What influences the clinical decision-making of dentists? A cross-sectional study

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Abstract

Clinical decision-making is a complex process influenced by clinical and non-clinical factors. The aim of this study was to investigate the association between provider, patient, and practice factors with clinical decision-making among dentists in Ontario, Canada’s most populated province and its largest dental care market. This was a cross-sectional, self-administered survey of a random sample of general dentists in Ontario (n = 3,201). The 46-item survey collected demographic, professional, and practice information. The outcome (treatment intensity) was measured using a set of clinical scenarios, which categorized dentists as either relatively aggressive or conservative in their treatment decisions. Associations were assessed using bivariate analysis and logistic regressions. One thousand and seventy-five dentists responded (33.6% response rate). Age (p = 0.001), place of initial training (p < 0.001), number of dependents (p = 0.001), number of hygienists employed (p = 0.001), and perceptions of practice loans (p = 0.020) were associated with treatment intensity. Dentists who were <40-years old (OR = 2.06, 95% CI: 1.39–3.06, p < 0.001), American-trained (OR = 2.48, 95% CI: 1.51–4.06, p < 0.001), and perceived their practice loans as large (OR = 1.57, 95% CI: 1.02–2.42, p = 0.039), were relatively more aggressive in their treatment decisions. Various non-clinical factors appear to influence the clinical decision-making of dentists in Ontario.

Introduction

Clinical decision-making is foundational to the practice of dentistry. Some argue that a substantial portion of dental care lies in the “gray zones” where the defining criteria for a “right” or “wrong” treatment are unclear. [1] Regardless, due to the imbalance of knowledge between dentist and patient, the latter must rely on the former to provide information on the most appropriate procedure and clinical direction. [2, 3] As a result, a dentist is ethically obligated to provide the recommendation that best guards a patient’s well-being.
Many definitions of clinical decision-making exist, but in its simplest terms, it is the process of choosing between different alternatives or options. [4] Such decisions are rarely simple and involve a complex process that requires gathering and evaluating clinical and other information to formulate decisions. Hence, many factors influence clinical decisions. [5, 6] Research has explored some of these factors in medicine, nursing, and dentistry, and putative factors can be classified into “clinical” (or sometimes referred to as “technical”) and “non-clinical” factors. Clinical factors are described as the factors attributed to the patient’s health, such as their current disease status, symptoms of disease, and history and future risk of disease. Non-clinical factors are described as factors that influence the clinician’s behavior yet are not exclusively related to the patient’s clinical status, such as the patient’s race, socioeconomic status, health insurance status, as well as other personal characteristics pertaining to the clinician and patient. [7]

Among dentists, previous studies demonstrate associations between non-clinical factors such as provider age, years of experience and place of initial training with clinical decisions. [8] Grembowski et al. [9], for example, found that younger dentists tend to adopt more aggressive clinical approaches and perform more unnecessary treatments compared to their older peers. Gordon et al. [10] revealed that dentists from the United States are more prompt to intervene on carious enamel lesions, whereas dentists from Scandinavian countries (Denmark, Norway, and Sweden) would rather intervene when the carious lesion is into dentin. Zadik and Levin [11] found that unnecessary prescription of postoperative antibiotics and endodontic treatments are more prevalent among Latin American and Eastern European graduates, respectively. Grembowski et al. [12] and Gordan et al. [10] have shown that dentists in practices that are “not busy enough” tend to intervene significantly more often in the treatment of enamel surface lesions and tend to offer a higher numbers of services per patient after controlling for all other factors. The same association has been found between the type of practice (solo or small vs. large practices) and dentists’ decisions regarding restorative treatment. [13]

To a lesser extent, factors such as the reimbursement system in place or a patient’s insurance status have also been associated with dentists’ treatment decisions. [12, 14, 15]

Ultimately, while this evidence clarifies some of this dynamic, it is still limited in scope, as it has tended to only explore a small number of variables that might contribute to the decision-making of dentists, in addition to being limited by small sample sizes. Also, despite this evidence, the dynamics of what influences clinical decision-making is yet to be studied within a Canadian context. To this end, this study explores the association between provider, patient, and practice factors with clinical decision-making among a large and representative sample of general dentists in Ontario, Canada’s most populated and diverse province, and its largest dental care market.

**Materials and methods**

This was a cross-sectional study conducted through a self-administered survey sent to a random sample of general dentists practicing in Ontario. The sampling frame (N = 7,067) was the 2016 register of the Royal College of Dental Surgeons of Ontario (RCDSO), the regulatory body for dentists in Ontario. The inclusion criterion was general practitioners in private practice with an RCDSO license, and the exclusion criteria were: 1) specialists; 2) those whose practice was not subject to the dental care market, such as public health dentists and university dental faculty members; and 3) those who participated in the pilot testing of the survey.

According to the sample size calculation proposed by Dillman, the required sample size was 1,067. [16] However, due to the traditional low response rate from dental professionals, this
number was tripled, and 3,201 surveys were sent out. [17] The sample was selected using a random start systematic sampling technique.

After reviewing the health and dental care literature for factors associated with clinical decision-making, a conceptual framework for this study was developed (Fig 1). The framework was partly based on similar models established by Bader and Shugars [18] and Brennan and Spencer [19]. The framework putatively links dentists’ clinical decisions with factors grouped into environmental, practice, provider, and patient domains. Also, speculative factors where no empirical evidence was found were included into the conceptual framework based on anecdotal reports of their potential influence (e.g. amount required to bill/hour to be profitable, perception of other dentists, and the clinician’s number of dependents).

Using the framework, the 46-item survey was developed, which contained closed-ended questions to collect information on: a) provider characteristics (e.g. age, gender, place of initial training, number of dependents, perception of professional role and student loans); b) practice characteristics (e.g. age of practice, number of hygienists employed, percentage breakdown of routine work, satisfaction with practice busyness, and perception of practice loans); and c) patient characteristics (e.g. insurance status). Survey questions were either sourced from previous literature or developed completely de novo (e.g. treatment intensity score). The survey instrument and the case scenarios described below are presented in S1 Appendix.

To quantify the outcome clinical decision-making, a “treatment intensity score” was assigned using ten vignettes, which were developed based on common clinical situations. For each vignette, four treatment options were provided. The options spanned from a very conservative treatment approach, scored as ‘1’, to a very aggressive treatment approach, scored as ‘4’. Adding up the scores for the ten vignettes yielded a continuous score. This allows for a range of values with the minimum and maximum scores of 10 and 40, respectively. The higher the
treatment intensity score, the relatively more aggressive the dentist’s treatment decisions were deemed to be. The case scenarios and categorizing answers were developed from the literature and with the help of expert advice from three content experts (two generalists and one specialist) at the University of Toronto’s dental faculty. Table 1 maps the survey questions to the domains outlined in the conceptual framework.

