Peer-reviewed paper; submitted February 2017; accepted July 2017

An update on New Zealand oral health practitioners' preparedness for medical emergencies

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Abstract

Background and objectives: To update information on the preparedness of New Zealand dentists and allied dental practitioners (ADPs) for medical emergencies.

Methods: Electronic and paper survey of a sample of 889 oral health practitioners (OHPs), comprising of dentists (general dental practitioners (GDPs) and specialists), and ADPs (dental hygienists, dental therapists and clinical dental technicians) randomly selected from the Dental Register.

Results: The response rate was 39.7%. About half of the respondents (43.3%) reported encountering at least one emergency event during the last ten years. Vaso-vagal syncope was the most commonly reported emergency event, followed by hyperventilation. The mean ten-year incidence of emergency events (excluding vaso-vagal syncope and hyperventilation) was 2.4 events per practitioner (SD, 7). Dentists were 6.8 times more likely to experience emergency events than ADPs ($p < 0.001$). The majority of OHPs had access to an emergency kit (96.9%). Of the dentists who reported using sedation (excluding relative analgesia), only 27.6% had an opioid antagonist, 52.6% had an advanced airway adjunct, and 59.2% had glucagon in their emergency kit. A majority of dentists not using sedation (90.8%) and ADPs (82.6%) had an NZRC certificate at level 4 or above, but only 71.1% of dentists using sedation (excluding relative analgesia) had an NZRC certificate at level 5 or above.

Conclusion: The majority of New Zealand OHPs had training and equipment for medical emergencies, and New Zealand appears better than many other countries in this respect. However, some OHPs still lacked some of the required emergency equipment, drugs, and training.

Introduction

The New Zealand population is ageing (Statistics New Zealand, 2015), as with other developed countries. This means that oral health practitioners (OHPs) are increasingly providing care for elderly patients. This demographic shift towards a greying population has numerous dental implications. Ageing is accompanied by chronic diseases, disabilities and poly-pharmacy (Hung et al., 2011), all of which are risk factors for the occurrence of medical emergencies in dental practices. Thus, the risk of medical emergency events is likely to be increasing, but no research has been conducted to determine whether this is so in New Zealand.

Most medical emergencies can be anticipated, and all OHPs should be well-versed in their prevention and management. The ability of a practitioner to provide basic life support is an essential and fundamental component of the provision of safe dental care. Despite this, studies have shown many general dental practitioners (GDPs) to be inadequately prepared for medical emergencies (Chapman, 1997; Muller et al., 2008; Arsati et al., 2010; Alhamad et al., 2015). Only about half of German GDPs were able to provide basic life support (Muller et al., 2008). About two in five Belgian dentists had never had adult basic life support training following graduation, and four in five never had paediatric basic life support training (Marks et al., 2013). Some years ago, only half of New Zealand GDPs had a current CPR or first-aid certificate, and one in five lacked an emergency equipment kit (Broadbent and Thomson, 2001).

Overseas studies have reported a range of incidence rates for medical emergencies in dental practice from 3.3 to 7.0 emergency events (excluding syncope) per practitioner during a ten-year practice period (Chapman, 1997; Atherton et al., 1999; Girdler and Smith, 1999; Atherton et al., 2000; Arsati et al., 2010). A 2001 study of 314 New Zealand GDPs reported a mean 4.5 emergency events per dentist during a ten-year practice period (Broadbent and Thomson, 2001). While this falls within the reported range from the overseas studies, most of those studies are dated, and there is a need for more contemporary information, particularly in light of the ageing population.

Previously published studies have tended to focus on GDPs. There is a lack of published data on the preparedness of allied dental practitioners (ADPs), including dental therapists, dental hygienists and clinical dental technicians for medical emergencies. Only one study investigated the incidence of medical emergencies among both dentists and dental auxiliaries ([dental] nursing staff, hygienists and radiographers). Atherton et al., (2000) noted that dentists reported more emergency events than dental auxiliaries. This suggests that ADPs also encounter medical emergencies, but less frequently than dentists. Whether this is true for the New Zealand dental workforce is unknown.

In September 2014, the Dental Council of New Zealand (DCNZ) updated its 'Code of Practice for Medical Emergencies in Dental Practice' (Dental Council of New Zealand, 2014). In this updated standard, the New Zealand Resuscitation Council Certificate of Resuscitation and Emergency Care (CORE) certification level required of OHPs was updated, along with the period of recertification. Little is known about the adherence of OHPs to this updated practice standard.

