Title: Pattern of Opioid Analgesic Prescription for Adults by Dentists in Nova Scotia, Canada.

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Abstract word count: 298
Total word count: 4118 (Abstract to acknowledgement)
Total number of Tables: 4
Total number of Figures: 1
Number of references: 40

Keywords: analgesics, opioid, dentists, Nova Scotia, prescription drugs, pain management, drug monitoring.

Knowledge Transfer statement: This study will serve to inform dentists and policy makers on the types and dosage of opioid analgesics being prescribed by dentists. The study may prompt dentists to reflect on and adjust their practice of opioid analgesic prescription in light of the current opioid analgesic epidemic.

Abstract

Global consumption of prescription opioid analgesics has increased dramatically in the past two decades; outpacing that of illicit drugs in some countries. The increase has been partly ascribed to the widespread availability of prescription opioid analgesics and their subsequent non-medical use, which may have contributed to the epidemic of opioid abuse, addiction, and overdose-related deaths. International studies report that dentists may be among the leading prescribers of opioid analgesics, thus adding to the societal impact of this epidemic.

Between 2009 and 2011, dentists in the USA prescribed 8 to 12% of opioid analgesics dispensed. There is little information on the pattern of opioid analgesic prescription by dentists in Canada. The aim of this study was to examine the pattern of opioid analgesics prescription by dentists in Nova Scotia (NS), Canada.

This retrospective observational study used the provincial prescription monitoring program's record of oral opioid analgesics and combinations dispensed to persons 16 years and older at community pharmacies that were prescribed by dentists from January 2011 to December 2015.

During the study period, more than 70% of licensed dentists in NS wrote a prescription for dispensed opioid analgesics, comprising about 17% of all opioid analgesic prescribers. However, dentists were responsible for less than 4% of all prescriptions for dispensed opioid analgesics, prescribing less than 0.5% of the total morphine milligram equivalent (MMEq) of opioid analgesics dispensed over the five years. There was a significant downward trend in total MMEq of dispensed opioid analgesics prescribed by dentists from about 2.23 million MMEq in 2011 to 1.93 million MMEq in 2015 ($r = - 0.97$; $p=0.006$).

Opioid prescription is common among dentists, but their contribution to the overall availability of opioid analgesics is low. Further, there has been a downward trend in total dispensed MMEq of opioid analgesics prescribed by dentists.

Introduction

Opioid analgesics have been described by the World Health Organization as essential medicines in the treatment of pain (Kraus et al. 2016). Weak opioids such as codeine, propoxyphene, meperidine, and tramadol, are generally recommended for the management of mild to moderate pain; and strong opioids such as hydromorphone, methadone, fentanyl, oxycodone and morphine, are recommended for the management of moderate to severe pain (NOUGG 2010).

In the past two decades, global consumption of opioid analgesics has increased by 618% (INCB 2015). This dramatic increase has contributed to an epidemic of opioid misuse, abuse, addiction, and overdose-related deaths (Gudin 2012). In 2011, Canada had the highest per capita opioid analgesic consumption, followed by the United States and Australia (INCB 2015). From 1999 to 2011, the opioid related overdose death rate in the USA nearly quadrupled (Kolodny et al. 2015). In Canada, the rate of dispensing high-dose opioid analgesics increased by 23%, from 781 units per 1000 population in 2006 to 961 units per 1000 population in 2011 (Gomes et al. 2014).

In some countries, consumption of prescription opioids has outpaced that of illicit drugs (INCB 2015). This is partly ascribed to the widespread availability of prescription opioid analgesics and the perception that they are less susceptible to abuse than illicit drugs (INCB 2015). The non-prescription or non-medical use of prescription drugs for self-medication has further exacerbated the problem (INCB 2015). Surveys carried out in Canada and in the United States revealed that 5–6% of the general adult population reported non-medical prescription opioid use (Fischer et al. 2015).

