)
Circulatory depression	22 (11.1)	1.9 (1-10)
Myocardial infarction	5 (2.5)	1.0 (1)
Cardiovascular accident	5 (2.5)	1.0 (1)
Respiratory depression	34 (17.2)	6.1 (1-40)
Respiratory obstruction	3 (1.5)	1.3 (1-2)
Severe asthma	15 (7.6)	2.1 (1-8)
Epilepsy (grand mal)	45 (22.7)	1.5 (1-3)
Status epilepticus	7 (3.5)	1.1 (1-2)
Allergic reaction to drug	60 (30.3)	2.7 (1-10)
Anaphylaxis	7 (3.5)	1.1 (1-2)
Hypoglycaemia	41 (20.7)	3.1 (1-30)
Swallowed or inhaled foreign body	41 (20.7)	1.7 (1-5)
Anaesthetic overdose	10 (5.1)	1.4 (1-2)
Drug interaction	11 (5.6)	2.0 (1-6)
Other emergencies	18 (9.1)	2.4 (1-10)

Vaso-vagal events were the most common event, over 60 percent of respondents encountering these during a single year, at a mean overall rate of 1.7 events per dentist per year (sd, 2.5). Of the 343 vaso-vagal events reported, specific details were provided for 70. Patients' apprehension was the most common cause (where more than one cause was given, the first given was the one reported); 25 events were attributed to it, followed by administration of local analgesia (22 events), tooth extraction (13 events), sight of blood (4 events), and other causes (6 events). As treatment, positioning the patient into a supine position was used in all instances except two. The patient was kept cool (generally by a wet towel on the forehead) in 21 instances; food or drink was given in 13 instances; reassurance in 9 instances; oxygen in 7 instances; and a doctor or ambulance was called in 6 instances. All patients recovered quickly, apart from three who required hospitalisation.

Hyperventilation was the second most common event, 28 percent of respondents encountering it within a single year, at a mean overall rate of 0.8 events per dentist per year (sd, 2.7). Details were given for 27 episodes, the most common cause being related to injections for local analgesia or intravenous sedation (12 events), followed by patient's apprehension (8 events), extractions (3 events), and pain or "other" (4 events). These were most commonly managed with reassurance (14 events), laying the patient flat (8

events), rebreathing of expired air (7 events), medical assistance (2 events), and drugs (2 events). One patient required hospitalisation. All patients recovered.

Of the 127 hypoglycaemic episodes reported for the 10-year period, details were available for 32. All instances but one were treated with oral glucose, the other being treated with intravenous glucose and oxygen. Assistance from medical doctors was sought for two patients. All patients recovered fully.

Details were given for 37 of the 74 reported instances of swallowed or inhaled foreign bodies. Foreign bodies were more commonly swallowed (70 events) than inhaled (4 events). Most commonly swallowed were extracted teeth (16 instances), dental instruments (9 instances), and dental restorations such as crowns or loose fillings (7 instances). Chest or abdominal radiographs were used to assess 16 patients in hospital; 10 patients were asked to report whether any problems developed. No treatment was given for seven patients, one patient "coughed up" the foreign body immediately, and one patient was sent to the hospital's accident and emergency department. Ten patients reported sighting the swallowed object later in a stool, and a matrix holder, a pin screwdriver, and a gold crown were reported as returned to the dentists. Data were missing for two of four inhalation events, but the other two involved amalgam fragments. One of these patients had quadriplegia, and respiratory arrest ensued. Both patients recovered and were sent for chest radiographs.

During the 10 years, 45 dentists reported patients having epileptic seizures, on 67 occasions. Treatment was aimed at minimising the chance of patient self-harm. Six patients were referred to medical doctors; and ambulances were called for two patients. All recovered normally, only one requiring hospitalisation. Eight episodes of status epilepticus were reported by seven dentists. Of the four events for which details were given, two occurred in patients with histories of such events. An ambulance was called for one patient. Assistance was sought from medical doctors for two patients, and the fourth patient was reassured.

Thirty-one severe asthmatic events were reported. Treatment in the form of an inhaled bronchodilator spray was provided for all patients. Only one patient was sent to hospital. All patients recovered.

