Emergency Department Use for Dental Problems among Homeless People in Toronto

by

Rafael Luis Fiori de Figueiredo

A thesis submitted in conformity with the requirements for the degree of Master of Science in Dental Public Health Specialty

Faculty of Dentistry
University of Toronto

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Abstract

**Objectives:** To evaluate ED visits for dental problems not associated with trauma among homeless people in Toronto, and to determine the diagnostic and coding accuracy of ICD-10-CA codes for such visits.

**Methods:** A random sample of 100 ED visits with a code for dental problem (K00-K14) was selected for evaluation of diagnostic and coding accuracy. Administrative data were used to examine ED visits among 1,165 homeless individuals and matched low-income controls.

**Results:** The rate of disagreement between the ICD-10-CA code assigned to ED visits and the code assigned by a dentist reviewing the chart was 58%. Homeless people were more likely to visit an ED for dental a dental problems compared to controls (OR=2.27, p=0.007).

**Conclusion:** There are substantial discrepancies between the ICD-10-CA diagnosis in administrative database and the diagnosis by this project. The utilization of EDs for dental problems is much higher among homeless individuals compared to low-income controls.
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1 Introduction

Homelessness is an important socio-economic problem in Canada (1-3). In Toronto, Canada’s largest municipality with a population of approximately five million people, it is estimated that 6,500 individuals are homeless every night (3-5). It is also estimated that approximately 32,000 individuals use the homeless shelter system every year (1, 3, 5). It is very common for people who are homeless to utilize emergency departments (EDs) as a primary source of health care (2, 3). This phenomenon of inappropriate utilization of EDs by population with lower socio-economic status occurs in many countries despite differences in their health care systems (2, 6, 7).

Moore et al. (6) have reported that homelessness is a strong socio-demographic predictor for utilization of the ED for frequent and non-life-threatening health problems. Generally, the frequent use of EDs for non-urgent health needs reflects the failure of the health care delivery system to provide accessible and affordable care to those in need (7-11). However, the reasons for inappropriate use of the ED are complex and multifactorial, including a strong behavioral component (9, 10). The decision to choose the ED as the primary source of health care is influenced not only by patients’ personal knowledge of their illness but also by their knowledge of how to use the health care system (9-11). The literature has also reported that although low socioeconomic status is directly related to the excessive use of EDs, cultural and psychosocial factors impact the utilization of health care services, especially for disadvantaged populations (8-15). For example, people who have few social supports, are without health insurance benefits, and are in some way socially marginalized either by lifestyle conditions, drug-related problems
or mental illness tend to choose EDs as their first option of health care, urgent or not (2, 11, 15-20).

The inappropriate utilization of EDs also extends to dental problems not associated with trauma (8). When access to dental care is more limited than access to medical care, EDs become an avenue by which patients can seek care for dental issues. As a result, toothaches have been reported as a common complaint in EDs (17, 18). In Toronto, the adult homeless population has a high rate of acute and chronic oral health problems compared to the general population (21-23). Therefore, the poor oral health status of the Toronto homeless population, coupled with the limitations in the dental care delivery system to meet the needs of this group, creates a situation in which homeless people are expected to be frequent users of EDs for dental problems (3, 8, 18, 21, 24).

The first aim of this project is to evaluate the accuracy of diagnosis coding of the ED visits for dental problems as per the International Classification of Diseases (ICD-10-CA) system. The evaluation of the accuracy of diagnosis coding for dental problems in turn will validate the information obtained from ED visits for dental problems realized by the homeless population. Only reliable information will provide a real sense of the burden of dental diseases handled in ED settings. The accurate use of diagnostic codes for dental diseases requires a distinct knowledge about oral/dental disease, and current Canadian ED settings generally do not include dentists or have adequate infrastructure to treat dental problems. With physicians examining and treating most patients, an important question is raised concerning the accuracy of the diagnosis classification for dental visits in ED settings conducted by non-dental professionals. For the purpose of this project, it is particularly important to confirm whether ICD-10-CA codes can be used to reliably identify ED visits for dental problems not associated with trauma, which would almost always be a potentially avoidable use of the ED, in contrast to
ED visits for dental problems associated with trauma, which would usually represent appropriate use of the ED.

The second aim of this project is to evaluate ED visits for dental problems not associated with trauma by the homeless in Toronto. Due to limited access to dental care and high prevalence of dental diseases in this population, homeless individuals would be expected to have a high rate of ED visits for dental problems. These visits may represent potentially avoidable ED visits. In addition, the findings of this investigation will provide insights into the impact of dental diseases on a marginalized population and on the acute care system. With the validity of the dental information obtained in EDs confirmed by Part 1 of this project, the findings of the Part 2 will present further evidence about the dental health circumstances of Toronto’s homeless population.
2 Literature review

2.1 Emergency department utilization

In North America, access to health care has been recognized as one of the fundamental challenges faced by homeless populations (25). It is common among homeless individuals to lack a regular source of health care, which leads them to over-utilize EDs (7). Low socio-economic status combined with lack of access to primary health care appears to underlie the utilization of EDs as a major source of health care. In 2004, Levy and colleagues (26) reported that homeless adults are at a high risk of morbidity and mortality with an average of eight to nine concurrent medical illnesses. The accessibility barriers and high prevalence of health issues lead low socio-economic individuals to be frequent users of EDs for most of their health problems. However, EDs are designed for the provision of care for health problems that require urgent medical attention and not for continuous and long-term care for any health problem. The cost of a service in an ED is generally high compared to health care services delivered in primary care settings, generating unnecessary extra costs to the health care system (27).

Conceptually, Anderson and Newman (13, 28) explain health services utilization by the interaction of societal determinants (norms and technology), health services system (resources and organization) and individual determinants (predisposing and enabling factors, and illness level or need). This behavioral model of psychosocial factors of health service utilization proposes that the decision making for health services utilization follows three steps: 1) the problem recognition; 2) the decision to seek help; and 3) the decision of which is the most appropriate service to seek care (13). Expanding this model to the utilization of health services
by vulnerable populations, such as homeless people, special consideration must be given to their living conditions and lifestyle. For homeless vulnerable populations, other aspects such as health insurance and income status, drug and alcohol use, mental health status, competing needs (e.g., food, shelter and safety), and victimization history strongly influence how and which health services they utilize (28).