The question thus arises as to the source(s) of these opioids; a recent review of the literature found inappropriate prescription, double-doctoring and prescription fraud/forgery as the most likely sources of non-medical opioids in Canada (Fischer and Argento 2012). In a 2007 survey of Ontario students, most (72%) of those who used opioid analgesics non-medically reported obtaining them from home (Brands et al. 2010). In a sample of high school students in Detroit, 34% reported getting these drugs from family members, and 17% from friends (Boyd et al. 2006)

Dentists are among the leading prescribers of opioid analgesics (Volkow et al. 2011). In 2009, dentists were responsible for 8.0% (6.4 million) of all opioid prescriptions dispensed in the US, and were the main prescribers (30.8%, 0.7 million) for patients aged 10 to 19 years (Volkow et al. 2011). In 2011, U.S. dentists were found to have prescribed 12% of Immediate Release (IR; intended for use every four to six hours (USFDA 2016)) opioids, second only to family physicians (Denisco et al. 2011).

The most common dental prescription for opioids is for pain management following surgical tooth extraction (Mutlu et al. 2013). In a survey of oral and maxillofacial surgeons, all but two of the 384 respondents stated they prescribed opioid analgesics as the primary means of post-operative pain control in patients requiring removal of impacted teeth (Fischer and Argento 2012). This is despite evidence that nonsteroidal anti-inflammatory drugs (NSAIDS) and acetaminophen provide effective analgesia and should be the first line medications for dental and post-dental procedure pain (Dionne and Moore 2016; Moore and Hersh 2013; Ong and Seymour 2008).

An understanding of the opioid prescribing patterns of dentists is an important first step in reducing the potential impact these prescribing patterns may have on opioid related morbidity and mortality. Data on the prevalence of dentist prescribed opioids in the US is available (THCI 2010), but this may differ in Canada.

Limited information is available on opioid analgesic prescription for adult patients by dentists in Canada. This study examined the opioid prescribing patterns of dentists from records of oral opioid analgesics prescribed by dentists and dispensed to persons 16 years and older at community pharmacies in the province of Nova Scotia, Canada.

Method

This retrospective observational study was conducted using data from the Provincial Prescription Monitoring Program database. The Nova Scotia Prescription Monitoring Program (NSPMP) captures and holds records of all opioid and opioid combinations dispensed to individuals at community pharmacies in Nova Scotia regardless of payer. Its legislated mandate is "to promote the appropriate use of monitored drugs in Nova Scotia and to reduce the abuse or misuse of monitored drugs in the province" (NSPMP 2016).

Ethics approval for the study was granted by the Dalhousie Health Sciences Research Ethics Board (REB approval 2016-3994) in compliance with the principles of the Tri-Council policies on Ethical Conduct for Research Involving Humans.

The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement (Benchimol et al. 2016) was used in preparing the report of this study.

Aggregate data on oral opioid analgesics prescribed by dentists and dispensed to persons 16 years and older at community pharmacies between January 1, 2011 and December 31, 2015 were provided by the NSPMP to the researchers. Data provided include: total and mean number of prescriptions, mean morphine milligram equivalent dispensed by drug type, number of all prescribers of dispensed opioid analgesics, number of dentists (categorized as general dentists, oral and maxillofacial surgeons, and other dental specialists) who prescribed dispensed opioid analgesics. Data on dentists' specialty, year of graduation from dental school and location (rural or urban) were also provided.

Data on all opioid analgesics and combinations monitored by the NSPMP were requested. Opioid analgesics included in this study were oral formulations (solid and liquid forms) of codeine, hydromorphone, oxycodone, meperidine and morphine, which were frequently prescribed by dentists in Nova Scotia. These were identified using the WHO Anatomic Therapeutic Chemical (ATC) codes (WHO 2016) (Appendix 1) . Once identified by ATC codes, the NSPMP database was queried and the total number of Canadian products at Drug Identification Numbers (DIN) level were used. To facilitate comparison of the dose of opioids dispensed, the total dose of each opioid analgesic was converted to morphine milligram equivalents (MMEq) using known conversion factors (Gutsein and Akil 2006),(NOUGG 2010). MMEq dispensed were analyzed by opioid and prescriber type.

The variables of interest for the study were prescribers' specialty, year of graduation from dental school and location (Rural or Urban). Location was based on the first 2 letters of the postcode, with all B0 codes designated as rural areas and B1-9 areas designated as urban areas based on Canada Post's forward sortation area (ISED 2015).

The provincial dental board of Nova Scotia (PDBNS) provided information on the number of dentists licensed in the province over the study period.