Accordingly, this study investigated the preparedness of New Zealand dentists and ADPs for medical emergencies in dental practice.

Methods

This study was approved by the University of Otago Ethics Committee. Data were collected between March and July 2016. OHPs were randomly selected from the 2015-2016 Dental Register, obtained from the DCNZ. The 896 randomly selected OHPs represented 20% of the source population for each OHP type, including GDPs, dental specialists, dental hygienists, dental therapists, and clinical dental technicians. A small number (7) who did not have a clinical role or were not practising in New Zealand were considered ineligible and were excluded from the sample, leaving 889 eligible participants.

The electronic survey used Qualtrics TM software. A link to the online questionnaire was emailed to each participant in March 2016. Participants who failed to respond within two weeks were sent a reminder email. Those who did not respond to the electronic survey were then sent a questionnaire with a cover letter and a reply-paid envelope.

Questionnaire

The questionnaire sought information on the respondents' socio-demographic characteristics (specifically gender, age, ethnicity, year of primary dental qualification, and practice location), experience and preparedness for medical emergencies. The frequency of specific medical emergencies was also assessed. To maximise the accuracy of recall, the question on the incidence of vaso-vagal syncope and hyperventilation was limited to the past practising year, while for other medical emergencies events extending to the past ten practising years, or as long as the practitioner had been practising in the event of practising life being less than ten years. Information on the availability of emergency equipment and drugs (and confidence in administering these) was also sought. The list of emergency equipment and drugs was derived from the DCNZ's practice standard (Dental Council of New Zealand, 2014).

In this study, findings are also reported from a 2007 survey. Details of the population sampled and method for the collection of data have been reported previously (Tay et al., 2008).

Statistical analysis

Data were entered electronically and analyzed using version 21 of the Statistical Package for Social Sciences (for Windows) (IBM). The level of statistical significance was set at $p < 0.05$. For a small number of items, extreme outliers were recoded to the next lowest value for that variable. The statistical significance of observed differences was tested using Analysis of Variance for continuous dependent variables, or Chi-Square tests and Fisher's Exact test (as appropriate) for categorical dependent variables.

Results

Responses were received from 353 of the 889 invited practitioners, giving a response rate of 39.7%. Dentists represented 65.7% of respondents, while the remainder were ADPs. For analysis purposes, the respondent age was dichotomized to less than 50 years old and 50 years or older. Comparison with the 2011-2012 Workforce Analysis (Dental Council of New Zealand, 2016a) suggested an over-representation of New Zealand qualified dentists and dentists aged above 50 years within the sample (Table 1). More than half of the respondents (64.4%) listed their ethnicity as New Zealand European.

The mean number of patients seen weekly was 49 (SD, 26) for dentists, and 44 (SD, 23) for ADPs. Most dentists (96.6%) reported treating patients with local analgesia (mean, 49 per week; SD, 26); 36.2% reported using intravenous sedation (IV), oral sedation (OS) or relative analgesia (RA) (IV: mean, 0.6; SD, 3, OS: mean, 0.3; SD, 1, RA: mean, 0.2; SD, 1); and 8.0% reported treating patients under general anaesthesia (GA) (mean, 0.5; SD, 2). The use of local analgesia during dental procedures was reported by 74.4% (n=90) of ADPs (mean, 19; SD, 14). Almost half (48.7%) of OHPs reported updating each patient's medical history at every visit; 45.8% did it at every new treatment plan/check-up, and the remaining 5.4% updated the medical history only occasionally.

Vaso-vagal syncope was the most commonly reported emergency event, followed by hyperventilation. Excluding hyperventilation and vaso-vagal events, there were 828 emergency events reported, corresponding to a mean of 2.4 events per respondent during the ten-year period (range, 0-62; SD, 7). Nearly half of respondents (43.3%) reported encountering at least one medical emergency during the last ten years. Dentists experienced a mean of 3.4 events (range, 0-62; SD, 8) and ADPs a mean of 0.5 events (range, 0-11; SD, 1). Dentists were significantly more likely to experience emergency events ($p<0.001$). Other emergency events reported were hypoglycaemia, allergic reaction to a drug, and respiratory depression (Table 2).