Importantly, the results from three case scenarios showed very little variability in the responses. Subsequently, statistical analysis was completed excluding these three scenarios. When these three case scenarios were removed, the minimum (and most conservative) score became ‘7’ and the maximum (and most aggressive) score became ‘28.’ Also, score proportioning was performed for participants who did not complete the full set of questions. Proportioning was performed using the following formula, \( \frac{\text{Score based on the completed questions}}{\text{Number of questions answered}} \times 7 \times 100 \). For instance, if a participant completed five questions with a score of 16, then their adjusted score is \( \frac{16}{5} \times 7 \times 100 = 22.4 \approx 22 \). Only the scores of respondents who answered five clinical scenarios or more were included in the data analysis. This resulted in the exclusion of the treatment scores of twenty-one respondents (2.0% of the sample size).

The survey was piloted with twenty general dentists for face validity and ease of completion, and any proposed modifications were discussed with the main research team (AG, BY, CQ) and undertaken as needed. Approval for the study (protocol number 00033950) was obtained from the Health Sciences Research Ethics Board at the University of Toronto in February 2017. Participation in the study was completely voluntary and all participants were informed about the purpose of the study and consented by filling in and returning the questionnaire.

In terms of data analysis, we underwent two types of statistical tests. First, we conducted our analysis based on a dichotomized outcome. The treatment intensity score was dichotomized with the median score used as the cut-off point. Respondents who scored less than the median were categorized as relatively conservative, while those who scored at or above the median were categorized as relatively aggressive. We performed bivariate tests (chi-square) on all the independent variables to explore if differences were associated with the outcome (relative aggressiveness vs. relative conservative). Independent variables with multiple levels were tested to the dependent variable at once. The level of significance for the bivariate analysis was set at \( p < 0.1 \). Then, the significant variables from the bivariate analysis were carried forward to perform binary logistic regression. Finally, the significant variables from the binary logistic regression were then entered into a multivariable logistic regression using the block method adjusting for all variables simultaneously. This was done to facilitate data analysis and presentation and to identify the factors that differentiate dentists who are conservative and aggressive in treatment decisions in relative terms. In other words, the goal was to assess dentists’ clinical leanings rather than make normative statements about their clinical decisions.

Alternatively, simple, and multiple linear regressions were carried out to test the relationship of each exploratory variables with the treatment intensity score as a continuous variable. This was particularly useful in observing the changes in the treatment intensity scores per unit change in the predictor variables. Variables significant at the \( p < 0.1 \) level in the simple linear regression model were included in the multiple linear regression analysis. All statistical analyses were performed using SPSS v.23. Finally, we created a correlation matrix to assess for collinearity between the independent variables. S2 Appendix outlines the matrix.

**Results**

After excluding returned surveys for reasons such as that the dentist had moved or retired or that the survey was filled out twice by the same respondent, the study had 1,075 usable surveys (33.6% response rate). Tables 2 and 3 present the descriptive characteristics of the sample. To
| Question number | Variable | Domain reflected in the conceptual framework |
|-----------------|----------|---------------------------------------------|
| 1               | Gender   | Provider characteristics                    |
| 2               | Age      |                                             |
| 3               | Place of initial training                  |                                             |
| 4               | Year of graduation                         |                                             |
| 5               | Number of years of practice                |                                             |
| 6               | Number of years of practice in Canada      |                                             |
| 7               | Case scenario                              | Clinical decision-making                   |
| 8               | Case scenario                              |                                             |
| 9               | Case scenario                              |                                             |
| 10              | Case scenario                              |                                             |
| 11              | Number of hours worked/week                | Provider characteristics                    |
| 12              | Amount billed/hour to profitable           | Practice characteristics                    |
| 13              | Percentage of private insurance patients   | Patient characteristics                     |
|                 | Percentage of public insurance patients    |                                             |
|                 | Percentage of out of pocket patients       |                                             |
| 14              | Number of dentists in clinic               | Practice characteristics                    |
| 15              | Practice ownership                         |                                             |
| 16              | Number of practices owned                  |                                             |
| 17              | Time spent in each practice                |                                             |
| 18              | Perception of practice loans               |                                             |
| 19              | Practice age                               |                                             |
| 20              | Number of hygienists                       |                                             |
| 21              | Number of hygiene hours                    |                                             |
| 22              | Case scenario                              | Clinical decision-making                   |
| 23              | Case scenario                              |                                             |
| 24              | Case scenario                              |                                             |
| 25              | Had student loans                          | Provider characteristics                    |
| 26              | Time taken to pay off student loans        |                                             |
| 27              | Perception of student loans                |                                             |
| 28              | Case scenario                              | Clinical decision-making                   |
| 29              | Case scenario                              |                                             |
| 30              | Case scenario                              |                                             |
| 31              | Number of patients seen/day                | Practice characteristics                    |
| 32              | Personal gross billing                     |                                             |
| 33              | Satisfaction with practice busyness        |                                             |
| 34              | Percentage of diagnostic and preventive services |                      |
|                 | Percentage of treatment services           |                                             |
|                 | Percentage of elective services            |                                             |
| 35              | Technologies used in practice              |                                             |
| 36              | Referral behaviours                        |                                             |
| 37              | Subjects of continuing education           | Provider characteristics                    |
| 38              | Perceived professional role                |                                             |
| 39              | Perception of other dentists               |                                             |

(Continued)
assess the representativeness of the sample, the demographic characteristics of respondents were compared to the members of the Ontario Dental Association (ODA), a voluntary professional association representing over 90% of Ontario dentists. [20] The respondents of the survey were comparable to the ODA’s records in terms of gender and place of initial training but not for age or year of graduation, with the sample overrepresented by older dentists. S3 Appendix outlines the full comparison.

In terms of the primary outcome, the distribution of treatment intensity scores ranged from a minimum score of ‘7’ to a maximum score of ‘25’. The mean and mode of the distribution were 14.7 and 15.0, respectively. The reported 50th and 90th percentiles were 15.0 and 19.8, respectively. This indicates that, overall, dentists tended to report relatively conservative treatment approaches.

Table 4 presents the binary and multivariable logistic regression findings. In the binary logistic regression, a positive correlation can be observed between age and treatment intensity. Dentists who belong to the youngest age group, 40 years and younger, have 100% greater odds (OR: 2.06; 95% CI: 1.39–3.06, p < 0.001) of reporting relatively aggressive treatment decisions than those 61 years and older. A similar trend is observed with year of graduation. Regarding place of initial training, graduates from American dental schools have 150% greater odds (OR: 2.48; 95% CI: 1.51–4.06, p < 0.001) of reporting relatively aggressive treatment decisions than those who graduated from Canadian schools. Practice ownership also demonstrated an association; dentists who owned or were a partner in their practices had 30% greater odds (OR: 1.33; 95% CI: 1.01–1.75, p = 0.232) of reporting aggressive treatment decisions than dentists who were associates. However, this is not statistically significant. Further, dentists who perceive themselves as business people have 60% greater odds (OR: 1.59; 95% CI: 0.98–2.58, p = 0.063) of reporting relatively aggressive treatment decisions than those who perceived themselves as healthcare professionals.