Data Analysis

All individual level data from the NSPMP secure database were processed by internal analysts at the NSPMP. The analysts removed all identifying information from the data set, to ensure anonymization of the data. Tables of aggregate data were then provided to the researchers. These aggregate data were used to:

- Determine the proportion of dentists who prescribed dispensed opioids amongst all dentists licensed in Nova Scotia for each year from 2011 to 2015.
- Determine the proportion of dispensed opioids for which dentists were responsible for each year from 2011 to 2015.
- Determine the types and dosage of dispensed opioid analgesics prescribed by dentists from 2011 to 2015.
- Assess trends in dosage (mean morphine milligram equivalents (MMEq)) per prescription of dispensed opioids over the study period (2011- 2015).
- Compare the mean morphine milligram equivalents (MMEq) per prescription of dispensed opioids prescribed by dentists' specialty groups (i.e. general dentists, oral and maxillofacial surgeons, other dental specialists).
- Compare the mean number of days supplied per prescription for dispensed opioid analgesics by dentists' specialty groups.
- Examine the relationship between year of dentists' graduation from dental school and prescription of dispensed opioid analgesics.
- Compare mean opioid prescriptions per year for rural vs urban dentists.

Data were analyzed and reported using descriptive statistics, including frequencies and percentages as well as inferential statistics. Pearson's correlation test was used to assess trends in total dosage, dosage per prescription, mean days supplied and number of prescriptions per year per dentist over the five-year study period. Repeated measures ANOVA with Bonferroni corrected post-hoc testing was used to compare specialty groups on dosage per prescription and days supply. Repeated measures ANOVA was also used to compare graduation year cohorts on their number of prescriptions per year per dentist. A paired samples t-test was used to compare mean number of prescriptions per year between urban and rural dentists. For repeated measures analyses, year dispensed was used as the unit of analysis.

A p-value of 0.05 was used to denote statistical significance throughout the study. Data were analyzed using IBM Statistical Package for Social Sciences (SPSS) for Macintosh, version 23 and Microsoft excel version 15.18.

Results

Proportion of dentists who prescribed dispensed opioids

From 2011 to 2015, three-quarters (75.6%) of licensed dentists prescribed opioid analgesics that were dispensed to persons 16 years and older at community pharmacies. This ranged from 74.3% in 2013 to 77.5% in 2011 (Table 1).

Proportion of opioid prescribing for which dentists were responsible

Dentists made up 17.3% (range: 16.1% (2015) to 18.1% (2011) of all prescribers of opioid analgesics dispensed between 2011 to 2015 to persons 16 years and older at community pharmacies (Table 2). Dentists wrote an average of 33 prescriptions for opioid analgesics per dentist per year (range: 30 (2015) to 37 (2012)) which amounted to 3.5% (range: 3.0% (2015) to 3.9% (2011)) of all prescriptions for dispensed opioid analgesics. On average, dentists prescribed 0.4% of the total morphine milligram equivalent (MMEq) of opioid analgesics dispensed over the five years.

Trends in dentists' opioid prescribing 2011-2015

There was a significant downward trend in the total amount (MMEq) of dispensed opioid analgesics prescribed by all dentists over the study period ($r = -0.97$; $p=0.006$), ranging from about 2.23 million MMEq in 2012 to 1.93 million MMEq in 2015 (Figure 1). The MMEq dispensed per dentist also decreased over the study period from 5512 MMEq per dentist in 2012 to 4721 MMEq in 2015 ($r = -0.92$; $p=0.03$). Similarly, the number of prescriptions per dentist also declined from 36.6 in 2012 to 29.6 in 2015 ($r=-0.91$; $p=0.03$).

The bulk of the total MMEq of dispensed opioids prescribed by dentists (mean 92.5%; range: 90.5% (2015) to 95.5% (2012)) were for immediate release opioid analgesic formulations; only 7.5% (range: 4.5% (2012) to 9.5% (2015)) were for controlled release formulations.

Codeine formulations accounted for the largest proportion of the total MMEq (66%), followed by hydromorphone (20%) and then oxycodone (12%). Morphine formulations were the least prescribed, ranging from 0.6% of total MMEq in 2012 to 0.1% in 2015 (Figure 1).

Codeine ($r= -0.91$, $p=0.03$), oxycodone ($r= -0.98$, $p=0.004$) and meperidine ($r= -0.98$, $p=0.005$) all showed significant downward trends in total dosage prescribed over the 5 years. Morphine showed a non-significant downward trend ($r= -0.86$, $p=0.06$). Conversely, hydromorphone showed a significant upward trend in MMEq prescribed ($r=0.96$, $p=0.008$) increasing from 16.5% of total MMEq in 2011 to 27.3% in 2015.