Most respondents (96.9%) reported having a medical emergency kit available. Only 38.6% reported checking their medical emergency kit more than twice annually. Details of the emergency equipment and drugs kept by respondents are shown in Table 3. Most respondents reported having an ambu bag and airway (82.3%), breathing apparatus for oxygen delivery (83.1%), an oxygen cylinder and regulator (82.3%) and a basic airway adjunct (77.4%) available. Among those who reported keeping these items, fewer than three in four had confidence in using them.

Dentists were further asked to provide information on the availability of a spacer device to deliver salbutamol and disposable hypodermic syringe and/or needles. Of the 71.1% who reported having a spacer device to deliver salbutamol, 83.6% were confident in using the device. A higher proportion of dentists reported having a disposable hypodermic syringe and/or needle available (84.8%), and 76.0% of dentists were confident in using it. Most dentists reported having adrenaline (91.3%), glyceryl trinitrate spray or tablets (86.9%), aspirin tablets (82.1%) or a salbutamol inhaler (79.0%) available in their emergency kit.

Most respondents (92.9%) reported holding a current NZRC certificate. The majority (90.8%) of dentists who did not use sedation reported holding an NZRC certificate of level 4 or above. Three dentists did not provide information on their NZRC certificate level, one reported having an NZRC certificate of level 3, and ten did not have a current NZRC certificate. For dentists who reported using any form of sedation (excluding

Table 1. Comparison of respondents' sociodemographic characteristics with those of the New Zealand (NZ) dental profession.

	Dentist (%)	Dentists in NZ dental profession [a] (%)	ADPs (%)	ADPs in NZ dental profession [a] (%)
Sex				
Male	140 (60.6) [e]	1347 (64.6)	9 (7.4)	54 (4.3) [c]
Female	91 (39.4) [e]	738 (35.4)	112 (92.6)	1191 (95.7) [c]
Age				
Younger than 50	104 (45.6) [b, e]	1220 (58.5) [b]	68 (56.2)	881 (61.1)
50 and over	124 (54.4) [b, e]	865 (41.5) [b]	53 (43.8)	561 (38.9)
Country of qualification				
New Zealand	184 (81.4) [b, e]	1456 (69.8) [b]	112 (92.6)	NR [d]
Other	42 (18.6) [b, e]	629 (30.2) [b]	9 (7.4)	NR [d]

[a] Dental Council of New Zealand (Workforce Analysis 2011-2012)
[b] $p<0.05$
[c] Excludes clinical dental technicians
[d] NR: not reported
[e] Some practitioners did not provide demographic information

Table 2. Incidence of medical emergencies by practitioner type.

Emergency event	Average number of GDPs reporting 1+ events per year (%)	Average number of specialists reporting 1+ events per year (%)	Average number of ADPs reporting 1+ events per year (%)	Mean number of events per reporting practitioners (sd)	Total number of events reported (max)
Vaso-vagal syncope [a]	71.0 (36.0)	10.0 (37.0)	1.5 (12.8)	3.3 (6.0)	313 (50)
Hyperventilation [a]	40.0 (20.3)	3.0 (11.1)	1.2 (10.3)	3.5 (5.1)	185 (25)
Hypoglycemia	4.4 (21.3)	0.7 (21.9)	0.4 (2.3)	0.4 (3.6)	195 (15)
Allergic reaction to a drug	2.8 (14.2)	0.5 (15.6)	0.2 (1.7)	0.3 (0.5)	112 (20)
Allergic reaction to latex	1.3 (6.6)	0.4 (12.4)	0.0 (0.0)	0.6 (1.2)	101 (50)
Respiratory depression	1.0 (5.1)	0.5 (15.6)	0.0 (0.0)	0.6 (0.6)	84 (80) [b]
Swallowed foreign body	2.9 (14.7)	0.5 (15.6)	1.2 (9.9)	0.2 (0.2)	83 (12)
Tachycardia	0.5 (1.5)	0.1 (3.1)	0.0 (0.0)	2.0 (2.2)	78 (50)
Angina pectoris (chest pain)	2.4 (12.2)	0.5 (15.6)	0.1 (0.8)	0.2 (0.1)	52 (5)
Epileptic seizures (grand mal)	1.7 (8.6)	0.4 (12.5)	0.3 (2.5)	0.2 (2.0)	44 (10)
Drug interaction	1.1 (5.6)	0.3 (9.4)	0.1 (0.8)	0.2 (0.1)	26 (5)
Hyperglycemia	6.0 (3.0)	0.1 (3.1)	0.2 (1.7)	0.3 (0.2)	23 (5)
Anaphylaxis	9.0 (4.6)	0.4 (12.5)	0.0 (0.0)	0.2 (0.1)	22 (5)
Acute asthma	7.0 (3.6)	0.1 (3.1)	0.2 (1.7)	0.2 (0.1)	18 (5)
Circulatory depression or collapse	4.0 (2.0)	0.2 (6.2)	0.2 (1.7)	0.2 (0.2)	17 (5)
Prolonged epileptic seizures	4.0 (2.0)	0.2 (6.2)	0.0 (0.0)	0.2 (0.2)	11 (5)
Overdose (eg of anesthetic)	4.0 (2.0)	0.2 (6.2)	0.1 (0.8)	0.1 (0.0)	10 (3)
Myocardial infarction	0.3 (1.5)	0.2 (6.2)	0.0 (0.0)	1.2 (0.4)	6 (2)
Death	0.0 (0.0)	0.1 (3.1)	0.0 (0.0)	4.0 (-)	4 (4)
Stroke (cardiovascular accident)	3.0 (1.5)	0.1 (3.1)	0.0 (0.0)	1.0 (-)	4 (1)
Bell's Palsy	0.2 (1.0)	0.0 (0.0)	0.0 (0.0)	3.0 (0.0)	3 (3)
Inhaled foreign body	2.0 (1.0)	0.0 (0.0)	0.1 (0.8)	1.0 (-)	3 (1)