Among dentists who have student loans, those who perceive these loans to be large have 50% greater odds (OR: 1.48; 95% CI: 0.96–2.29, p = 0.078) of reporting relatively aggressive treatment decisions than those who perceive their loans as small. Similarly, dentists who perceive their practice loans as large or medium have 60% (OR: 1.57; 95% CI: 1.02–2.42, p = 0.039) and 80% (OR: 1.76; 95% CI: 1.18–2.61, p = 0.005) higher odds of reporting relatively aggressive treatment decisions, respectively, than those with no loans.

Other variables such as the number of dependents, the amount billed per hour to be profitable, and the number of hygienists employed demonstrate significant associations with odds of adopting aggressive treatment behaviours. However, the relation does not seem to be changing ordinally for every level above the reference group (i.e. non-linear relationship).
Table 2. Descriptive characteristics (categorical variables).

| Variable | n (% of total) |
|----------|----------------|
| **Socio-demographics** | |
| Gender | |
| Male | 701 (65.5) |
| Female | 369 (34.5) |
| Age | |
| 40 and younger | 154 (14.4) |
| 41 to 50 years | 274 (25.6) |
| 51 to 60 years | 325 (30.4) |
| 61 and older | 316 (29.6) |
| Place of initial training | |
| Canadian dental school | 807 (75.4) |
| American dental school | 84 (7.9) |
| International dental school | 179 (16.7) |
| Year of graduation | |
| Before 1980 | 220 (21.3) |
| 1980–1989 | 302 (29.2) |
| 1990–1999 | 296 (28.7) |
| 2000–2009 | 160 (15.5) |
| 2010–2016 | 55 (5.3) |
| Total years of practice | |
| 0–10 years | 106 (9.1) |
| More than 10 years | 962 (90.9) |
| Years of practice in Canada among those that were internationally or American-trained | |
| 0–10 years | 56 (22.2) |
| More than 10 years | 196 (77.8) |
| Primary income earner | |
| No | 122 (11.7) |
| Yes | 748 (71.4) |
| Number of dependents | |
| 0 | 158 (14.8) |
| 1 | 233 (21.9) |
| 2–4 | 610 (57.2) |
| 5 or more | 65 (6.1) |
| Annual personal after-tax income | |
| Less than $100,000 | 203 (22.5) |
| $100,000–150,000 | 267 (29.6) |
| $150,000–200,000 | 170 (18.8) |
| $200,000–250,000 | 98 (10.9) |
| $250,000 or more | 164 (18.2) |
| Clinical characteristics | |
| Number of hours worked/week | |
| Less than 20 hours | 121 (11.4) |
| 20–35 hours | 474 (44.8) |
| 35–50 hours | 433 (40.9) |
| More than 50 hours | 31 (2.9) |
| Number of dentists in practice | 1059 |

(Continued)
Table 2. (Continued)

| Variable                                | n (% of total) |
|------------------------------------------|----------------|
| Practice ownership                       |                |
| Associate                                | 283 (26.7)     |
| Owner/Partner                            | 778 (73.3)     |
| Number of practices owned/partnered in   |                |
| 1                                        | 677 (87.8)     |
| 2 or more                                | 94 (12.2)      |
| Practice age                             |                |
| 0–10 years                               | 109 (14.1)     |
| More than 10 years                       | 662 (85.9)     |
| Number of hygienists employed            |                |
| 0                                        | 82 (8.0)       |
| 1                                        | 128 (16.6)     |
| 2                                        | 196 (25.4)     |
| 3                                        | 158 (20.5)     |
| 4                                        | 121 (15.7)     |
| 5 or more                                | 107 (13.9)     |
| Number of hygiene hours/week             |                |
| Less than 20 hours                       | 61 (8.6)       |
| 20–35 hours                              | 167 (23.6)     |
| 35–50 hours                              | 175 (24.7)     |
| More than 50 hours                       | 306 (43.2)     |
| Number of patients seen/day              |                |
| 1–9 patients                             | 569 (53.3)     |
| More than 9 patients                     | 499 (46.7)     |
| Personal gross billing income/day        |                |
| Less than $1500                          | 169 (16.3)     |
| $1500–2000                               | 155 (14.9)     |
| $2000–2500                               | 210 (20.2)     |
| $2500–3000                               | 183 (17.6)     |
| $3000–3500                               | 115 (11.1)     |
| $3500 or more                            | 206 (19.8)     |
| Percentage of patients with private insurance |        |
| 0–69%                                    | 400 (41.0)     |
| 70–100%                                  | 575 (59.0)     |
| Percentage of patients with public insurance |            |
| 0–9%                                     | 409 (41.9)     |
| 10–100%                                  | 568 (58.1)     |
| Percentage of patients paying out of pocket (OOP) |        |
| 0–19%                                    | 484 (49.5)     |
| 20–100%                                  | 493 (50.5)     |
| Percentage of preventive procedures      |                |
| 0–15%                                    | 514 (49.9)     |
| 16–100%                                  | 517 (50.1)     |
| Percentage of treatment procedures       |                |

(Continued)
### Table 2. (Continued)

| Variable                              | n (% of total) |
|---------------------------------------|----------------|
| **Percentage of elective procedures** |                |
| 0–19%                                 | 480 (46.6)     |
| 20–100%                               | 551 (53.4)     |
| **Number of technologies used**       |                |
| 0                                     | 122 (11.5)     |
| 1                                     | 414 (39.0)     |
| 2                                     | 273 (25.7)     |
| 3                                     | 143 (13.8)     |
| 4 or more                             | 106 (10.0)     |
| **Perceptions**                       |                |
| Perceived professional role           |                |
| Health care professional              | 852 (92.0)     |
| Business person                       | 74 (8.0)       |
| Perception of other dentists          |                |
| Colleague                             | 751 (81.9)     |
| Competitor                            | 166 (18.1)     |
| Had student loans                     |                |
| Yes                                   | 524 (48.9)     |
| No                                    | 548 (51.1)     |
| Time taken to pay student loans       |                |
| Less than 1 year                      | 84 (16.4)      |
| 1–5 years                             | 235 (49.8)     |
| 5–10 years                            | 90 (17.6)      |
| More than 10 years                    | 28 (5.5)       |
| My student loans are not yet paid off | 55 (10.7)      |
| Status of student loan                |                |
| Student loans paid off                | 457 (89.9)     |
| Student loans not paid off yet        | 55 (10.7)      |
| Perception of student loans           |                |
| Small                                 | 194 (37.5)     |
| Medium                                | 175 (33.8)     |
| Large                                 | 148 (28.6)     |
| Satisfaction with practice busyness   |                |
| Very satisfied                        | 289 (28.9)     |
| Somewhat satisfied                    | 459 (45.9)     |
| Somewhat dissatisfied                 | 206 (20.6)     |
| Very dissatisfied                     | 45 (4.5)       |
| Perception of practice loans          |                |
| No practice loans                     | 335 (43.7)     |
| Small                                 | 165 (21.3)     |
| Medium                                | 150 (19.6)     |
| Large                                 | 117 (15.3)     |
| Perception of pressure from other dental clinics |        |
| No pressure                           | 333 (33.5)     |
| Small                                 | 365 (34.5)     |

(Continued)
In the multivariable regression, year of graduation, place of initial training, satisfaction with practice busyness, and perception of other dentists demonstrated the strongest associations with reporting aggressive treatment decisions after adjusting for all other variables simultaneously.