About one-third of dentists reported a total of 166 allergic reactions. Details were provided for 57 of these events. Contact allergies were reported to latex gloves (two events), endodontic irrigation solution (two), cavity liner (one), impression material (one), toothpaste (one), and radiograph fixative (one). All patients recovered, the dentists reassuring two patients, referring two to a medical doctor, and providing drugs for two patients; "other" or no treatment was given to the remaining patient. Among the drug allergies, antibiotics caused 29 events, local analgesic agents caused 16 events, an anti-inflammatory drug caused 1 event, and the causes of the other 2 events were unknown. Of the antibiotic allergies, the drug was changed or stopped for 20 patients, and 13 patients were referred to medical doctors. Of the 16 instances of allergy to local analgesia, 5 patients were referred to medical doctors, oxygen was given to 3 patients, and "other" or no treatment was given to the remainder.

Anaphylaxis was a relatively rare event, only seven dentists reporting incidents (one reported two events and the others one event each). Three of these were attributed to prescribed oral penicillin (one pre-operative, and two occurring away from the surgery), and the others were

respectively attributed to "ibuprofen", "xylocaine" (lignocaine), "adrenaline in local anaesthetic", and an unspecified "local anaesthetic". The cause of one event was unspecified. The patient whose anaphylactic event was associated with lignocaine had received that drug in the past with no ill effects, as was the case with one of those associated with oral penicillin. Emergency services were used for three patients, a medical doctor managed one situation, and the dentists themselves managed the other three patients – oxygen was administered to one, and adrenaline administered to the other two patients (one after advice from a medical general practitioner). All patients made rapid and full recoveries.

Adverse drug interactions were reported by 11 dentists. Of the five episodes for which details were provided, three were reactions of dentally related drugs with other drugs the patients were taking, one was a reaction between two dental drugs, and the cause of one event was unknown. Two events required assistance from a medical doctor, but all had favourable outcomes.

Fourteen patients received overdoses of anaesthetic agents. Details were provided for six of these events. Half were due to excessive local analgesic, and the rest were due to over-sedation. All patients recovered, one requiring emergency services.

Forty-two episodes of circulatory depression were reported, by 22 dentists; details were provided for 9 episodes, mostly related to anaesthesia. Three of these patients required emergency services, three required assistance from a medical doctor, and three were managed by the dentists.

Thirty-four dentists reported a total of 208 episodes of respiratory depression, the majority being due to sedation of patients. As treatment, most dentists simply gave the patient a verbal command to breathe, some administered oxygen, and a few used flumazenil (a benzodiazepine antagonist). One patient required hospitalisation, but the rest recovered very quickly. Some respondents reported respiratory depression as an overdose of intravenous or oral or other sedation, and these were treated in the same manner.

Details were provided for 28 of the 49 episodes of angina, which were reported by 29 dentists. Angina medication (usually the patient's own) was administered to 24 patients, oxygen to three patients, nitrous oxide to 1 patient, and none or "other" treatment was given to 3 patients. Emergency services were called for four patients, and other medical assistance was used for five cases. All patients recovered.

Five myocardial infarctions were reported. Two dentists administered oxygen, and one also administered adrenaline and performed CPR. All patients were hospitalised, and recovery of three patients was reported. One cardiac arrest was reported; this occurred in a hospital where extractions were being performed under general anaesthesia in the presence of an anaesthetist who resuscitated the patient successfully.

Five cerebrovascular accidents (CVA, or stroke) were reported. One patient was immediately hospitalised, two were followed-up by general medical practitioners, and no details were given for the other two patients.

The four "severe bleeding" episodes were all associated with tooth extraction, though patient medications were believed to have contributed to two events. Sutures were used in three events and, in two of these, local analgesia and pressure packs were also used. In the fourth patient, the bleeding was severe enough that the patient had to be removed from the surgery by ambulance, and given intravenous fluids.