In this context, the delivery of health services in the ED can be very attractive. The convenience and accessibility of the ED in providing diagnosis and treatment of acute injuries and illness; accessibility 24 hours every day of the year; availability of care without an appointment and/or physician referral are powerful incentives to ED services utilization (7, 10, 29). A major disadvantage of the utilization of the ED might be the time spent in the waiting room; however, for some people, waiting is reasonable compared with days or weeks to get an appointment at primary health care settings or to inaccessible and unaffordable private practitioners (3, 12, 24, 25).

From an administrative health services perspective, the frequent use of EDs for non-urgent health problems arguably contributes substantially to the high cost of the medical care system. The use of EDs as the primary source of medical care is neither ideal nor efficient, representing a misuse of health care resources. However, the ED for socio-economically disadvantaged individual is frequently the easiest and preferable source of health care including dental health care (13, 24, 25). A high frequency of repeated visits to EDs has also been observed (30). Ruger (30) reported that the most frequent users of EDs, those who had at least 20 ED visits annually, are more likely to have less urgent health problems compared with those less frequent users. These aspects of the inappropriate utilization of EDs reveal the impact of the deficiency of the health care system concerning accessibility.
Overall, the literature suggests the following factors as associated with both overutilization and repeated use of EDs by the homeless population:

- lack of health insurance (8-10, 18, 23, 26, 31, 32);
- economic barriers (7-9, 23, 26, 31, 33);
- poor access to primary care (8, 9, 17, 23, 31);
- poor general health and high rates of morbidity (7, 10, 15, 20, 26, 33, 34);
- lack of transportation (9, 10, 27);
- unintentional injuries or traumatic ones from assault (7, 29);
- alcohol and drug abuse (6, 15, 27, 29, 34);
- mental illness (6, 15, 20, 27, 29).

In the United States, the utilization of EDs increased by 36% during the period 1996 to 2006 (35). The same report observed that although ED frequent users account for only approximately 6% of all patients, their visits corresponded to 25% of all visits (35). The inappropriate utilization of ED also concerns visits for dental problems. Cohen (17), in 2002, reported the frequency of ED visits for dental problems and stated that toothache is a public health problem. Further, Milbrett (15), in 2009, reported that 85% of the chief complaints from patients who frequently use the ED were pain related, with oral pain and toothache among the top chief complaints.(15, 36) Homeless people, considered to have high morbidity, have been described as using EDs three times more than the general population (14, 30). Another study confirmed that the inappropriate utilization of EDs by homeless people is a reality in the US with utilization rates 40% higher than the general population (29). These studies are in agreement, suggesting that the lack of access to dental care services is the major reason for the inappropriate utilization of EDs for dental problems.
One of the main concerns of this inappropriate utilization is related to the ineffectiveness of services provided. EDs are not usually equipped for dental interventions, and patients are not usually seen by dental professionals, so a definitive resolution of the dental problem is not achieved. The level of dental care provided in EDs rarely involves more than symptomatic advice and pharmacotherapy. Regardless, standard charges of the medical procedure are applied and those visits place an unnecessary burden on already busy ED settings.

In Canada, despite a universal health care system with full coverage of most hospital and physician services, the frequency of ED visits is constantly increasing and, surprisingly, “[t]he annual rate of ED visits is higher in Canada than in the United States” (2). It was also observed that the prevalence of ED visits among low-income adults is higher than among those with moderate or high incomes (2, 6).

Although physician and hospital care in Canada is universally insured, dental care services are not. Many have argued that the current system of delivering dental care is not effectively meeting the oral health needs of socio-economically disadvantaged subgroups of the population (21, 22, 37). Dental care is limited to those who can pay, either out-of-pocket or through dental insurance plans funded as an employment-based benefit. The public health care system has limited programs for dental care, which mainly address the needs of children in low-income families with acute problems (3). Thus, the barriers that homeless people face in accessing dental care services are also related to the general scarcity of dental resources (18). Furthermore, it is expected that homeless people’s lifestyles exacerbate existing oral diseases, increasing symptomatic problems (7).

In Ontario, Quiñonez et al (18), in 2009, observed that dental problems not associated with trauma were a common reason for ED visits and were more frequent than ED visits for
diabetes and hypertension. The dental problems most commonly observed included periapical abscesses, teething syndrome and dental caries, all of which are associated with pain. These dental problems, although they impact people’s lives, are classified as non-urgent or non-life threatening and are more appropriately and conveniently treated in dental offices. Moreover, these potentially avoidable ED visits for dental problems occurred more frequently among adults and low-income groups, specifically those without private or public dental insurance (3, 8, 18).

As stated, while EDs can provide temporary measures such as pain relief or treatment of infection, they do not provide definitive dental care, and thus fail to resolve the underlying problems (8).

In Toronto, although the utilization of ED for dental problems among homeless individuals has not been investigated, it is expected that the rate of these visits is at least as high as the rate for non-homeless individuals. The rationale for this assumption is based on the poor oral health status of this population and their limited access to dental professionals. The oral health status of the adult homeless population in Toronto, reported for the first time in 2011 by Figueiredo et al (23), showed a critically high rate of chronic and acute oral health problems among the sample population examined. Only 3% of the participants did not need any dental treatment, and 40% of the participants were found to need urgent care. The same report also indicated that this sample of homeless adults was aware of their dental needs and classified the appearance of their teeth as important, despite their low utilization of dental services. One-third of the participants had not seen a dentist within the preceding four years and 37% of them reported that their last visit to the dentist was for emergency reasons. Fifty-two percent of these individuals stated that the ED was their first choice for any kind of health problem (21, 23).
2.2 Medical classification system

With increased policy and advocacy attention on the utilization of EDs for dental problems, concerns have been raised regarding the recording accuracy of dental problems addressed in ED settings by non-dental professionals. The recording system is important and used for administrative data recording of service utilization and outcome evaluation; and consequently, for epidemiological, clinical purposes, reimbursement, resource management and allocation decision-making (25, 38-40). In Canada, the International Classification of Diseases (ICD-10-CA) codes for disease classification are standard in most clinical settings including EDs (39, 40). This medical classification system is used to code and classify diseases, signs or symptoms, and procedures associated with hospital utilization (25, 38-42).