As per the linear regression, similar observations were noted. That being, younger dentists, those who graduated from American dental schools, those who had not paid off their student loans, those who perceived their practice loans to be medium or large, perceived themselves as business people, were dissatisfied with their practice busyness, and perceived the competitive pressures from other dental clinics to be large reported higher treatment intensity scores. After controlling for all other variables, the multiple linear regression analysis showed that treatment intensity scores was significantly associated with the place of initial training (American dental school $\beta$: unstandardized partial regression coefficient = 0.84, international dental school $\beta$ = -0.70), the number of patients seen/day (9 or more patients/day $\beta$ = -0.80), gross billing income/hour (3500 or more gross billing/hour $\beta$ = 0.85), the amount billed/hour to be profitable ($200-300/hour $\beta$ = 0.98, $300-400/hour $\beta$ = 1.01, $400-500/hour $\beta$ = 1.35, $500 or more $\beta$ = 1.86), perceived professional role (business person $\beta$ = 0.83), and perceived pressure from other dental clinics (medium pressure $\beta$ = 0.75). Tables 5 and 6 outline the findings from the simple and multiple linear regressions, respectively.

### Discussion

The results of this study suggest an association between various non-clinical factors and dentists’ clinical decision-making in a representative sample of dentists in Ontario, Canada’s most populated and diverse province, and its largest dental care market. The findings are corroborated in the existing literature. For example, previous studies have reported that older dentists make more conservative treatment decisions. [8, 12, 21, 22] It might be that the experience accumulated over years of practice allows dentists to be a better judge of clinical cases. [22] Others believe that older dentists are more ethically inclined and less pressured by financial incentives when recommending procedures. [23]

Place of initial training has also been found to be associated with differences in dentists’ treatment decisions. [11, 24, 25] One hypothesis that can explain these differences is the variation in dental curricula and clinical practices taught in different international settings. It has been suggested that such differences would fade away as time practiced in the host country increases, as practitioners adapt to the oral health needs and professional culture of the respective population. [25] However, in this study, the years practiced in Canada was not significantly associated with clinical decision-making.

Perception of practice loans and perception of practice busyness were also significantly associated with clinical decision-making in this study. It might be that dentists who are less

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**Table 2. (Continued)**

| Variable     | n (% of total) |
|--------------|----------------|
| Medium       | 237 (22.4)     |
| Large        | 122 (11.5)     |

This table was previously published in Ghoneim A, Yu B, Lawrence HP, Glogauer M, Shankardass K, Quiñonez C. Does competition affect the clinical decision-making of dentists? A geospatial analysis. Community Dent Oral Epidemiol. 2019;00:1–11. https://doi.org/10.1111/cdoe.12514

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busy and perceive their loans to be large tend to recommend more involved and higher-cost treatments. Previous studies have found a similar association between practice busyness and treatment decisions. [9, 22] Financial challenges facing dentists, such as outstanding educational loans and the perception of large practice loans, were all pointing in the same direction, too. Despite the absence of published empirical evidence to support these findings, anecdotally, it is suggested that when facing financial hardships, dentists may overtreat or recommend unnecessary procedures to alleviate some of their financial pressures. [26]

A fundamental argument that has presented itself in dentistry is whether dentists are health care professionals and/or business persons. [27] Dentistry in general is described as a profession, which assumes that the professional “professes” to protect and foster “the benefit of the public”. [28] This means that the patient’s welfare is always prioritized over those of the practitioner’s. [28] However, some argue that the values and norms of dentistry, as a health professional culture, often conflict with the demands of its other culture, namely that of business, which emphasizes profit and high income as priorities. [29] This can manifest when dentists prioritize those who demand costly interventions (veneers) over those who are in more need of less costlier procedures (simple restorations) to maximize profit. This could explain the differences in clinical decision-making between those who consider themselves primarily health care professionals compared to business persons.

There have been previous attempts to quantify clinical decision-making among dentists. The most popular method appears to be through assessing the depth of a carious lesion at which a dentist would restoratively intervene based on radiographic images. [8, 13, 30] Another method includes “ethical” calibration of recommended treatment options to a hypothetical vignette, [31] and comparing differences between treatments proposed and delivered by dentists under different reimbursement systems. [14, 32] Importantly though, to our knowledge, our study is the first to use an aggregated treatment intensity score utilizing common clinical situations.

The most significant shortcoming of this study is the potential presence of social desirability bias when answering the vignettes and other questions. Respondents may tend to provide answers based on textbook recommendations, which might not necessarily mirror their actual

| Table 3. Descriptive characteristics (continuous variables). |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                | Percentage of private insurance | Percentage of public insurance | Percentage of out-of-pocket | Percentage of diagnostic and preventive procedures per week | Percentage of treatment procedures per week | Percentage of elective procedures per week |
| N valid                        | 977              | 977             | 977              | 1034            | 1034            | 1034            |
| Missing                        | 98              | 98              | 98              | 43              | 43              | 43              |
| Mean                           | 65.7            | 15.2           | 19.1            | 20.2            | 57.5            | 22.3            |
| Median                         | 70.0            | 10.0           | 20.0            | 15.9            | 60.0            | 20.0            |
| Mode                           | 70.0            | 10.0           | 20.0            | 10.0            | 70.0            | 10.0            |
| Standard Deviation (SD)        | 20.8            | 17.9           | 12.2            | 15.5            | 18.2            | 16.0            |
| Minimum                        | 0               | 0              | 0               | 0               | 0               | 0               |
| Maximum                        | 100             | 96             | 100             | 95              | 100             | 100             |
| Percentiles                     |                 |                 |                 |                 |                 |                 |
| 25th percentile                | 60.0            | 5.0            | 10.0            | 10.0            | 45.0            | 10.0            |
| 75th percentile                | 80.00           | 20.00          | 25.00           | 29.4            | 70.0            | 30.0            |

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Table 4. Binary and binomial logistic regression models presenting the odds of adopting relatively aggressive treatment decisions$^2$.