[a] Vaso-vagal syncope and hyperventilation during the previous year. All other events were taken as an average/year during the past ten years.

[b] One respondent reported their patients had 80 episodes of respiratory depression in the past 10 years. For the purpose of statistical analysis, this outlier was recoded to the next lowest value (20).

RA), 71.1% had an NZRC level 5 certificate or above and 21.1% reported having an NZRC level of 4. Five dentists practicing sedation did not have a current NZRC certificate and one did not provide information on their NZRC certificate level. Most ADPs (82.6%) had an NZRC certificate of level 4 and above. Four ADPs had an NZRC level of 3 and two reported having an NZRC level of 2. Five ADPs did not provide information on their certification level, while 10 reported not having a current NZRC certificate.

Data on the emergency items available to dentists who use any form of sedation (including no sedation) are presented in Table 4. Just over one in four dentists using sedation (excluding RA) reported having an opioid antagonist. Excluding opioid antagonists, dentists who reported using IV sedation were significantly more likely to have these emergency items (listed in Table 4) than dentists not practising sedation ($p<0.05$).

The mean number of emergency events reported by dentists over the past ten years by the use of varying modes of sedation (including no sedation) are presented in Table 5. A statistically significant difference was observed in the frequency of angina pectoris, respiratory depression, allergic reaction to a drug, acute asthma

Table 3. Emergency equipment and drugs kept by oral health practitioners.

Emergency equipment and drugs	Number of GDPs reporting having the equipment (%)	Number of specialists reporting having the equipment (%)	Number of dentists using sedation reporting having the equipment (%)[a]	Number of ADPs reporting having the equipment (%)	Overall number of practitioners reporting having the equipment (%)
All practitioners					
Ambu bag & airways	175 (88.8)	28 (87.5)	67 (88.2)	85 (70.2)	288 (82.3)
Breathing apparatus for oxygen delivery	167 (84.8)	26 (81.3)	69 (90.8)	98 (81.0)	291 (83.1)
Oxygen cylinder and regulator	167 (84.8)	22 (68.8)	67 (88.2)	99 (81.8)	288 (82.3)
Basic airway adjuncts (oropharyngeal airways)	167 (84.8)	25 (78.1)	66 (86.8)	79 (65.3)	271 (77.4)
GDPs and specialists only					
Spacer device to deliver salbutamol	140 (71.1)	21 (65.6)	60 (78.9)	42 (34.7)	203 (58.0)
Syringe and needles	167 (84.8)	22 (68.8)	68 (89.5)	39 (32.2)	228 (65.1)
Adrenaline (1:1000, 1:10000)	182 (92.4)	27 (84.4)	70 (92.1)	55 (45.5)	265 (75.4)
Glyceryl trinitrate spray or tablets	174 (88.3)	25 (78.1)	70 (92.1)	47 (38.8)	246 (70.3)
Aspirin tablets	169 (85.8)	19 (59.4)	65 (85.5)	58 (47.9)	246 (70.3)
Salbutamol inhaler	160 (81.2)	21 (65.6)	65 (85.5)	42 (34.7)	223 (63.7)

[a] The sedative methods included are general anesthesia, intravenous anesthesia, and oral sedation.