The original objective of ICD codes was to establish a standard classification of diseases for international comparison of mortality and morbidity statistics (38, 43). The utilization of the ICD-10 version for coding started in 1999 after nine previous World Health Organization (WHO) revisions (38). In 2000, Canada introduced its own version of the codes, the ICD-10-CA, developed by the Canadian Institute for Health Information (CIHI) in collaboration with an expert panel of physicians (39, 40). According to CIHI, “ICD-10-CA is more comprehensive and specific than current standards and extends well beyond the traditional causes of death and hospital admission” (39).

In this classification, the codes for dental problems are many and very specific. There are 133 codes for dental problems not associated with trauma included in the ICD-10-CA, ‘Chapter XI - Diseases of the digestive system,’ ranging from codes ‘K00 to K14 - Diseases of the oral cavity, salivary glands and jaws’ (39, 40). These codes are very detailed and require special training and knowledge in oral/dental disease diagnosis (39, 40). This increases the uncertainty
regarding the appropriate selection of diagnosis codes for dental problems in EDs. The codes for dental problems which are associated with trauma are classified with a separate set of codes in the ICD-10-CA, listed in ‘Chapter XIX - Injury, poisoning and certain other consequences of external causes,’ ranging from codes ‘S00 to S09 - Injury to the head’ (39, 40).

The organization of the recording and coding process used in ED settings is the same for all medical procedures, including for visits of dental problems. Therefore, for the coding classification of ED visits for dental problems, there are two chances of error occurring during the recording process, an error in diagnosis and an error in the coding of that diagnosis. The first error may occur when a patient is assessed by the health professional in charge. Here, the health professional records the patient’s main complaint, history of disease, clinical observations, medical procedures and the discharge diagnosis corresponding to the visit. The second error may occur during the selection of the code applied to that ED visit. The ICD-10-CA code is chosen by the code abstractor, who is an administrative employee, based on the discharge diagnosis selected by the health professional and recorded on the patient’s medical chart.

This situation has policy implications given current debates related access to dental care. In Canada, it is assumed that the utilization of EDs for dental problems not associated with trauma is high due to barriers in accessing dental care (37). In contrast, ED visits for dental problems associated with trauma are much more likely to represent appropriate use of the ED and less likely to be related to barriers to accessing dental care. Thus, ensuring that coding practices are accurate is critical in order to get a clear sense of the magnitude and frequency of the different dental problems addressed in EDs. The accurate assessment of the number and kind of ED visits for dental problems not associated with trauma provides policy makers and health authorities with an estimate of the burden that poor access to dental care may place on the health care system. In this regard, diagnostic inaccuracy and coding misclassifications for general
medical conditions have been frequently described in the literature (42, 44-48) but not the inaccuracy for dental codes. For that reason, this project also proposed to investigate if dental problems not associated with trauma are correctly diagnosed and coded, as per the ICD-10-CA classification, in ED settings.

2.3 Purpose of the study

This study is divided into two parts. The purpose of part 1 is to determine the accuracy of ICD-10-CA used to identify ED visits for dental problems not associated with trauma. This will be accomplished by classifying ED visits at a large downtown teaching hospital in Toronto, for which the main diagnosis has an ICD-10-CA code of K00 to K14 - Diseases of oral cavity, salivary glands and jaws.

The research questions for part 1 are:

1) What is the accuracy of the dental diagnosis recorded by the physician on patients’ medical charts during ED visits for dental problems not associated with trauma?

2) What is the accuracy of the ICD-10-CA dental codes chosen by the abstractor corresponding to the ED visits for dental problems not associated with trauma?

The specific objectives for part 1 are:

1) To identify the proportion of misclassification in diagnoses of dental problems not associated with trauma performed by physicians in an ED of a large downtown teaching hospital in Toronto;
2) To identify the proportion of misclassification in the ICD-10-CA dental codes selected by the code abstractor for corresponding ED visits for dental problems not associated with trauma.

The purpose of part 2 is to evaluate ED visits for dental problems using a representative sample of the homeless population in Toronto over an observation period of approximately 4-years.

The research questions for part 2 are:

1) How often do homeless adults in Toronto visit EDs for dental problems not associated with trauma?

2) What factors are associated with ED visits for dental problems not associated with trauma among homeless adults in Toronto?

3) Do homeless adults in Toronto use ED services for dental problems not associated with trauma more often than age- and sex-matched low income controls?

The specific objectives for part 2 are:

1) To measure the overall rate of utilization of ED visits for dental problems not associated with trauma among a population-based sample of homeless adults using administrative health care databases;

2) To identify associations between characteristics of homeless adults and the likelihood of having an ED encounter for dental problems not associated with trauma during the study period;
3) To compare rates of ED visits for dental health problems of homeless participants to age- and sex-matched low income controls from the general population.
3 Manuscript # 1

Title: The Accuracy of International Classification of Diseases Coding for Dental Problems Not Associated with Trauma in a Hospital Emergency Department

Authors: Rafael Figueiredo, Sonica Singhal, Laura Dempster, Stephen W. Hwang, Carlos Quiñonez

3.1 Abstract

Objectives: Emergency department (ED) visits for dental problems not associated with trauma may be a sign of unmet need for dental care. The objective of this study was to determine the accuracy of the International Classification of Diseases codes (ICD-10-CA) for ED visits for dental problems not associated with trauma.

Methods: ED visits in 2008-9 at one hospital in Toronto were identified if the discharge diagnosis in the hospital’s administrative database system was an ICD-10-CA code for a dental problem not associated with trauma (K00-K14). A random sample of 100 visits was selected and the medical records for these visits were reviewed by a dentist. The description of the clinical signs and symptoms were evaluated by the dentist, and a diagnosis was assigned. This diagnosis was compared with the diagnosis assigned by the ED physician and the ICD-10-CA code assigned to the ED visit.

Results: The 100 ED visits reviewed were associated with 16 different ICD-10-CA codes for dental problems not associated with trauma. Only 2% of these ED visits were clearly caused by trauma. The ICD code K0887 (toothache) was the most frequent diagnostic code (31%). We found a 43.3% disagreement between the discharge diagnosis reported by the ED physician and
the diagnosis identified by the dentist reviewing the chart, and 58.0% disagreement between the ICD-10-CA code in the administrative database and the code selected by the dentist reviewing the chart.