|                           | Model 1 Unadjusted Odds ratio$^*$ (95% CI) | P     | Model 2 Adjusted Odds ratio† (95% CI) | P     |
|---------------------------|---------------------------------------------|-------|---------------------------------------|-------|
| **Socio-demographic**     |                                             |       |                                       |       |
| Gender                    |                                             |       |                                       |       |
| Male (reference)          | 1.00                                        | -     |                                       | -     |
| Female                    | 1.26 (0.98, 1.63)                           | 0.075 |                                       | -     |
| Years of practice (continuous) | 0.98 (0.96, 0.99)                   | <0.001|                                       | -     |
| Age                       |                                             |       |                                       |       |
| 40 and younger            | 2.06 (1.40, 3.06)                           | <0.001|                                       | -     |
| 41–50                     | 1.69 (1.21, 2.34)                           | 0.002 |                                       | -     |
| 51–60                     | 1.40 (1.02, 1.92)                           | 0.036 |                                       | -     |
| 61 and older (reference)  | 1.00                                        | -     |                                       | -     |
| Year of graduation        |                                             |       |                                       |       |
| Before 1980 (reference)   | 1.00                                        | -     | 1.00                                 | -     |
| 1980–1989                 | 1.44 (1.01, 2.06)                           | 0.046 | 1.83 (1.05, 3.21)                     | 0.034 |
| 1990–1999                 | 1.89 (1.32, 2.71)                           | <0.001| 1.77 (0.97, 3.22)                     | 0.061 |
| 2000–2009                 | 2.03 (1.34, 3.09)                           | 0.001 | 1.76 (0.89, 3.50)                     | 0.105 |
| 2010–2016                 | 3.21 (1.71, 5.60)                           | <0.001| 3.08 (1.30, 7.29)                     | 0.011 |
| Years of practice categorized |                                     |       |                                       |       |
| Less than 10 years        | 1.45 (0.96, 2.19)                           | 0.075 |                                       | -     |
| More than 10 years (reference) | 1.00                                   | -     |                                       | -     |
| Place of initial dental training |                                       |       |                                       |       |
| Canadian dental school (reference) | 1.00                               | -     | 1.00                                  | -     |
| American dental school    | 2.48 (1.52, 4.06)                           | <0.001| 2.97 (1.36, 6.48)                     | 0.006 |
| International dental school | 0.76 (0.55, 1.06)                        | 0.108 | 0.69 (0.42, 1.14)                     | 0.151 |
| Number of dependents      |                                             |       |                                       |       |
| 0 (reference)             | 1.00                                        | -     | 1.00                                  | -     |
| 1                         | 0.63 (0.42, 0.95)                           | 0.029 | 1.03 (0.55, 1.93)                     | 0.925 |
| 2–4                       | 1.16 (0.82, 1.66)                           | 0.401 | 1.35 (0.77, 2.37)                     | 0.295 |
| 5 or more                 | 0.88 (0.49, 1.57)                           | 0.654 | 0.76 (0.30, 1.90)                     | 0.553 |
| Annual personal after-tax income |                                         |       |                                       |       |
| Less than 100,000 (reference) | 1.00                              | -     | 1.00                                  | -     |
| 100,000–150,000           | 1.30 (0.90, 1.89)                           | 0.167 | 1.160 (0.676, 1.992)                  | 0.590 |
| 150,000–200,000           | 1.72 (1.14, 2.61)                           | 0.011 | 1.63 (0.87, 3.05)                     | 0.130 |
| 200,000–250,000           | 1.65 (1.01, 2.69)                           | 0.044 | 1.35 (0.64, 2.87)                     | 0.432 |
| More than 250,000         | 1.80 (1.18, 2.74)                           | 0.006 | 1.40 (0.69, 2.85)                     | 0.355 |
| Clinical characteristics  |                                             |       |                                       |       |
| Number of hours worked/week |                                         |       |                                       |       |
| Less than 20 hours (reference) | 1.00                              | -     | 1.00                                  | -     |
| 20–35 hours               | 1.80 (1.19, 2.71)                           | 0.005 | 0.65 (0.33, 1.28)                     | 0.213 |
| 35–50 hours               | 1.53 (1.01, 2.32)                           | 0.043 | 0.57 (0.28, 1.18)                     | 0.131 |
| More than 50 hours        | 1.75 (0.78, 3.92)                           | 0.173 | 0.41 (0.11, 1.49)                     | 0.177 |
| Amount to bill per hour per chair to be profitable |                        |       |                                       |       |
| Less than $200 (reference) | 1.00                                        | -     | 1.00                                  | -     |
| 200–300                   | 1.96 (1.26, 3.05)                           | 0.003 | 1.26 (0.69, 2.31)                     | 0.460 |
| 300–400                   | 1.73 (1.11, 2.71)                           | 0.017 | 1.20 (0.62, 2.31)                     | 0.582 |
| 400–500                   | 2.66 (1.60, 4.42)                           | <0.001| 1.77 (0.82, 3.83)                     | 0.147 |
| More than 500             | 1.89 (1.18, 3.02)                           | 0.008 | 2.25 (0.97, 5.21)                     | 0.059 |
| Percentage of private insurance |                                  |       |                                       |       |

(Continued)
| Table 4. (Continued) | Model 1 Unadjusted Odds ratio (95% CI) | P | Model 2 Adjusted Odds ratio (95% CI) | P |
|-----------------------|--------------------------------------|---|-------------------------------------|---|
| 0–69% (reference)     | 1.00                                 | - | 1.00                                | - |
| 70–100%               | 1.38 (1.07, 1.79)                    | 0.014 | 1.20 (0.81, 1.75)                    | 0.331 |
| Percentage of public insurance |                                      |    |                                      |    |
| 0–9% (reference)      | 1.00                                 | - | -                                   | - |
| 10–100%               | 0.80 (0.62, 1.04)                    | 0.092 | -                                   | - |
| Practice ownership    |                                      |    |                                      |    |
| Associate (reference) | 1.00                                 | - | 1.00                                | - |
| Partner/Owner         | 1.33 (1.01, 1.75)                    | 0.044 | 1.25 (0.78, 2.00)                    | 0.357 |
| Number of practices dentist is owner/partner |                                      |    |                                      |    |
| 1 (reference)         | 1.00                                 | - | -                                   | - |
| 2 or more             | 1.31 (0.843, 2.028)                  | 0.232 | -                                   | - |
| Number of hygienists  |                                      |    |                                      |    |
| 0 (reference)         | 1.00                                 | - | -                                   | - |
| 1                     | 3.15 (1.61, 6.15)                    | 0.001 | -                                   | - |
| 2                     | 2.90 (1.54, 5.48)                    | 0.001 | -                                   | - |
| 3                     | 4.13 (2.14, 7.95)                    | <0.001 | -                                   | - |
| 4                     | 3.32 (1.69, 6.52)                    | <0.001 | -                                   | - |
| 5                     | 3.69 (1.85, 7.35)                    | <0.001 | -                                   | - |
| Number of patients/day|                                      |    |                                      |    |
| 0–9                   | 1.31 (1.03, 1.67)                    | 0.030 | 1.61 (1.07, 2.43)                    | 0.023 |
| 9 or more (reference) | 1.00                                 | - | 1.00                                | - |
| Personal gross billing/day |                                      |    |                                      |    |
| Less than $1500 (reference) | 1.00                                 | - | 1.00                                | - |
| 1500–2000             | 1.42 (0.91, 2.22)                    | 0.120 | 1.25 (0.64, 2.45)                    | 0.517 |
| 2000–2500             | 1.60 (1.06, 2.42)                    | 0.026 | 1.48 (0.75, 2.93)                    | 0.260 |
| 2500–3000             | 1.76 (1.15, 2.70)                    | 0.010 | 1.90 (0.90, 3.98)                    | 0.091 |
| 3000–3500             | 1.59 (0.98, 2.59)                    | 0.059 | 2.09 (0.87, 4.85)                    | 0.099 |
| 3500 or more          | 2.09 (1.40, 3.14)                    | <0.001 | 2.10 (0.92, 4.81)                    | 0.079 |
| Percentage of diagnostic and preventive procedures/ week |                                      |    |                                      |    |
| 0–15% (reference)     | 1.00                                 | - | 1.00                                | - |
| 16–100%               | 0.71 (0.55, 0.91)                    | 0.006 | 0.79 (0.54, 1.15)                    | 0.209 |