In terms of numbers of prescriptions, codeine formulations were the most frequently prescribed, representing 82% of dispensed opioid analgesics prescriptions, followed by oxycodone alone and in combination (10% of dispensed prescriptions) and hydromorphone formulations (6% of all opioid prescriptions).

On a per prescription basis, dentists in Nova Scotia as a group prescribed an average of 40.69 ± 1.26 MMEq/day/prescription (mean ± SD) with an average 4.15 ± 0.21 days (mean ± SD) supply per prescription. There was a significant upward trend in dosage per day per prescription over the study period ($r=0.99$, $p<0.001$) (Table 3) and a significant downward trend in mean days' supply ($r=-0.99$, $p<0.001$).

Opioid prescribing and dentists' specialty type

Of the dentist groups (i.e. general dentists, oral and maxillofacial surgeons and other dental specialists), general dentists (GD) were by far the largest group, comprising 91% of dental prescribers, and were responsible for prescribing more than 50% (range: 52.4% (2012) to 60.8% (2015)) of the total MMEq of all opioid analgesics dispensed for dentists. This compares to 38.7% (2014) to 45.7% (2012) for oral and maxillofacial surgeons (OMFS) and 0.5% (2015) to 2.3% (2011) for other dental specialists (ODS). However, on a per prescriber basis, general dentists wrote an average of only 19 opioid prescriptions per dentist per year, compared to 331 prescriptions per dentist per year for OMFS. ODS were similar to GD at 14 prescriptions per year.

On a per prescription basis, OMFS prescribed higher doses (43.70 ± 0.48 MMEq /day/prescription (mean ± SD)) than GD (38.44 ± 1.86 MMEq /day/prescription), and GD in turn prescribed higher doses than ODS (27.73 ± 1.67 MMEq/day/ prescription) ($p<0.01$). In terms of days' supply, OMFS supplied fewer days per prescription (3.61 ± 0.16 (mean ± SD)) than GD (4.60 ± 0.26) and ODS (4.94 ± 0.32) ($p<0.01$). There was no difference between GD and ODS in days supplied ($p=0.164$).

Opioid prescribing and dentists' year of graduation from dental school

Table 4 summarizes the relationship between dentists' year of graduation from dental school and the mean number of opioid prescriptions per dentist per year (MPPY). There was a statistically significant difference between the groups ($p<0.001$), with dentists who graduated between 1991 and 1995 having the highest overall MPPY and those who graduated between 2001 and 2005 having the lowest overall MPPY, compared to most other cohorts (Table 4).

Opioid prescribing and dentists' location

The number of opioid prescriptions per year per dentist (MPPY) was higher for general dentists practicing in urban areas compared to those in rural areas (19.97 ± 1.71 vs. 13.45 ± 1.30 (mean ± SD); $p=0.001$). Almost all of the dental specialists (OMFS and ODS) were located in urban areas therefore no comparisons based on location could be made for these groups.

Discussion

This study was undertaken to establish the pattern of opioid analgesic prescribing by dentists in Nova Scotia, Canada. The study was conducted on five opioid analgesics; codeine, hydromorphone, oxycodone, meperidine and morphine, which are the most commonly prescribed opioid analgesics by dentists in Nova Scotia.

In this study, more than 70% of licensed dentists wrote a prescription for opioid analgesics that were dispensed to persons 16 years and older at community pharmacies during each year of the study period. However, dentists made up only 17% of all opioid analgesic prescribers over the study period and were responsible for less than 4% of all prescriptions written and less than 0.5% of the total MMEq of all opioid analgesics dispensed over the 5 years. This is similar to data from Ontario, Canada (MOHLTC 2016), showing that dentists constituted 16.7% of opioid prescribers in the fiscal year 2014/2015. It is also comparable with findings from Australia, where the proportion of paracetamol (acetaminophen) plus codeine prescribed by dental practitioners compared to all other medical prescribers was 2.3% (Hollingworth et al. 2017). However, this study contrasts with studies from the United States that found that dentists were responsible for 8-12% of all opioid prescriptions dispensed (Denisco et al. 2011; Volkow et al. 2011). McCauley et al (2016) found that the average number of dispensed opioid prescriptions per dentist in South Carolina was more than 150 per year in 2012 and 2013 (McCauley et al. 2016). This was much higher than the average number of dispensed opioid prescriptions per dentist in Nova Scotia found in this study over the same time period (33 per year).