**Conclusion:** There are substantial discrepancies between the ICD-10-CA diagnosis assigned in administrative databases and the diagnosis assigned by a dentist reviewing the chart retrospectively. However, ICD-10-CA codes can be used to accurately identify ED visits for dental problems not associated with trauma.
3.2 Introduction

Improving the effectiveness and efficiency of health services has constantly been an agenda item for health authorities and policy makers across Canada (8, 18, 31). In this regard, the utilization of emergency departments (EDs) for non-urgent health conditions that could otherwise be handled at primary care settings has been a keen concern. Literature suggests that 30% of ED visits are for non-urgent or non-life threatening health conditions (15). Inappropriate utilization of EDs not only poses an economic burden on the health care system but also affects the quality of care delivered. A high load of non-urgent visits diverts resources, which can be better utilized for life-threatening conditions, affecting both staff and patients (29, 30, 49).

The inappropriate utilization of EDs also extends to dental problems not associated with trauma (8). In Canada and the United States, toothache is a common chief complaint in EDs, since access to dental care is more limited compared to medical care (17, 18). Under the Canada Health Act every Canadian citizen has right to comprehensive hospital and physician care but not to dental care, as it is excluded (50). Financial barriers to accessing dental care thus leave socioeconomically disadvantaged populations with limited choice, driving many to utilize EDs for their dental-related problems (3, 18). Importantly, their dental problems are not efficiently addressed in EDs, as they are not equipped to deal with such problems. The physician approach in ED settings is generally limited to drug therapy (18).

Acknowledging this, health policy makers have continuously advocated for improved access to dental care for such vulnerable populations (8, 18, 31). They argue that if ED settings are not used for dental problems not associated with trauma, health care dollars can be saved. A case can then be made to allocate those savings specifically to improve access to care. In this regard, identifying such dental problems correctly is the primary step to build a strong argument.
Only reliable information will provide a real sense of the burden of dental diseases handled in ED settings. Nonetheless, the accurate use of diagnostic codes for dental diseases requires a specific knowledge about oral/dental disease, and current Canadian ED settings do not include dentists nor do they have adequate infrastructure to treat dental problems. With physicians examining and treating most patients, an important question is raised concerning the accuracy of diagnoses regarding the dental problems that present in ED settings.

In Canada, the International Classification of Diseases (ICD) codes for disease classification are standard in most clinical settings, including EDs (39, 40). This medical classification system is used to code and classify diseases, signs or symptoms, and procedures associated with hospital utilization (25, 38-42). In this classification, the codes for dental problems are many and very specific. There are 133 codes for dental problems not associated with trauma included in the ICD-10-CA, ‘Chapter XI – Diseases of the digestive system,’ ranging from codes ‘K00 to K14 - Diseases of the oral cavity, salivary glands and jaws’ (39, 40). These codes are very detailed and require special training and knowledge in oral/dental disease diagnosis (39, 40). This increases the uncertainty regarding the appropriate selection of diagnosis codes for dental problems in EDs.

Diagnostic inaccuracy and coding misclassifications for general medical conditions have been described in the literature (42, 44-48). However, the evaluation of accuracy for dental codes has not been previously reported. The objective of this study is thus to investigate if dental problems not associated with trauma are correctly diagnosed and coded, as per the ICD-10-CA classification, in ED settings.
3.3 Methods

3.3.1 Study overview

This study was conducted at St. Michael’s Hospital (SMH), a large teaching hospital in Toronto, Ontario. SMH is located in the downtown core and provides tertiary and quaternary services for the sick and poor of Toronto’s inner city. For all ED visits, patient diagnoses are recorded according to clinical description of the health problems and discharge diagnoses guidelines for ICD-10-CA. The clinical descriptions and the discharge diagnoses are recorded by the health professional in charge, generally a physician, into patient medical charts and then, at a later date, recoded into a hospital administrative database by a coder/abstractor using the ICD-10-CA codes.

Medical charts from SMH’s administrative database system having codes K00-K14 were identified for the 24-month time period of 2008 and 2009. For a patient’s record to be selected, one of the ICD-10-CA codes for a dental problem not associated with trauma had to be the main diagnosis assigned to the patient ED visit. Subsequently, from this sampling frame, 100 charts were randomly selected for this project. Random selection was accomplished using a random number generator (www.random.org). The principal investigator (PI), who is a dentist, evaluated the description of the clinical signs and symptoms of the dental problems presented in the patient chart. According to this evaluation, an ICD-10-CA code was selected by the PI and then compared to the corresponding code for that ED visit, as recorded in the administrative database system. This study was approved by the Research Ethics Board of St. Michael’s Hospital in Toronto.
3.3.2 Sample size calculation

The sample size calculation for this project followed the criteria used by Tu and colleagues (51), which investigated the accuracy of myocardial infarction codes using a 5% random sample of electronic medical records from the Institute for Clinical and Evaluative Sciences (ICES). The ‘Health Care System Quarterly - Fall 2011 Report’ of the Ministry of Health and Long Term Care (52) documented 6,964 ED visits for dental problems not associated with trauma in Toronto, distributed across 35 hospitals in the city, meaning an average of 200 visits per hospital in one year. Thus, our random sample of 100 medical records would constitute approximately 50% of the average ED visits for dental problems not associated with trauma per hospital in one year. Even though SMH possibly has a higher prevalence of ED visits for dental problems due its downtown location and the population that it serves, the sample proposed by this project was still larger than the 5% proposed by Tu and colleagues (51).

3.3.3 Data collection

All data collection, manipulation and evaluation occurred electronically through the hospital administrative database. The data were extracted and stored in a password-protected computer accessible only by the PI. All patient records received a number specific to this study for privacy and data management purposes. The information extracted consisted of basic socio-demographic information (age, sex and residential status), date of the visit, the description of the clinical signs and symptoms of the dental problem, the discharge diagnoses selected by the physician, and the ICD-10-CA code selected by the code abstractor.
3.3.4 Data analysis

The PI performed the analysis of agreement for all patient charts. The inter-examiner reliability of the PI was assessed by a second reviewer, also a dentist, in a 20% randomly selected subsample of the medical charts included in the study. The kappa statistic test was used to assess the agreement between the two, using SPSS Statistics 19.0. The value of the kappa statistic test obtained for the PI reliability test was $K = 0.89$ for the agreement of the discharge diagnosis, reported by the physician, and $K = 0.90$ for the agreement of the ICD-10-CA codes, chosen by the abstractor. Further, descriptive analysis was performed, identifying the most common codes used, and for the agreement and disagreement of the medical charts analyzed between the discharge diagnosis selected by the physician and what the PI found to be the most likely diagnosis; the same was done for the ICD-10-CA code chosen by the abstractor.