Recollection of undergraduate training

Most respondents (162, 81.8 percent) recalled at least some undergraduate training in medical emergencies (Table II). Dentists who had been practising for longer were less likely to recall or be satisfied with their undergraduate training. Of those recalling having such training, 141 (87.0 percent) recalled some CPR training, 86 (53.0 percent) recalled IV-access training, 81 (50.0 percent) recalled some training in the use of emergency drugs, and 20 (12.4 percent) recalled other training. Ninety-two (46.7 percent) respondents felt their undergraduate training had prepared them at least adequately for managing medical emergencies in practice – these dentists were three times less likely to currently feel unprepared ($P<0.01$). Dentists who reported receiving satisfactory training were also more likely to have a medical emergency kit available ($P<0.01$). Dentists graduating outside New Zealand were more likely to describe their undergraduate training as satisfactory (64.0 percent compared with 44.2 percent), but this difference did not reach statistical significance.

TABLE II – Dentists' recall and rating of undergraduate-level medical-emergency training by source of qualification and time in practice.

	Number recalling some undergraduate training in medical emergencies (%)	Number who deemed their training to be adequate (%)
Source of qualification		
University of Otago	138 (80.2)	76 (44.2)
Other university	24 (92.3)	16 (64.0)
Years in practice		
1-10	41 (87.2)*	24 (52.2)*
11-18	50 (92.6)	31 (57.4)
19-28	44 (93.6)	25 (53.2)
28+	27 (54.0)	12 (24.0)
All respondents	162 (81.8)	92 (46.7)

* $P<0.01$

First-aid courses had been attended by 154 respondents (77.8 percent) since graduation, 114 (57.6 percent) had attended continuing dental education courses on managing medical emergencies, and 70 (35.4 percent) had attended other related courses.

General preparedness for medical emergencies

Exactly half the respondents reported having a current CPR or first-aid certificate, and 160 (80.8 percent) reported having some form of medical emergency kit available in their offices. Written instructions for CPR were available in 125 practices (63.1 percent); anaphylaxis diagnosis and treatment instructions were available in 95 (48.0 percent); and 21 practices (10.6 percent) had other relevant written instructions. Overall, 75 (37.9 percent) of respondents felt well prepared for a medical emergency, 95 (48.0 percent) felt adequately prepared, and 27 (13.6 percent) felt poorly prepared for an emergency event. Only one dentist reported feeling totally unprepared.

The associations between preparedness for, and experience of, medical emergencies in practice by length of time in practice, patient throughput, current CPR or first-aid certification, and possession of a medical emergency kit are shown in Table III. Dentists were more likely to feel unprepared if they lacked a first-aid certificate or medical emergency kit, or had not gained their dental qualification from the University of Otago.

TABLE III – Preparedness for medical emergency in practice by length of time in practice, patient throughput, current CPR-first aid certification, and possession of a medical emergency kit.

	Number feeling poorly prepared (%)
Source of qualification	
University of Otago	21 (12.2)*
Other university	7 (26.9)
Years in practice	
1-10	9 (19.1)
11-18	4 (7.4)
19-28	5 (10.6)
28+	10 (20.0)
Number of patients per week	
1-32	9 (20.0)
35-48	10 (20.0)
50-60	5 (9.4)
61+	4 (8.5)
Current CPR-first aid certification	
Yes	7 (7.1)†
No	19 (20.4)
Medical emergency kit	
Yes	11 (6.9)‡
No	17 (45.9)
All respondents	28 (14.2)

* $P<0.05$, † $P<0.01$, ‡ $P<0.001$

Overall, respondents seemed eager to improve their preparedness for medical emergencies; for example, one dentist commented:

I would like to see short courses covering the most common emergencies run once a year. We all learn CPR, but we never use it. Therefore it needs to be reinforced.

Only 10 respondents (5.2 percent) believed they had no need for improvement, but 73 (36.9 percent) wanted hands-on courses and lectures, 93 (47.0 percent) wanted only hands-on courses, 15 (7.5 percent) wanted only lectures, and 5 (2.5 percent) wanted only other courses (respondents were permitted to tick more than one option).