Dentists in Nova Scotia prescribed mainly (90.5% to 95.5%) immediate release opioid formulations over the study period. This is similar to findings by studies from the United States where 90% to 99.9% of opioid analgesics prescribed by dentists were immediate release formulations (THCI 2010),(McCauley et al. 2016). The most commonly dispensed opioid analgesic prescribed over the five years was codeine and codeine combinations (66%), followed by hydromorphone (20%) and oxycodone (12%) formulations. Codeine and codeine compounds were also the most commonly dispensed opioids prescribed by Ontario dentists in 2014/15, followed by oxycodone (MOHLTC 2016). This prescribing pattern is in contrast to data from the U.S., where the most commonly dispensed opioid between 2012 and 2013 was hydrocodone (76%) and oxycodone (12%) (McCauley et al. 2016) and from 2000 to 2010, it was hydrocodone (78% of all prescriptions), followed by oxycodone (15.4%), propoxyphene (3.5%), and codeine (1.6%) (Baker et al. 2016). It is important to note that hydrocodone is only available as antitussive preparations in Canada (Health Canada 2016) while propoxyphene and its combinations were withdrawn in Canada (Health Canada 2010) and the USA (USFDA 2010) in 2010.

Codeine and codeine products were most commonly chosen although codeine products may result in lack of efficacy or toxicity in some patients especially those with genetic variability in metabolism (Dionne and Gordon 2015). Meperidine was prescribed by a few dentists during this study period despite being delisted from the Nova Scotia provincial drug program in 1998 because of its unfavorable risk benefit profile compared to other opioids (Fisher et al. 2012).

Of the Nova Scotia dentists who prescribed opioids, the average daily prescription was 40.69 ± 1.26 MMEq. This is below the recommended limit of 50-90 MMEq/ day for patients beginning opioid therapy (Busse et al. 2017) based on evidence of uncommon serious side effects of overdose or death at these doses. However, it should be noted that 50-90 MMEq/ day is a recommendation for the management of patients with chronic non-cancer pain (Busse et al. 2017), rather than acute dental or post-operative pain. The mean dosage/day/prescription dispensed for Nova Scotia dentists' contrasts to the median value of 120 MMEq that was dispensed for dentists in the USA from 2000-2010 (Baker et al. 2016). The mean number of days' supplied per prescription for our study population was 4.15 ± 0.21 (mean ± SD). This duration exceeds the suggested 2-3 days supply of opioid analgesics for management of acute dental or post-operative pain (Dionne et al. 2016; Thorson et al. 2014)

This study found general dentists in urban areas wrote more prescriptions per year for opioid analgesics than did general dentists in rural areas. This finding is in contrast to that of Keyes et al., who found that prescriptions for opioids were increasing in rural areas (Keyes et al. 2014); however, their study was not limited to dentists.

When dentists' years of graduation and mean opioid prescription were considered, the cohort with the highest mean prescription per dentist were those who graduated between 1991 and 1995. Further research is needed to explore the factors that may account for this difference. For example, are there more oral and maxillofacial surgeons in this cohort than others or was there a change in the dental curriculum around this time?

It is uncertain how access to dental care affects opioid prescribing by dentists. A study using health survey data from British Columbians aged 19 years and older, found that dental care utilization frequency and dental insurance did not predict use of opioid analgesics, irrespective of the presence of tooth ache (Moeller et al. 2017). Other services may also influence the rate of dental opioid prescribing, for example, a study from Pennsylvania reported that opioid prescribing rates by dentists were 81% lower when pharmacy services were integrated into a free dental clinic for medically underserved patients (Stewart et al. 2017). However, this study did not collect that type of information.

Strengths and Limitations

One of the strengths of this study is the use of the NSPMP database for data extraction. The NSPMP is a population based prescription monitoring program that collects comprehensive and reliable information on all monitored medications dispensed at community pharmacies throughout Nova Scotia, regardless of payer.

Another strength of this study is the use of dental specialty data. Dentists were categorized into three specialty cohorts (general dentists, oral and maxillofacial surgeons, other specialties) to assess and identify real differences in opioid prescription patterns between specialties. Analyzing opioid prescribing data for dentists as a whole would obscure these important differences in prescribing patterns.