3.4 Results

Of the 100 randomly selected medical records of ED visits for dental problems not associated with trauma, 67% were for visits made by males. The average age was 38 years old, ranging from 15 to 79 years old. Homeless individuals or those who had reported no fixed address were responsible for 21% of the visits. We found a disagreement of 43.3% between the discharge diagnosis reported by the physician and the diagnosis suggested by the PI. Higher disagreement (58.0%) was encountered between the ICD-10-CA code chosen by the abstractor and the code suggested by the PI (Table 1). Overall, from the 133 possible ICD-10-CA codes, only 16 codes were used in the administrative database versus 31 codes suggested by the PI.
The discrepancies observed between the codes suggested by the PI and the codes in the administrative database are presented in Table 2. Most of the discrepancies are related to the code ‘Toothache NOS–K0887’. Toothache is a symptom and can be applied to the majority of the cases for dental problems seen in EDs; however, the specification of NOS – not otherwise specified – should limit this code to cases where an unknown source of the toothache is present.

Other problems related to the discrepancies found on both discharge diagnosis and coding records arguably concern knowledge and awareness of dental diseases and the codes listed in the ICD-10-CA classification. Some examples are as follows: the code ‘K10.3 – Alveolitis of jaws’ and the code ‘K01.1 – Impacted teeth’, in all recorded cases, were not consistent with the dental problems described in the medical chart. In addition, two percent of the ED visits that were assigned ICD-10-CA codes for dental problems not associated with trauma were for conditions that were clearly caused by trauma, as demonstrated by the use of key words: “punched in face”, “hit”, “assault”, “fall/fell” or “accident” in ED documentation. However, these visits were classified as a dental problem not associated with trauma in the hospital’s administrative database.

Other coding misclassifications were encountered in 13% of the cases. However, these errors were considered minor because they were related to differences that occurred after the third character of the code, meaning variations of the same health condition (53). For instance, the code K04.7 was consistently used for all cases of periapical abscess: either for cases of ‘Periapical abscess with sinus’ (K04.6); or for ‘Periapical abscess without sinus’ (K04.7). Further, the codes ‘K07.63 – Arthralgia of temporomandibular joint’ and ‘K07.69 – Temporobandibular joint disorder, unspecified’ were used interchangeably in cases of pain associated with the temporomandibular joint. In the cases where the code ‘K10.8 – Other specified diseases of jaws’ was recorded in the administrative data, more appropriate codes could
have been chosen, among them: ‘K10.3 – Alveolitis of jaws (dry socket); ‘K01.1 –Impacted teeth’; ‘K07.69 – Temporomandibular joint disorder, unspecified’; ‘K11.5 –Sialolithiasis’; and cases of dental trauma. For all the examples mentioned above, the diagnoses were correctly identified as described in the medical records but the selection of the codes was inaccurate.
Table 3-1: Agreement and disagreement with the discharge diagnosis and ICD-10-CA code

<table>
<thead>
<tr>
<th></th>
<th>Agree (%)</th>
<th>Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement with the discharge diagnosis</td>
<td>55 (56.7)</td>
<td>42 (43.3)</td>
</tr>
<tr>
<td>Agreement with the ICD-10-CA code</td>
<td>42 (42.0)</td>
<td>58 (58.0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>97 (100)</td>
<td>100 (100)</td>
</tr>
</tbody>
</table>

Table 3-2: Frequency of ICD-10-CA codes used on the administrative data and codes suggested by this analysis

<table>
<thead>
<tr>
<th>ICD-10-CA code</th>
<th>Description of the codes</th>
<th>Administrative Data (N=100)</th>
<th>PI (N=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K08.87</td>
<td>Toothache NOS</td>
<td>31.0</td>
<td>10.0</td>
</tr>
<tr>
<td>K04.7</td>
<td>Periapical abscess without sinus</td>
<td>29.0</td>
<td>38.0</td>
</tr>
<tr>
<td>K10.8</td>
<td>Other specified diseases of jaws</td>
<td>8.0</td>
<td>1.0</td>
</tr>
<tr>
<td>K08.9</td>
<td>Disorder of teeth and supporting structures, unspecified</td>
<td>7.0</td>
<td>3.0</td>
</tr>
<tr>
<td>K02.9</td>
<td>Dental caries, unspecified</td>
<td>6.0</td>
<td>9.0</td>
</tr>
<tr>
<td>K07.63</td>
<td>Arthralgia of temporomandibular joint</td>
<td>3.0</td>
<td>-</td>
</tr>
<tr>
<td>K07.69</td>
<td>Temporomandibular joint disorder, unspecified</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>K10.3</td>
<td>Alveolitis of jaws (dry socket)</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>K01.1</td>
<td>Impacted teeth</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>K04.6</td>
<td>Periapical abscess with sinus</td>
<td>-</td>
<td>3.0</td>
</tr>
</tbody>
</table>

* The codes which were used in less than 2% of the cases have not been listed in the table

** Dental problems associated with trauma represented 2% of the cases and were misclassified as non-traumatic dental problems
3.5 Discussion

As this is the first study assessing the accuracy of ICD dental codes in an ED setting in Canada and internationally, no other data are available for comparison. The evaluation of the accuracy of dental codes was assessed retrospectively by investigating medical charts and associated assigned codes. Our study revealed that 58% of dental related problems were inaccurately coded, which is much higher than the misclassification described for general medical conditions. Farzandipour (54), in 2010, reported a discrepancy of 23% in hospital coding diagnosis, and similarly, MacIntyre (47), in 1997, found 22% of coding inaccuracy in the principal diagnosis of hospital morbidity data. In Canada, Walker (43), in 2012, using ICD-10-CA, described coding misclassification for general medical conditions in hospitals as being substantial with 29% inaccuracy. Therefore, the 58% of misclassification for dental codes identified in this study is substantially higher and merits attention.