Emergency equipment and drugs kept by practitioners

The emergency items and drugs kept by respondents are shown in Table IV. The longer the respondents had been practising, the less emergency equipment they reported having available in their practices ($P<0.05$). A similar association was apparent for emergency drugs ($P<0.001$). The average number of patients treated per week under local analgesia had no association with the presence of either emergency equipment or emergency drugs. Most dentists felt fully competent in the use of the equipment and drugs they possessed. Low confidence was most commonly reported in the use of laryngoscopes, adrenaline, intravenous glucose, and intravenous cannulae.

DISCUSSION

Because of the random sampling procedure and the high response rate, the study findings are generalisable to the greater population of general dental practitioners in New Zealand. The rate of medical emergencies reported in this study is higher than the rates shown in most previous studies^{4,6,7,9,11}, but it is not known whether this is a real difference, or a result of minor differences in study design.

Our findings show a large proportion of respondents lacked much of the equipment recommended in the New Zealand Dental Association's guidelines¹³. A surprisingly large proportion lacked emergency kits (20 percent) and even CPR certificates (50 percent). Not surprisingly, perhaps, virtually all respondents believed they would benefit from further training in managing medical emergencies.

TABLE IV – Emergency equipment and drugs kept by practitioners (N=199).

Emergency item	Number of practitioners who keep each item (%)
Emergency equipment	
Suction	186 (93.9)
Disposable needles	167 (84.3)
Ambubag	162 (81.8)
Hypodermic syringes	153 (77.3)
Oxygen apparatus	149 (75.3)
Oxygen-nitrous oxide apparatus	105 (53.0)
Tourniquet	108 (54.5)
Paper bag	104 (52.5)
Blood-pressure monitor	100 (50.5)
Intravenous cannulae	92 (46.5)
Pulse oximeter	82 (41.4)
Apparatus for delivering air	67 (34.8)
Laryngoscope	47 (24.7)
ECG monitor	8 (4.0)
Defibrillator	7 (3.5)
Other equipment	10 (5.1)
Emergency drugs	
Oxygen	156 (78.8)
Adrenaline	135 (68.2)
Oral glucose	120 (60.6)
Nitrous oxide	110 (55.6)
Salbutamol	109 (55.1)
Flumazenil	72 (36.4)
Midazolam	70 (35.4)
Other benzodiazepine	44 (22.2)
IV glucose	44 (22.2)
Naloxone	34 (17.2)
Other drugs	23 (11.6)
Protocol displays	
CPR wall chart	125 (63.1)
Anaphylaxis wall chart	95 (48.0)
Other chart or written instructions	21 (10.6)
Other items	
Medical emergency kit	160 (80.8)
First-aid certificate	98 (50.0)

Noteworthy is the association between the length of time in practice and the reported occurrence of medical emergencies, younger practitioners reporting a higher number. A likely explanation for this finding is that recent graduates were using sedation more frequently, and that they might be more prepared to treat medically compromised patients in the first place. Some support for this assertion is the positive association of emergencies and the presence of medical emergency kits; this may reflect those dentists' concomitant awareness of, and preparedness for, such events.

It is difficult to account for the finding that overseas graduates were more likely to describe their undergraduate training as satisfactory, but were more likely to feel unprepared for emergencies. This seemingly paradoxical finding may be due to chance or, alternatively, it may reflect the difficulty of practising in a new country.

With a relatively high rate of medical emergencies occurring in dental practice, it is important that New Zealand's dentists are confident in the management of a medical emergency,

particularly in its initial stages, have the recommended emergency equipment and drugs available in their practices, and receive appropriate training at both undergraduate and postgraduate levels. Previous workers have recommended yearly CPR refresher courses, and that further courses should be made available to dentists as required. We see no reason for this not to apply in this country. Awareness of the contents of the recommended minimal medical emergency kit¹³ should be actively promoted among New Zealand's dentists. Training in readiness for medical emergencies and emergency drug use should be made a priority topic for continuing dental education courses, and these should be aggressively promoted.

ACKNOWLEDGMENTS

Jonathan Broadbent thanks the New Zealand Dental Research Foundation for awarding him the RC Tonkin Summer Studentship, which enabled and funded the study. Dr GJ Atherton, University Dental Hospital of Manchester, United Kingdom, is thanked for his helpful advice in the design of the questionnaire.

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