This study has some limitations. For confidentiality reasons, the researchers were provided with aggregate data. The use of aggregate data (as opposed to individual level data) precluded multivariate analysis of patient factors that may influence opioid prescribing patterns.

Another limitation of this study is that dispensed opioids were used as proxy for prescriptions. This may have underestimated the prevalence of opioid prescription, as Tamblyn et al (2014) reported that about a third of incident prescriptions are not filled by patients (Tamblyn et al. 2014). It is unknown if this applies to opioid analgesics. A database that includes records of both prescribed and dispensed medications would provide an interesting perspective.

This study examined dentists' prescribing of opioid analgesics to adults; no information was collected on opioids dispensed to persons less than 16 years of age. Therefore, it is possible that this study underestimates the overall proportion of dentists who prescribe opioids and the total MMEq dispensed. Patterns of opioid prescribing to children may differ from that to adults and as such this is an area for future research.

The NSPMP allows prescribers to login and securely access a patients' history of dispensed monitored medications. This study did not address whether dentists accessed the NSPMP system before prescribing opioids. Prescription monitoring programs are common in the US, however a study based in South Carolina found that few dentists accessed the state prescription monitoring program prior to opioid prescription (McCauley et al. 2016). Another US study in a dental urgent care center in New York state showed that when consultation of a prescription monitoring program was required before prescribing opioids, opioid prescribing dropped by 78% (Rasubala et al. 2015).

Further research is required to ascertain dentists' decision-making processes when choosing to prescribe opioid analgesics, their awareness of opioid prescription guidelines, and whether they perform addiction risk assessments. Some studies suggest that for many types of dental surgery, nonsteroidal anti-inflammatory drugs (NSAIDs) are preferred (Dionne and Moore 2016; Dionne et al. 2016; Ong and Seymour 2008). However, opioids may be indicated if other therapies such as NSAIDs or acetaminophen have previously been ineffective for patients or there are contraindications to their use.

Conclusion

Opioid prescribing is common among dentists in Nova Scotia, with more than 70% of licensed dentists writing at least one prescription for opioid analgesics that were dispensed to persons 16 years and older at community pharmacies from 2011 to 2015. Dentists comprised 17% of all prescribers of dispensed opioid analgesics.

There was a downward trend in the total morphine milligram equivalent of opioid analgesics dispensed that were prescribed by dentists over the study period, which may reflect an increasing awareness of the risks of opioid addiction and alternative ways of managing pain.

This work provides insights for the development of continuing professional development programs. Further work is needed to determine dentists' reasons for prescribing opioids instead of alternatives, their selection of opioid type, dose and duration.

Acknowledgement

We will like to acknowledge the Nova Scotia Prescription Monitoring Programme (NSPMP) for collection, collation and provision of aggregate data used for this study. We also acknowledge the Provincial Dental Board of Nova Scotia (PDBNS) for consenting to the study and provision of information on number of licensed dentists in Nova Scotia over the study period.

The authors declare no conflicts of interest regarding the study and publication.

Author contributions

K. Jimoh: contributed to the conception and design of the study, data acquisition, collation, analysis and interpretation, as well as preparation of the manuscript.
D. Matthews: contributed to study conception and design, data acquisition, interpretation and critically revised the manuscript.
I. Sketris: contributed to study design, data acquisition, interpretation and critically revised the manuscript.
M. Brillant: contributed to study design, data acquisition, analysis, interpretation and critically revised the manuscript.
All authors approved the final manuscript.

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FIGURE AND TABLES LEGEND

FIGURE:

Figure 1: Total Morphine Milligram Equivalent (MMEq) of opioid analgesics dispensed to persons 16 years and older at community pharmacies in Nova Scotia that were prescribed by dentists from 2011 to 2015.

TABLES:

Table 1: Total number of licensed dentists (i.e. general dentists and dental specialists) in Nova Scotia and the percentage who prescribed opioid analgesics dispensed to persons 16 years and older at community pharmacies from 2011 to 2015.

Table 2: Percentage of dental prescribers in relation to total prescribers of opioid analgesics dispensed to persons 16 years and older at community pharmacies in Nova Scotia from 2011 to 2015.

Table 3: Mean dosage of opioid analgesics (MMEq per day per prescription) dispensed to persons 16 years and older at community pharmacies in Nova Scotia from 2011 to 2015 by dental specialty groups.