Table 4. Emergency equipment and drugs available for dentists using no sedation (NS), oral sedation (OS), intravenous sedation (IV) and general anesthesia (GA).

Emergency equipment and drugs	Does not practise sedation, NS (%)	Oral sedation, OS (%)	Intravenous sedation, IV (%)	General anesthesia, GA (%)	All sedation (excluding RA) (%)	F(3,216)	p-value	Pair-wise differences
Intravenous drug delivery device	75 (52.1)	21 (67.7)	24 (88.9)	15 (83.3)	60 (78.9)	6.437	0.000[a]	IV>NS, GA>NS
Automated external defibrillator (AED)	61 (42.4)	14 (45.2)	20 (74.1)	12 (66.7)	46 (60.5)	4.056	0.009[a]	IV>NS
Advanced airway adjuncts	52 (36.1)	10 (32.3)	19 (70.4)	11 (61.1)	40 (52.6)	5.228	0.002[a]	IV>NS, IV>OS
Dextrose	59 (41.0)	19 (61.3)	20 (74.1)	12 (66.7)	51 (67.1)	5.093	0.002[a]	IV>NS
Glucagon	62 (41.7)	18 (58.1)	19 (70.4)	8 (44.4)	45 (59.2)	2.763	0.043[a]	IV>NS
Normal saline	67 (46.8)	22 (71.0)	21 (77.8)	13 (72.2)	56 (73.7)	5.334	0.001[a]	IV>NS
Benzodiazepine antagonist	28 (19.2)	16 (51.6)	21 (77.8)	12 (66.7)	49 (64.5)	20.485	0.000[a]	IV>NS, OS>NS, GA>NS
Opoid antagonist	15 (10.3)	6 (19.4)	6 (22.2)	9 (50.0)	21 (27.6)	6.995	0.000[a]	GA>NS, GA>OS

[a] $p<0.05$

and prolonged epileptic seizures between dentists who reported using sedation and those who did not practise sedation. Dentists using GA reported a significantly higher occurrence of angina pectoris than those who used other forms of sedation or did not use sedation, while dentists using RA reported more episodes of acute asthma than those who did not use sedation ($p < 0.05$).

Discussion

This survey aimed to investigate the preparedness of New Zealand dentists and ADPs for medical emergencies. It found that dentists were significantly more likely to encounter emergency events than ADPs and that the majority of New Zealand OHPs were adequately prepared to manage a medical emergency.

The response rate of 39.7% was higher than that reported by Muller et al., (2008) but lower than other studies (Atherton et al., 2000; Broadbent and Thomson, 2001). The participants in this survey were randomly and anonymously selected from the Dental Register, and so, differences in demographic characteristics between responders and non-responders could not be investigated. However, certain characteristics of the study respondents differed significantly from the wider New Zealand dental workforce (Table 1). Dentists aged under 50 years and those who qualified overseas were under-represented**.** This may affect the generalizability of the findings. Another limitation of this study, is the use of a self-administered survey. The reported incidence of medical emergency in this study is dependent on the participant's recollection. There is a tendency for

Table 5. Comparison of the mean number of emergency events reported by dentists (GDPs and specialists) using different modalities of sedation.