The coding process in hospital, including coding for dental problems, although expensive and time consuming, is very important in many aspects of the health care system (43, 53, 55). It is based on the information provided by the coding system that health policies and operational decisions related to care delivered in hospitals is supported. ED visits for dental problems are no different: firstly, with inaccuracy of coding, data are at risk of becoming invalid and arguably useless, as well as inappropriate for disease surveillance; secondly, any strategic planning and targeted hospital funding initiatives concerning the appropriate utilization of health services in a busy ED is dependent on the frequency and demand of health conditions observed. Reliable information on the burden of dental problems addressed in EDs is essential to arguments for allocative efficiency of health resources. ED visits for dental problems not associated with trauma are preventable and avoidable, and ultimately suggest barriers in accessing dental care in primary care settings. To be sure, they suggest the need for health policies that focus on the
delivery of more appropriate and adequate dental services for socioeconomically disadvantaged populations.

3.6 Limitations

This project analyzed ED visit charts from one hospital. For a complete analysis of the accuracy of ICD-10-CA codes for dental related problems in ED settings, the investigation would need to be performed in multiple hospitals and locations across the city and/or province. Another limitation is that the analysis was based on the description of dental problems recorded in medical charts, and none of the patients were clinically examined. However, the findings of this project provide an initial assessment of the degree of inaccuracy of ICD-10-CA codes used in ED settings for dental problems not associated with trauma.

3.7 Conclusion

To improve on the coding accuracy for dental problems in ED settings, we argue that the ICD-10-CA codes should be simplified for use by non-dental health professionals. A coding system with a high level of specification and coding alternatives does not increase either the accuracy or reliability of the information obtained (53). In addition, the literature suggests that attempts to find the correct code for a health condition, when it is known that appropriate health care will not be provided, is not only frustrating but also demotivating for health professionals. For improvement in coding credibility, particularly for dental problems, in-service training courses should be a periodic requirement for all ED health professionals and code abstractors (56).
The ideal solution to this challenge would be the establishment of more appropriate, convenient and accessible dental care in primary care settings. Dental problems are more efficiently and effectively treated by dental professionals in dental offices than in the ED. With the fiscal challenges that exist today in the acute care sector, there is no doubt that the inappropriate utilization of EDs for dental problems represents an unnecessary waste of health care resources.
3.8 References


40. Canadian Institute of Health Information, ICD-10-CA, 10th Revision, Volume 1: Tabular List. 2009.


4 Manuscript # 2

Title: Emergency department use for dental problems among homeless individuals: A population-based cohort study

Authors: Rafael Figueiredo, Laura Dempster, Carlos Quiñonez, Stephen W. Hwang

4.1 Abstract

Objectives: To evaluate emergency department (ED) visits for dental problems not associated with trauma among Toronto’s homeless population.

Methods: A random sample of 1,189 homeless individuals was recruited from shelters and meal programs in Toronto, Canada, in 2005. Participants were required to have a provincial health insurance number, which made it possible to link 1,165 participants (98%) to administrative health care data for the period 2005-2009. Age- and sex-matched controls were selected from individuals living in low-income neighborhoods in Toronto. ED visits for non-traumatic diseases of the oral cavity, salivary glands and jaws (ICD-10-CA codes K00-K14) were identified. Descriptive and multivariable analysis assessed the likelihood of homeless individuals with specific characteristics using ED for dental problems.

Results: Homeless individuals and matched controls had 182 and 10 ED visits for dental problems respectively during the 4-year study period. ED visits for dental problems represented 2.1% of the total number of ED visits by homeless individuals and 0.9% of the total number of ED visits by their matched controls. Homeless individuals were significantly more likely to have
at least one ED visits for dental problems than controls (OR=2.27; 95%CI. 1.16-4.57). Over 80% of the ED visits for dental problems by homeless individuals were for odontogenic infections associated with pain, and 46% of homeless individuals had more than one such visit.

**Conclusion:** The high rate of ED visits for dental problems by Toronto’s homeless population suggests that their access to dental care is inadequate.
4.2 Introduction

In North America, access to health care has been recognized as one of the fundamental challenges faced by homeless populations (25). Homeless individuals often lack a regular source of health care and have inadequately treated physical and mental health conditions, which in turn can lead to potentially avoidable use of hospital emergency departments (EDs) (7). Some have claimed that ED visits for health problems that could have been treated in an ambulatory setting contribute substantially to high health care costs and represent an inefficient use of health care resources (10, 15, 17, 27). However, for marginalized and socioeconomically disadvantaged individuals, EDs often represent the most accessible source of health care (13, 24, 25).

ED visits for dental problems not associated with trauma are of particular interest, because almost all dental problems not associated with trauma are more appropriately addressed in a dental office rather than the ED (8). In 2009, Quiñonez et al. observed that dental problems not associated with trauma were a common reason for ED visits in Ontario and were more frequent than ED visits for diabetes and hypertensive diseases (18). These potentially avoidable ED visits for dental problems occurred more frequently among adults and low-income groups, specifically those without private or public dental insurance (3, 8, 18). While EDs can provide temporary measures such as pain relief or treatment of infection they do not provide definitive dental care, so fail to resolve underlying dental problems.

Canada has a universal system of publicly funded insurance for physician and hospital care but not dental care, the oral health needs of socio-economically disadvantaged populations often go unmet (18, 21, 22). While Canadian provinces have limited programs for dental care, they mainly address the needs of children in low-income families with acute dental problems (3).
Thus, homeless people face barriers to accessing dental care that reflect the general scarcity of dental care resources for low-income individuals across the country (18, 30).

In Toronto, Canada’s most populous municipality, the adult homeless population has a higher prevalence rate of acute and chronic oral health problems compared to the general population (21, 22). In 2013, Figueiredo et al. reported that the oral health status of homeless adults in Toronto was precarious: 40% required urgent dental treatment, 88% restorative treatment, and 71% periodontal treatment (21). Due to limited access to dental care and the high prevalence of dental diseases in this population (8, 18, 31), homeless individuals would be expected to have a high rate of ED use for dental problems. Again, these visits may represent potentially avoidable ED visits.

In light of the above, the main objective of this study is to determine the frequency of ED visits for dental problems not associated with trauma among a population-based sample of homeless adults, compared to a control group of low-income non-homeless adults. A secondary objective is to identify characteristics of homeless adults that are associated with an increased likelihood of ED visits for dental problems. These findings will provide insights into the impact of dental diseases on a marginalized population and on the acute care system.