**Perceptions**

| Perception of practice loans |                                      |    |                                      |    |
|------------------------------|--------------------------------------|---|-------------------------------------|---|
| No outstanding loans (reference) | 1.00                                 | - | -                                   | - |
| Small                        | 1.34 (0.92, 1.96)                    | 0.126 | -                                   | - |
| Medium                       | 1.76 (1.18, 2.61)                    | 0.005 | -                                   | - |
| Large                        | 1.57 (1.02, 2.42)                    | 0.039 | -                                   | - |

| Status of student loans      |                                      |    |                                      |    |
|------------------------------|--------------------------------------|---|-------------------------------------|---|
| Loans paid off (reference)   | 1.00                                 | - | -                                   | - |
| Loans not paid off yet       | 2.75 (1.47, 5.14)                    | 0.002 | -                                   | - |

| Perception of student loans  |                                      |    |                                      |    |
|------------------------------|--------------------------------------|---|-------------------------------------|---|
| Small (reference)            | 1.00                                 | - | -                                   | - |
| Medium                       | 1.26 (0.83, 1.90)                    | 0.282 | -                                   | - |
| Large                        | 1.48 (0.96, 2.29)                    | 0.078 | -                                   | - |

| Satisfaction with practice busyness |                                      |    |                                      |    |
|-------------------------------------|--------------------------------------|---|-------------------------------------|---|
| Very satisfied (reference)          | 1.00                                 | - | 1.00                                | - |
| Satisfied                           | 1.33 (0.98, 1.79)                    | 0.065 | 1.45 (0.93, 2.28)                    | 0.104 |

(Continued)
clinical practices. This bias may also persist despite the confidentiality promised to participants. This represents one of the reasons for dichotomizing the outcome, aside from the simplicity of data analysis and presentation. The analysis tried to identify the factors associated with dentists’ leanings in clinical decision-making (relatively conservative vs. relatively aggressive). While there are consequences to dichotomizing a continuous variable, such as the loss of information or the misclassification of respondents, the authors believe that, in this data set, where the responses are not normally distributed, dichotomization offered a simpler and potentially more valid way of representing the outcome.

Another limitation of this study is the underrepresentation of younger dentists (14% compared to 29% in the ODA’s membership) within the sample. This has arguably led to the underestimation of the effects of age, which was significantly associated with the primary outcome. This has relevance to our decision not to employ weighting adjustment due to the unavailability of demographic and other descriptive data about Ontario dentists. We recognize this as a shortcoming that hinders the generalizability of our findings. Also, it is important to consider the study design when interpreting results, thus due to its cross-sectional nature, causation cannot be inferred. For instance, based on the findings from this study, we cannot tell if those who have fewer patients choose to do more aggressive, time filling procedures, or those who like to do more aggressive procedures have fewer patients because there is no time to squeeze others in. Finally, while we acknowledge the inevitable presence of moderate data collinearity (VIF scores between 1–5), between some of our independent variables, we believe that it does not impact on the validity of our findings in a significant way, hence not warranting the need for corrective measures.

Table 4. (Continued)

| Perceived dentist role | Model 1 Unadjusted Odds ratio* (95% CI) | P | Model 2 Adjusted Odds ratio† (95% CI) | P |
|------------------------|-----------------------------------------|---|--------------------------------------|---|
| Dissatisfied           | 1.58 (1.10, 2.27)                       | 0.013 | 2.38 (1.32, 4.30) | 0.004 |
| Very dissatisfied      | 1.33 (0.70, 2.51)                       | 0.382 | 3.17 (1.14, 8.78) | 0.027 |
| Perceived pressure from other dental clinics | | | | |
| No pressure/small amount (reference) | 1.00 | - | 1.00 | - |
| Medium/Large pressure | 1.32 (1.02, 1.70)                       | 0.037 | 0.90 (0.57, 1.52) | 0.658 |

* Model 1 entered all the variables independently
† Model 2 entered significant variables (p<0.05) from Model 1, adjusting for all variables simultaneously.

Variables “perception of practice loans”, “status of student loans”, and the “number of hygienists employed” were not included in Model 2 as they only pertain to practice owners.

Variables “age” is highly correlated with “years of practice” and “year of graduation” (Spearman’s correlation -0.910 and 0.936 respectively), hence, only “year of graduation” was included in Model 2.

This table was previously published in Ghoneim A, Yu B, Lawrence HP, Glogauer M, Shankardass K, Quiñonez C. Does competition affect the clinical decision-making of dentists? A geospatial analysis. Community Dent Oral Epidemiol. 2019;00:1–11. https://doi.org/10.1111/cdoe.12514

https://doi.org/10.1371/journal.pone.0233652.t004
Table 5. Simple linear regression of the treatment intensity scores represented as a continuous variable.