Emergency event	Not using sedation (NS) mean (sd)	Relative analgesia (RA) mean (sd)	Oral sedation (OS) mean (sd)	Intravenous sedation (IV) mean (sd)	General anesthesia (GA) mean (sd)	F (4, 224)	p-value	Pair-wise differences
Vaso-vagal syncope [a]	1.014 (2.9)	0.233 (0.7)	0.839 (1.2)	3.037 (9.7)	1.833 (2.8)	1.678	0.156	-
Hyperventilation [a]	0.772 (2.9)	0.111 (0.3)	0.290 (4.2)	1.296 (4.2)	0.167 (0.4)	0.792	0.531	-
Angina pectoris	0.008 (0.3)	0.011 (0.3)	0.016 (0.5)	0.048 (1.1)	0.111 (1.8)	10.003	0.000[b]	IV>NS, GA>NS, GA>RA, GA>OS, GA>IV
Swallowed foreign body	0.029 (1.2)	0.000 (0.0)	0.016 (0.4)	0.059 (2.0)	0.011 (0.3)	0.801	0.526	-
Epileptic seizures (grand mal)	0.009 (0.4)	0.000 (0.0)	0.006 (0.4)	0.044 (1.2)	0.078 (2.4)	3.668	0.006	-
Hypoglycemia	0.101 (2.7)	0.122 (3.3)	0.033 (0.9)	0.030 (0.7)	0.061 (1.1)	1.040	0.387	-
Myocardial infarction	0.001 (0.1)	0.000 (0.0)	0.003 (0.2)	0.004 (0.2)	0.011 (0.5)	1.182	0.320	-
Respiratory depression	0.015 (1.7)	0.022 (0.7)	0.013 (0.7)	0.193 (4.6)	0.056 (1.5)	4.181	0.003[b]	IV>NS, IV>OS
Allergic reaction to a drug (excluding anaphylaxis)	0.021 (0.7)	0.011 (0.3)	0.029 (1.0)	0.189 (5.4)	0.100 (2.6)	4.203	0.003[b]	IV>NS, IV>OS
Anaphylaxis	0.009 (0.6)	0.011 (0.3)	0.029 (1.0)	0.004 (0.2)	0.033 (0.8)	1.226	0.300	-
Overdose (eg of anesthetic)	0.001 (0.1)	0.011 (0.3)	0.003 (0.2)	0.011 (0.6)	0.011 (0.5)	1.294	0.277	-
Circulatory depression or collapse	0.003 (0.3)	0.000 (0.0)	0.003 (0.20)	0.022 (1.0)	0.022 (1.0)	1.530	0.194	-
Stroke (Cerebrovascular accident)	0.002 (0.1)	0.000 (0.0)	0.000 (0.0)	0.000 (0.0)	0.006 (0.2)	0.695	0.194	-
Inhaled foreign body	0.000 (0.0)	0.000 (0.0)	0.003 (0.2)	0.003 (0.2)	0.000 (0.0)	1.503	0.202	-
Acute asthma	0.007 (0.4)	0.056 (1.7)	0.003 (0.2)	0.000 (0.0)	0.000 (0.0)	3.145	0.015[b]	RA>NS
Hyperglycemia	0.006 (0.5)	0.056 (1.7)	0.003 (0.2)	0.007 (0.4)	0.000 (0.0)	2.201	0.070	-
Prolonged epileptic seizures	0.000 (0.0)	0.000 (0.0)	0.000 (0.0)	0.003 (1.0)	0.011 (0.5)	3.185	0.005[b]	IV>NS, IV>OS
Drug interaction	0.008 (0.4)	0.011 (0.3)	0.029 (1.0)	0.000 (0.0)	0.017 (0.7)	1.333	0.258	-

[a] Vaso-vagal syncope and hyperventilation during the previous year. All other events were taken as an average/year during the past ten years.

[b] $p<0.05$

participants to under- or over-report the incidence due to recall bias. Despite these limitations, this is the first cross-sectional survey study which attempts to evaluate the incidence and preparedness of all New Zealand OHPs (not just GDPs) for medical emergencies in dental practice.

Vaso-vagal syncope was the most common emergency reported by OHPs, followed by hyperventilation events. This is in accordance with previously published studies (Muller et al., 2008; Veiga et al., 2012; Marks et al., 2013; Alhamad et al., 2015) with the exception of Broadbent and Thomson (2001) who reported hyperventilation as the most common emergency event. Comparison of the findings of the current study in respect of GDPs to those of Broadbent and Thomson (2001) found that while the percentage of GDPs reporting vaso-vagal syncope and hyperventilation was lower than the 2001 study, the overall mean number of events per reporting participant in this study was higher.

The use of sedation in dentistry has a positive influence on patients but, while it reduces anxiety and fear, it also increases the risk of respiratory depression (Becker and Haas, 2007; Gross et al., 2002). This was reflected in this study. Dentists using IV sedation reported a significantly greater incidence of respiratory depression than those who did not use it. The incidence of respiratory depression reported by GDPs was 1.5 times lower than in the 2001 study (Broadbent and Thomson, 2001). This decrease may be due to greater awareness and preparedness among GDPs, combined with practitioners adhering to stricter regulations imposed by the DCNZ.