Table 4: Dentists' year of graduation from dental school and number of opioid analgesic prescriptions by dentists that were dispensed to persons aged 16 and older at community pharmacies in Nova Scotia.

Figure : Total Morphine Milligram Equivalent (MMEq) of opioid analgesics dispensed to persons 16 years and older at community pharmacies in Nova Scotia that were prescribed by dentists from 2011 to 2015.

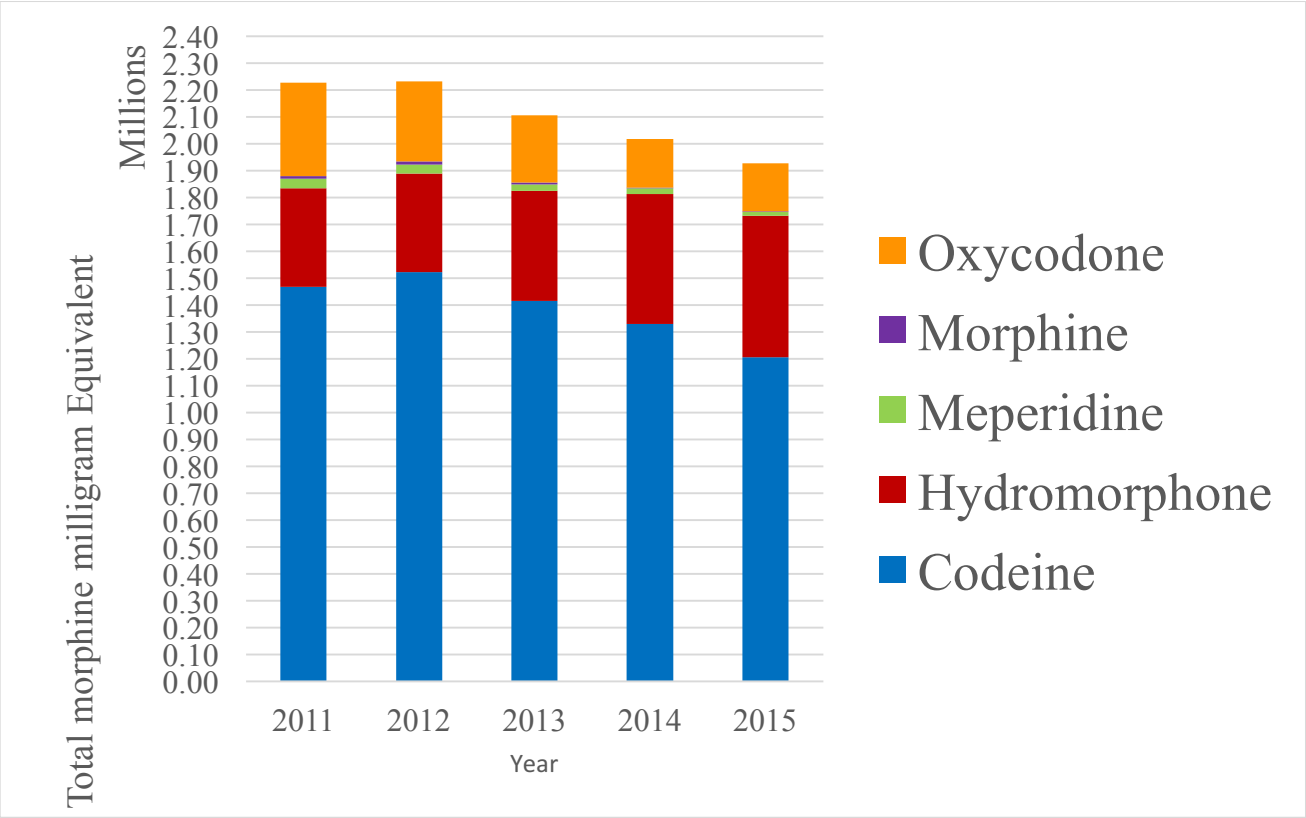

TABLE 1

Year	Number of licensed dentists	Percentage of dentists who prescribed dispensed opioid analgesics. % (number)
2011	537	77.5% (416)
2012	544	74.4% (405)
2013	561	74.3% (417)
2014	545	76.0% (414)
2015	539	75.7% (408)
Mean	545	75.6% (412)

Table 1: Total number of licensed dentists (i.e. general dentists and dental specialists) in Nova Scotia and the percentage who prescribed opioid analgesics dispensed to persons 16 years and older at community pharmacies from 2011 to 2015.