4.3 Materials and Methods

The cohort of homeless individuals examined in this study has been described previously (57, 58). In brief, a representative sample of 1,189 homeless individuals was recruited at shelters and meal programs in Toronto, Ontario, Canada, from December 2004 to December 2005 (57,
For the purpose of this study homeless individuals were defined as individuals living in an emergency or transitional shelter, public place, vehicle, abandoned building, or someone else’s home, and not having a home of one’s own within the last 7 days (57, 58). Participation was voluntary and selected individuals were considered for their eligibility according to the study’s homelessness definition. Homeless individuals who did not meet the study criteria; or were unable to communicate in English; or were unable to provide informed consent were excluded. Study participants were required to have a provincial health insurance number, a unique 10-digit number that is assigned to every insured individual in the province of Ontario and does not change over an individual’s lifetime. Health insurance numbers were used to link to administrative health care databases at the Institute for Clinical and Evaluative Sciences (ICES). A total of 1,165 homeless participants (98%) were successfully linked. All homeless participants gave written informed consent to perform this linkage.

Homeless participants were matched 1:1 to low income controls from the general population based on year of birth and sex. Personal health card numbers for matched controls were obtained from the Registered Persons Database (RPDB). The RPDB provides basic demographic information (including personal health numbers) for all individuals who had ever possessed an Ontario Health Insurance Plan card number, which serves as proof of health insurance coverage in the province of Ontario. Eligible controls were restricted to individuals who live in Toronto (based on postal code) and who lived in the lowest neighborhood income quintile according to 2006 Canadian census data (Statistics Canada, 2006) as of July 1, 2005 (the approximate mid-point of our study) and who were alive and registered in the RPDB during the study enrollment period. Eligible controls were grouped according to sex and birth year and matched to homeless participants using an algorithm that randomly assigned each case a matched
control. Matching was performed for all homeless participants who provided consent for data linkage and who possessed a valid personal health number (n=1,165).

Data on ED visits by homeless participants and matched controls were obtained from the National Ambulatory Care Reporting System (NACRS) database, which captures information on almost all ED visits in the province of Ontario. Each ED visit is assigned a main diagnosis using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10-CA). Dental problems not associated with trauma were identified using ICD-10-CA codes K00 through K14 (diseases of the oral cavity, salivary glands and jaws).

4.3.1 Data Analysis

Descriptive statistics for all potential predictor variables among homeless participants were examined. As the outcome variable was categorical in nature, logistic regression was performed to calculate odds ratios and 95% confidence intervals. To adjust for other confounder variables, multivariable modeling was performed to determine which characteristics of homeless individuals were associated with increased likelihood of using EDs for dental problems. Stepwise regression using backward elimination (using retention of p-value < 0.01) was used to include predictor variables in the final model. Analyses were performed using SAS Version 9.2 (SAS Inc., Cary, NC).
4.4 Results

During the follow-up period (December 2004 to December 2008), 1,165 homeless participants had 182 ED visits for dental problems not associated with trauma, representing 2.1% of all their ED visits. The 182 ED visits for dental problems were made by 94 homeless individuals, with 46% visiting the ED at least two times for their dental problems during the study period. The data available did not provide enough information to determine if any of the repeated ED visits were for the same dental problem. Table 4-1 shows the distribution of the ED visits. In contrast, during the same time period, the controls had 10 ED visits for dental problems, which represented 0.9% of their total ED visits.

Homeless individuals had 8.0 times as many total ED visits as controls, and 18.2 times as many ED visits for dental problems as controls. Homeless individuals were significantly more likely to have at least one ED visit for dental problems than controls (OR = 2.27; 95% CI, 1.16 - 4.57).
### Table 4-1: Frequency of ED visits by homeless individuals and controls per year

<table>
<thead>
<tr>
<th></th>
<th>2004*</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Homeless Individuals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of ED visits for dental problems</td>
<td>3</td>
<td>34</td>
<td>47</td>
<td>55</td>
<td>43</td>
<td>182 (2.1)</td>
</tr>
<tr>
<td>Number of ED visits for all other conditions</td>
<td>199</td>
<td>2095</td>
<td>2227</td>
<td>2075</td>
<td>1898</td>
<td>8494 (97.9)</td>
</tr>
<tr>
<td>Total number of ED visits</td>
<td>202</td>
<td>2129</td>
<td>2274</td>
<td>2130</td>
<td>1941</td>
<td>8676 (100.0)</td>
</tr>
<tr>
<td><strong>Controls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of ED visits for dental problems</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>10 (0.9)</td>
</tr>
<tr>
<td>Number of ED visits for all other conditions</td>
<td>18</td>
<td>197</td>
<td>282</td>
<td>294</td>
<td>269</td>
<td>1060 (99.1)</td>
</tr>
<tr>
<td>Total number of ED visits</td>
<td>18</td>
<td>199</td>
<td>284</td>
<td>297</td>
<td>272</td>
<td>1070 (100.0)</td>
</tr>
</tbody>
</table>

*Year 2004 accounted for only one month*
Table 4-2 shows the frequency of ED visits for dental problems by the homeless sample based on ICD-10-CA codes. Three dental problems -- Toothache NOS (K0887), Periapical abscess without sinus (K047) and Dental caries (K029) -- accounted for 72% of the total number of ED visits for dental problems. The remaining 28% of the dental problems were related to conditions that occurred much less frequently, including those of non-odontogenic etiology such as disorders of the temporomandibular joint and lesions of the oral mucosa.