| Variable                  | Unstandardized coefficient | Standard Error | p-value | 95% CI lower bound | 95% CI upper bound |
|---------------------------|-----------------------------|----------------|---------|--------------------|--------------------|
| Age                       |                             |                |         |                    |                    |
| 40 and younger            | 1.45                        | 0.35           | 0.000   | 0.77               | 2.14               |
| 41 to 50 years            | 1.05                        | 0.30           | 0.000   | 0.47               | 1.63               |
| 51 to 60 years            | 0.38                        | 0.28           | 0.175   | -0.17              | 0.94               |
| 61 years and older (constant) | 14.10                   | 0.20           | 0.000   | 13.71              | 14.49              |
| Gender                    |                             |                |         |                    |                    |
| Male (constant)           | 14.53                       | 0.14           | 0.000   | 14.26              | 14.80              |
| Female                    | 0.47                        | 0.23           | 0.044   | 0.01               | 0.92               |
| Place of initial training |                             |                |         |                    |                    |
| Canadian dental school (constant) | 14.68                      | 0.13           | 0.000   | 14.43              | 14.93              |
| American dental school    | 1.14                        | 0.409          | 0.005   | 0.34               | 1.94               |
| International dental school | -0.49                     | 0.30           | 0.099   | -1.07              | 0.09               |
| Year of graduation        |                             |                |         |                    |                    |
| Before 1980 (constant)    | 13.92                       | 0.22           | 0.000   | 13.49              | 14.36              |
| 1980–1989                 | 0.58                        | 0.30           | 0.055   | -0.01              | 1.18               |
| 1989–1999                 | 1.08                        | 0.31           | 0.000   | 0.48               | 1.68               |
| 2000–2009                 | 1.38                        | 0.36           | 0.000   | 0.68               | 2.08               |
| 2010–2016                 | 1.89                        | 0.53           | 0.000   | 0.85               | 2.92               |
| Years of practice         |                             |                |         |                    |                    |
| Less than 10 years (constant) | 15.21                     | 0.34           | 0.000   | 14.54              | 15.88              |
| 10 years or more          | -0.59                       | 0.36           | 0.106   | -1.29              | 0.12               |
| Years of practice in Canada |                             |                |         |                    |                    |
| Less than 10 years (constant) | 15.21                     | 0.34           | 0.000   | 14.54              | 15.88              |
| 10 years or more          | -0.59                       | 0.36           | 0.106   | -1.29              | 0.12               |
| Primary income earner     |                             |                |         |                    |                    |
| No (constant)             | 14.76                       | 0.30           | 0.000   | 14.18              | 15.34              |
| My partner and myself contribute equally | -0.12             | 0.40           | 0.775   | -0.09              | 0.67               |
| Yes                       | -0.07                       | 0.32           | 0.831   | -0.70              | 0.57               |
| Number of dependents      |                             |                |         |                    |                    |
| 0 (constant)              | 14.58                       | 0.28           | 0.000   | 14.04              | 15.13              |
| 1                         | -0.65                       | 0.37           | 0.078   | -1.36              | 0.07               |
| 2–4                       | 0.43                        | 0.31           | 0.173   | -0.19              | 1.05               |
| 5 or more                 | 0.06                        | 0.53           | 0.914   | -0.98              | 1.09               |
| Annual after-tax income   |                             |                |         |                    |                    |
| Less than 100k (constant) | 14.41                       | 0.19           | 0.000   | 14.04              | 14.77              |
| 100-150k                  | 0.09                        | 0.29           | 0.768   | -0.48              | 0.65               |
| 150-200k                  | 0.82                        | 0.33           | 0.014   | 0.17               | 1.48               |
| 200-250k                  | 0.42                        | 0.41           | 0.301   | -0.38              | 1.22               |
| More than 250k            | 0.61                        | 0.34           | 0.070   | -0.05              | 1.28               |
| Number of hours worked/week|                             |                |         |                    |                    |
| Less than 20 hours (constant) | 14.02                     | 0.307          | 0.000   | 13.42              | 14.62              |
| 20–35 hours               | 0.87                        | 0.349          | 0.018   | 0.14               | 1.51               |
| 35–50 hours               | 0.69                        | 0.353          | 0.049   | 1.00               | 1.39               |
| More than 50 hours        | 0.92                        | 0.712          | 0.201   | -0.49              | 2.34               |
| Number of dentists        |                             |                |         |                    |                    |
| 1 dentist (constant)      | 14.48                       | 0.18           | 0.000   | 14.12              | 14.84              |
| 2–4 dentists              | 0.25                        | 0.24           | 0.284   | -0.21              | 0.71               |

(Continued)
Table 5. (Continued)

| Variable                                      | Unstandardized coefficient | Standard Error | p-value | 95% CI lower bound | 95% CI upper bound |
|-----------------------------------------------|----------------------------|----------------|---------|-------------------|-------------------|
| 5 or more dentists                            | 0.87                       | 0.44           | 0.047   | 0.01              | 1.73              |
| Practice ownership                            |                            |                |         |                   |                   |
| Associate (constant)                          | 14.36                      | 0.21           | 0.000   | 13.95             | 14.77             |
| Owner/partner                                 | 0.46                       | 0.25           | 0.064   | -0.03             | 0.94              |
| Number of practices                           |                            |                |         |                   |                   |
| 1 practice (constant)                         | 14.61                      | 0.12           | 0.000   | 14.38             | 14.84             |
| 2 or more practices                           | 0.91                       | 0.39           | 0.019   | 0.15              | 1.68              |
| Practice age                                  |                            |                |         |                   |                   |
| Less than 10 years                            | 0.53                       | 0.36           | 0.149   | -0.19             | 1.24              |
| 10 years or more (constant)                   | 14.64                      | 0.12           | 0.000   | 14.41             | 14.87             |
| Number of hygiene hours                       |                            |                |         |                   |                   |
| Less than 20 hours (constant)                 | 14.18                      | 0.17           | 0.000   | 13.84             | 14.52             |
| 20–35 hours                                   | 0.52                       | 0.33           | 0.110   | -0.12             | 1.16              |
| 35–50 hours                                   | 0.93                       | 0.33           | 0.005   | 0.29              | 1.56              |
| 50 hours or more                              | 0.99                       | 0.27           | 0.000   | 0.46              | 1.52              |
| Number of patients seen/day                   |                            |                |         |                   |                   |
| 1–9 patients (constant)                       | 14.86                      | 0.15           | 0.000   | 14.57             | 15.16             |
| More than 9 patients                          | -0.37                      | 0.22           | 0.093   | -0.81             | 0.06              |
| Gross billing/day                             |                            |                |         |                   |                   |
| Less than $1500 (constant)                    | 13.78                      | 0.25           | 0.000   | 13.29             | 14.28             |
| $1500–2000                                    | 0.64                       | 0.38           | 0.096   | -0.11             | 1.39              |
| $2000–2500                                    | 0.97                       | 0.35           | 0.006   | 0.28              | 1.66              |
| $2500–3000                                    | 1.20                       | 0.37           | 0.001   | 0.48              | 1.92              |
| $3000–3500                                    | 1.11                       | 0.42           | 0.008   | 0.29              | 1.94              |
| $35000 or more                                | 1.56                       | 0.36           | 0.000   | 0.86              | 2.25              |
| Amount to bill/hour to be profitable          |                            |                |         |                   |                   |
| Less than $200 (constant)                     | 13.41                      | 0.25           | 0.000   | 12.91             | 13.91             |
| $200–300                                      | 1.24                       | 0.32           | 0.000   | 0.61              | 1.87              |
| $300–400                                      | 1.41                       | 0.33           | 0.000   | 0.76              | 2.06              |
| $400–500                                      | 1.76                       | 0.39           | 0.000   | 0.99              | 2.52              |
| $500 or more                                  | 2.51                       | 0.40           | 0.000   | 1.72              | 3.30              |
| Perceived professional role                   |                            |                |         |                   |                   |
| Healthcare professional (constant)            | 14.62                      | 0.11           | 0.000   | 14.40             | 14.85             |
| Business person                               | 0.95                       | 0.43           | 0.027   | 0.11              | 1.80              |
| Perception of other dentists                  |                            |                |         |                   |                   |
| Colleague (constant)                          | 14.64                      | 0.12           | 0.000   | 14.41             | 14.88             |
| Competitor                                    | 0.31                       | 0.31           | 0.302   | -0.28             | 0.91              |
| Had student loans                             |                            |                |         |                   |                   |
| Yes                                           | 0.17                       | 0.221          | 0.43    | -0.26             | 0.61              |
| No (constant)                                 | 14.61                      | 0.154          | 0.000   | 14.31             | 14.91             |
| Time taken to payoff student loans            |                            |                |         |                   |                   |
| Less than 1 year (constant)                   | 14.66                      | 0.14           | 0.000   | 14.40             | 14.93             |
| 1 to 5 years                                  | -0.02                      | 0.26           | 0.938   | -0.54             | 0.50              |
| 5 to 10 years                                 | 0.11                       | 0.41           | 0.797   | -0.70             | 0.92              |
| 10 years or more                              | 0.88                       | 0.70           | 0.213   | -0.50             | 2.26              |
| Status of student loans                       |                            |                |         |                   |                   |
| Student loans paid off (constant)             | 14.61                      | 0.11           | 0.000   | 14.39             | 14.83             |