TABLE 2

Year	Total number of prescribers* of dispensed opioid analgesics.	Percentage of prescribers of dispensed opioid analgesics who were dentists % (number)
2011	2295	18.1% (416)
2012	2299	17.6% (405)
2013	2370	17.6% (417)
2014	2423	17.1% (414)
2015	2528	16.1% (408)
Mean	2383	17.3% (412)

*All professionals licensed to prescribe opioid analgesics (physicians, dentists and nurse practitioners).

Table 2: Percentage of dental prescribers in relation to total prescribers of opioid analgesics dispensed to persons 16 years and older at community pharmacies in Nova Scotia from 2011 to 2015.

TABLE 3

Year	Dosage Dispensed for all Dentists (mean MMEq/day/prescription*)	Dosage dispensed for OMFS (mean MMEq/day/prescription	Dosage dispensed for GD (mean MMEq/day/prescription	Dosage dispensed for ODS (mean MMEq/day/prescription
2011	39.07	43.12	36.55	25.92
2012	40.00	43.66	37.05	27.05
2013	40.59	43.47	38.12	27.03
2014	41.46	44.42	39.29	30.16
2015	42.33	43.85	41.18	28.51
Mean	40.69±1.26	43.70±0.48	38.44±1.86	27.73±1.64

*Mean MMEq /day/prescription = total quantity dispensed X morphine equivalent conversion factor/ days supplied/ number of prescriptions.

Table 3: Mean dosage of opioid analgesics (MMEq per day per prescription) dispensed to persons 16 years and older at community pharmacies in Nova Scotia from 2011 to 2015 by dental specialty groups.

TABLE 4

Years of graduation from dental school	Number of opioid prescriptions per year (PPY)									
	2011		2012		2013		2014		2015	
	Total PPY (N)	Mean PPY per dentist	Total PPY (N)	Mean PPY per dentist	Total PPY (N)	Mean PPY per dentist	Total PPY (N)	Mean PPY per dentist	Total PPY (N)	Mean PPY per dentist
≤1990	5372 (186)	28.9	5215 (168)	31.0	4558 (170)	26.8	4238 (161)	26.3	3798 (152)	25.0
1991-1995	3345 (49)	68.3	3433 (48)	71.5	3251 (43)	75.6	2596 (42)	61.8	2255 (41)	55.0
1996-2000	2187 (58)	37.7	2018 (56)	36.0	2187 (59)	37.1	2356 (61)	38.6	2141 (58)	36.9
2001-2005	1130 (57)	19.8	996 (55)	18.1	1022 (51)	20.0	882 (47)	18.8	719 (45)	16.0
2006-2010	2141 (58)	36.9	1981 (56)	35.4	1522 (56)	27.2	1605 (50)	32.1	1576 (49)	32.2
2011-2015	445 (8)	55.6	1179 (22)	53.6	1136 (38)	29.9	1383 (53)	26.1	1607 (63)	25.5

(N): number of prescribers

Table 4: Dentists' year of graduation from dental school and number of opioid analgesic prescriptions by dentists that were dispensed to persons aged 16 and older at community pharmacies in Nova Scotia.

Appendix 1

WHO Anatomic Therapeutic Chemical (ATC) Codes for opioid analgesics and combinations in this study.

ATC Codes	Opioid content	Combination
R05DA04	Codeine	Codeine
N02BA51	Codeine	ASA/caffeine/codeine
N02AA79	Codeine	ASA/caffeine/codeine/butalbital
N02BE51	Codeine	acetaminophen/codeine/caffeine
N02AA59	Codeine	acetaminophen/codeine
M03BA53	Codeine	codeine/methocarbamol/acetaminophen/ASA
N02AA03	Hydromorphone	Hydromorphone
N02AB02	Meperidine (Pethidine)	Meperidine (Pethidine)
N02AA01	Morphine	Morphine
N02AA05	Oxycodone	Oxycodone
N02BA51	Oxycodone	ASA/oxycodone
N02BE51	Oxycodone	Oxycodone/acetaminophen
N02AA55	Oxycodone	Oxycodone/naloxone

ASA: Acetylsalicylic acid.