However, the overall incidence of hypoglycaemia reported by OHPs in our study was higher than that reported by Arsati et al. (2010) and Broadbent and Thomson (2001). A likely explanation for this is the rising prevalence of diabetes in New Zealand. The reported number of cases of diabetes in 2016 was 241,463 which is about 1.7 times the number reported in 2006 (Ministry of Health, 2017). However, proper diagnosis of hypoglycaemia is also dependent on the observation of the Whipple's triad; low plasma glucose concentration, hypoglycaemic symptoms and relief of symptoms following carbohydrate administration (Nelson, 1985). It is possible that any one of these criteria may be overlooked by the practitioner when making a diagnosis, resulting in over-diagnosis.

Excluding vaso-vagal syncope and hyperventilation, the overall rate of medical emergency events among OHPs in New Zealand was lower than reported in previous overseas studies (Table 6). Comparison with the findings of Broadbent and Thomson (2001) suggests a decrease in the incidence of emergency events reported by GDPs, dipping from 4.5 to 2.4 emergency events per practitioner over a ten-year period in this study ($p < 0.05$, Figure 1), despite the ageing New Zealand population. Significant emergency events in dentistry can usually be prevented by thorough pre-operative assessment. About half of the participants reported updating a patient's medical history at each appointment and another 45% at every treatment plan or check-up. The greater awareness of adequate medical history taking in dentistry may have contributed to this observed drop in incidence of medical emergencies. Another possibility is that the non-respondents may have observed more medical emergency events than the respondents, but there is no reason to suggest that this is so; furthermore, if it had occurred, it would be likely that the same situation would have applied to the previous study.

Dentists were 6.8 times more likely to experience an emergency event than ADPs. This is consistent with findings of the 2000 United Kingdom survey, which also reported a greater frequency of emergency events by dentists than auxillary staff (Atherton et al., 2000). Several factors could contribute to the latter difference. First, dentists are more likely to provide more complicated treatment than ADPs. Second, patients who have more complex medical problems (or who are more anxious) may be more likely to attend a dentist than ADPs for dental treatment.

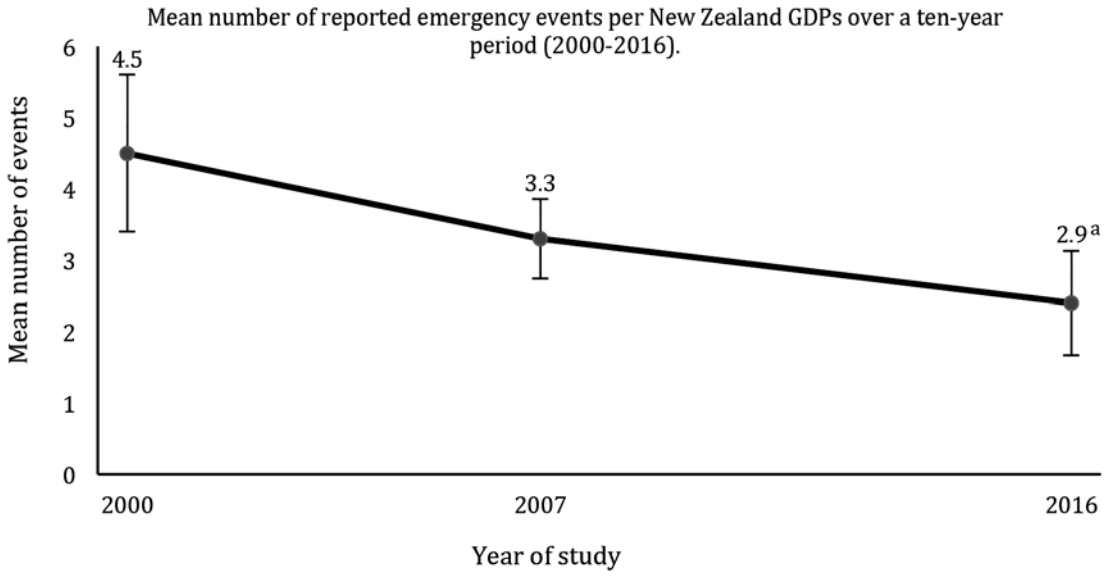
Being prepared with the proper equipment and drugs for the management of an emergency event is important,

Table 6. Comparison of the incidence of medical emergencies between countries over a ten-year period (excluding vaso-vagal syncope and hyperventilation).