(Continued)
The strengths of this study include the achievement of the minimum sample size, which allows for, within its limits, the generalization of the findings to the entire population of practicing dentists in Ontario, as the data was collected province-wide by utilizing a comprehensive sampling frame (i.e. all registered dentists in Ontario). In addition, this study was robust compared to previous studies exploring similar outcomes, as it investigated more than thirty variables potentially associated with clinical decision-making. Further, from a methodological standpoint, the study presents a potentially innovative method to quantify clinical decision-making and presents an opportunity for formal exploration of its reliability and validity through future research. Despite the contribution this study provides to the clinical decision literature in dentistry, the data suggest that we have a long way to go before we fully understand what impacts dentists’ treatment decisions. Future research should investigate the impact of other important environmental and patient characteristics on dentists’ clinical decisioning such as regulations on dental advertising, patient insurance coverage, and patient demand dental procedures.

The results of this study have numerous educational and professional implications. Some of the educational implications include the potential need to train students to deal with the anticipated financial stresses of clinical life and emphasizing ethical principles in practice. From a professional standpoint, it is important that the public perceives dental professionals as their health advocates, first and foremost. Yet, unfortunately, due to the arguably prevalent shift in the mindset of dental practices towards a business model, the erosion of public trust is a serious consequence facing the profession. [33] Strengthening the ethical reasoning of dentists can arguably mitigate financially driven treatment decisions, which in return can mitigate the general undermining of public trust.
| Variable | Unstandardized coefficient | Standard Error | p-value | 95% CI lower bound | 95% CI upper bound | Variance Inflation Factor (VIF) |
|----------|----------------------------|----------------|---------|---------------------|-------------------|-------------------------------|
| Age: 61 years and older as a reference | 0.56 | 0.64 | 0.384 | -0.70 | 1.82 | 4.626 |
| 40 and younger | 0.37 | 0.40 | 0.348 | -0.41 | 1.15 | 2.689 |
| Gender: Male as a reference | Female | 0.43 | 0.25 | 0.094 | -0.07 | 0.93 | 1.314 |
| Place of initial training: Canadian dental school as a reference | American dental school | 0.84 | 0.41 | 0.041 | 0.04 | 1.64 | 1.104 |
| International dental school | -0.70 | 0.32 | 0.027 | -1.33 | -0.08 | 1.266 |
| Year of graduation: 1980 and before as a reference | 1981 to 1990 | 0.38 | 0.31 | 0.221 | -0.23 | 1.00 | 1.777 |
| 1991–2000 | 0.07 | 0.41 | 0.873 | -0.74 | 0.87 | 3.033 |
| 2001–2010 | -0.09 | 0.61 | 0.877 | -1.30 | 1.11 | 4.321 |
| 2010–2016 | 0.09 | 0.84 | 0.912 | -1.55 | 1.73 | 3.099 |
| Number of dependents: No dependents as a reference | 1 dependent | -0.52 | 0.28 | 0.057 | -1.06 | 0.02 | 1.147 |
| Annual after-tax income: Less than $100,000 as a reference | 150-200k income | 0.46 | 0.30 | 0.119 | -0.119 | 1.045 | 1.055 |
| Number of hours worked/week: Less than 20 hours worked as a reference | 20–35 hours worked | 0.19 | 0.34 | 0.570 | -0.47 | 0.86 | 2.541 |
| 35–50 hours worked | -0.06 | 0.36 | 0.869 | -0.77 | 0.65 | 2.829 |
| Number of dentists in the clinic: One dentist as a reference | 5 or more dentists | 0.59 | 0.41 | 0.153 | -0.22 | 1.39 | 1.071 |
| Practice ownership: Associate as a reference | Owner/partner | -0.43 | 0.34 | 0.207 | -1.09 | 0.24 | 2.083 |
| Number of practices owned/partnered in: One practice as a reference | Own two or more practices | 0.44 | 0.40 | 0.273 | -0.34 | 1.21 | 1.136 |
| Number of hygiene service hours/week: Less than 20 hours/week as a reference | 35–50 hygiene hours | 0.43 | 0.34 | 0.212 | -0.25 | 1.16 | 1.426 |
| 50 or more hygiene hours | 0.49 | 0.31 | 0.116 | -0.12 | 1.09 | 1.755 |
| Number of patients seen/day: Less than 9 patients/day as a reference | 9 or more patients seen/day | -0.80 | 0.24 | 0.001 | -1.27 | -0.33 | 1.288 |
| Gross billing income/hour: Less than $1500/hour as a reference | 1500–2000 gross billing/hour | 0.23 | 0.39 | 0.546 | -0.52 | 0.99 | 1.665 |
| 2000–2500 gross billing/hour | 0.55 | 0.37 | 0.139 | -0.18 | 1.27 | 1.936 |
| 2500–3000 gross billing/hour | 0.72 | 0.40 | 0.072 | -0.07 | 1.50 | 2.03 |
| 3000–3500 gross billing/hour | 0.58 | 0.46 | 0.204 | -0.32 | 1.48 | 1.79 |
| 3500 or more gross billing/hour | 0.85 | 0.43 | 0.050 | 0.00 | 1.69 | 2.596 |
| Amount billed/hour to be profitable: Less than $200/hour as a reference | 200–300 amount billed/hour to be profitable | 0.98 | 0.32 | 0.002 | 0.35 | 1.61 | 1.958 |
| 300–400 amount billed/hour to be profitable | 1.01 | 0.34 | 0.003 | 0.34 | 1.68 | 2.029 |
| 400–500 amount billed/hour to be profitable | 1.35 | 0.41 | 0.001 | 0.55 | 2.14 | 1.720 |
| 500 or more amount billed/hour to be profitable | 1.86 | 0.44 | 0.000 | 1.00 | 2.72 | 1.827 |
| Perceived professional role: Healthcare provider as a reference | (Continued) |
Conclusion

The results from this study suggest an association between non-clinical factors and dentists’ self-reported treatment decisions. This is the first study to explore the factors potentially contributing to the clinical decision-making of dentists in Canada. Moreover, it serves as a foundation for further studies exploring factors thought to influence dentists’ treatment decisions using a novel measurement approach.

Supporting information

S1 Appendix. The survey instrument. (PDF)

S2 Appendix. The correlation matrix. (PDF)

S3 Appendix. Demographic comparison. (PDF)

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