Study	Country	Year	Subjects	Period	Mean incidence of emergency events over a ten-year period
Chapman et al.,	Australia	1997	GDPs	Practicing lifetime	3.3
Girdler et al.,	United Kingdom	1999	GDPs	One year	7.0
Atherton et al.,	United Kingdom	1999	GDPs	Ten years	NR[a]
Broadbent and Thomson	New Zealand	2001	GDPs	Ten years	4.5
Atherton et al.,	United Kingdom	2000	Dentists, hygienists, nurses and radiographers	One year	NR[a]
Unpublished data	New Zealand	2007	GDPs	Ten years	3.5
Muller et al.,	Germany	2008	Dentists	One year	NR[a]
Arsati et al.,	Brazil	2010	Dentists	One year	NR[a]
Marks et al.,	Belgium	2013	Dentists	NR[a]	NR[a]

[a] NR: Not reported.

Figure 1



[a] For the purpose of statistical analysis, extreme outliers were recoded to the next lowest value (20).

and most OHPs did have access to an emergency kit. With respect to GDPs, an 18.2% increase over 2001 was observed in the proportion of GDPs with an emergency kit (Broadbent and Thomson, 2001). The four basic emergency pieces of equipment meant to be contained within an emergency kit (regardless of practitioner type) are an ambu bag and airway, breathing apparatus for oxygen delivery, oxygen cylinder and regulator, and basic airway adjuncts. The majority of GDPs (85%-89%) had these items, which was a marked improvement from the 2001 study where it ranged between 24% and 81%. ADPs were lacking in the availability of an ambu bag and airways (29.8%) and basic airway adjunct (34.7%). The drugs required by the DCNZ practice standard were available to the majority of GDPs, but a relatively high proportion of specialists lacked some drugs, namely glyceryl trinitrate spray or tablets (21.9%), aspirin tablets (40.6%), and salbutamol inhaler (34.4%). The availability of oxygen was not specifically asked about in this survey, instead, the availability of an oxygen cylinder and regulator was assessed. We also did not specifically ask OHPs whether the oxygen cylinder was filled. It was assumed that, if respondents had this equipment, oxygen would available.

Dentists using sedative agents would be expected to be best prepared with appropriate medications and equipment. While they were well equipped (>86%) with the four basic pieces of equipment (listed in the previous paragraph), they were not well equipped with the additional equipment and drugs required for sedation, especially in the availability of an opioid antagonist (27.6%). It is likely that some practitioners may be using a form of sedation that negates the use of these equipment and drugs. However, regardless of the form of sedation used, the requirement set by the DCNZ should always be followed.

Proper training in the management of medical emergencies is important. Most dentists not using sedation (90.8%) and ADPs (82.6%) had the appropriate NZRC Level 4 certificate. Comparison with other overseas studies found OHPs in New Zealand to be better equipped in this area. Arsati et al., (2010) showed that only 59.6% of Brazilian dentists had undergone some form of resuscitation training, while only 47.5% of Belgian dentists (Marks et al., 2013) and 64% of Australian GDPs had undertaken basic life support trainings or CPR courses (Chapman, 1997)

For dentists using sedation, NZRC CORE Level 5 (as outlined by the DCNZ guideline, implemented in 2014) is mandatory. However, fewer than three in four dentists practising sedation had a level 5 or above NZRC certificate and five reported not having a current certificate at the time of the questionnaire administration. This may be a concern because these practitioners are likely to undertake more complex procedures, and in patients with complicated medical conditions. We observed that they were more likely to experience emergency events in their practices. Thus, additional reinforcement is necessary to ensure that all OHPs have the appropriate NZRC CORE level training, and the skills required to manage medical emergencies.

It should be noted, that in December 2016, the Dental Council of New Zealand once again updated its medical emergencies practice standard. This updated practice standard reflected a change in the NZRC CORE courses, with the introduction of CORE Immediate and NZRC CORE Advanced replacing CORE Level 4 and NZRC CORE Level 5 respectively. Hydrocortisone injection was also added into the list of required drugs for dentists practising sedation, excluding RA (Dental Council of New Zealand, 2016b). This reflects the importance of continuous re-evaluation of OHPs' adherence to practice standards.

Conclusion

Most New Zealand OHPs were trained and equipped for medical emergencies, and New Zealand OHPs appear better than OHPs from many other countries in

this respect. However, some groups of OHPs were still lacking some of the required emergency equipment and drugs. Our findings also clearly show that, while there has been a marked improvement from the 2001 study, some OHPs still lacked training (NZRC CORE), and so it is possible that these practitioners may lack competence in treating medical emergencies.

Acknowledgements

The authors would like to thank the departmental administrators, Mrs Shirley Claxton and Mrs Julie McNaughton, and Mr. Nick Rolfe from ITS for their support.

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