Socio-economic and demographic characteristics of homeless individuals who visited the ED for dental problems are presented in Table 4-3. Characteristics significantly associated with greater likelihood of an ED visit for dental problems were male sex, birth in Canada, homeless for more than two years, presence of chronic health conditions, using recreational drugs and smoking.
Table 4-2: Frequency of ED visits by discharge diagnosis

<table>
<thead>
<tr>
<th>ICD-10-CA code</th>
<th>Description of the code</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K0887</td>
<td>Toothache NOS</td>
<td>70 (38.46)</td>
</tr>
<tr>
<td>K047</td>
<td>Periapical abscess without sinus</td>
<td>40 (21.98)</td>
</tr>
<tr>
<td>K029</td>
<td>Dental caries, unspecified</td>
<td>21 (11.54)</td>
</tr>
<tr>
<td>K040</td>
<td>Pulpitis</td>
<td>5 (2.75)</td>
</tr>
<tr>
<td>K108</td>
<td>Other specified diseases of jaws</td>
<td>4 (2.20)</td>
</tr>
<tr>
<td>K122</td>
<td>Cellulitis and abscess of mouth</td>
<td>4 (2.20)</td>
</tr>
<tr>
<td>K130</td>
<td>Disease of lips</td>
<td>4 (2.20)</td>
</tr>
<tr>
<td>K137</td>
<td>Other and unspecified lesions of oral mucosa</td>
<td>4 (2.20)</td>
</tr>
<tr>
<td>K049</td>
<td>Other and unspecified diseases of pulp and periapical tissues</td>
<td>3 (1.65)</td>
</tr>
<tr>
<td>K051</td>
<td>Chronic gingivitis</td>
<td>3 (1.65)</td>
</tr>
<tr>
<td>K052</td>
<td>Acute periodontitis</td>
<td>3 (1.65)</td>
</tr>
<tr>
<td>K089</td>
<td>Disorder of teeth and supporting structures, unspecified</td>
<td>3 (1.65)</td>
</tr>
<tr>
<td>K069</td>
<td>Disorder of gingiva and edentulous alveolar ridge, unspecified</td>
<td>2 (1.10)</td>
</tr>
<tr>
<td>K120</td>
<td>Recurrent oral aphthae</td>
<td>2 (1.10)</td>
</tr>
<tr>
<td>K121</td>
<td>Other forms of stomatitis</td>
<td>2 (1.10)</td>
</tr>
<tr>
<td>various</td>
<td>Other dental problems with only one visit</td>
<td>12 (6.6)</td>
</tr>
</tbody>
</table>
Table 4-3: Demographic characteristics of homeless individuals who had at least one ED visit for dental problems not associated with trauma

<table>
<thead>
<tr>
<th>Demographic group:</th>
<th>Visited ED Freq. (%)</th>
<th>Not Visited ED Freq. (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Males</td>
<td>58 (61.7)</td>
<td>529 (49.4)</td>
<td>Ref.</td>
</tr>
<tr>
<td>Single females</td>
<td>24 (25.5)</td>
<td>272 (25.4)</td>
<td></td>
</tr>
<tr>
<td>Adults with Families</td>
<td>12 (12.8)</td>
<td>270 (25.2)</td>
<td>0.017</td>
</tr>
<tr>
<td>Age:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 years or less</td>
<td>27 (28.7)</td>
<td>254 (28.7)</td>
<td>0.336</td>
</tr>
<tr>
<td>25 years or more</td>
<td>67 (71.3)</td>
<td>871 (76.3)</td>
<td></td>
</tr>
<tr>
<td>Immigration status:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canadian born</td>
<td>79 (84.0)</td>
<td>717 (66.9)</td>
<td>0.001</td>
</tr>
<tr>
<td>Immigrant</td>
<td>15 (15.9)</td>
<td>354 (33.0)</td>
<td></td>
</tr>
<tr>
<td>Level of education:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less</td>
<td>49 (52.1)</td>
<td>538 (50.4)</td>
<td>0.827</td>
</tr>
<tr>
<td>High school diploma or more</td>
<td>45 (47.9)</td>
<td>530 (49.6)</td>
<td></td>
</tr>
<tr>
<td>Lifetime duration of homelessness:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 years or less</td>
<td>32 (34.0)</td>
<td>552 (51.6)</td>
<td>0.002</td>
</tr>
<tr>
<td>More than 2 years</td>
<td>62 (65.9)</td>
<td>519 (48.5)</td>
<td></td>
</tr>
<tr>
<td>Alcohol problem:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>59 (62.8)</td>
<td>767 (71.6)</td>
<td>0.090</td>
</tr>
<tr>
<td>Yes</td>
<td>35 (37.2)</td>
<td>304 (28.3)</td>
<td></td>
</tr>
<tr>
<td>Drug problem:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>42 (44.7)</td>
<td>665 (62.0)</td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>52 (55.3)</td>
<td>406 (37.9)</td>
<td></td>
</tr>
<tr>
<td>Smoke:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>10 (10.6)</td>
<td>328 (30.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>84 (89.4)</td>
<td>742 (69.3)</td>
<td></td>
</tr>
<tr>
<td>Chronic health condition:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>28 (29.8)</td>
<td>442 (41.3)</td>
<td>0.038</td>
</tr>
<tr>
<td>Yes</td>
<td>66 (70.2)</td>
<td>628 (58.7)</td>
<td></td>
</tr>
</tbody>
</table>
Table 4-4 presents the results of logistic regression models examining the characteristics of homeless individuals associated with having at least one ED visit for a dental problem. The unadjusted model shows six characteristics significantly associated with ED visits for dental problems. However, in the adjusted model, after controlling for the influence of all the variables simultaneously, smoking was the only characteristic significantly associated with an increased likelihood of visiting an ED for dental problems.
Table 4-4: The odds of visiting ED for dental problems not associated with trauma among homeless individuals

<table>
<thead>
<tr>
<th>Demographic group:</th>
<th>Unadjusted OR (95% CI)</th>
<th>P-value</th>
<th>Adjusted OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single Males</strong></td>
<td>Ref.</td>
<td></td>
<td>Ref.</td>
<td></td>
</tr>
<tr>
<td>Single females</td>
<td>0.81 (0.49-1.32)</td>
<td>0.382</td>
<td>0.91 (0.55-1.51)</td>
<td>0.412</td>
</tr>
<tr>
<td>Adults with Families</td>
<td>0.41 (0.21-0.77)</td>
<td>0.013</td>
<td>0.63 (0.32-1.25)</td>
<td>0.412</td>
</tr>
</tbody>
</table>

| Age:                          |                        |         |                      |         |
| 24 years or less              | Ref.                   |         | Ref.                 |         |
| 25 years or more              | 0.99 (0.98-1.02)       | 0.779   | 0.99 (0.98-1.01)     | 0.414   |

| Immigration status:          |                        |         |                      |         |
| Canadian born                 | Ref.                   |         | Ref.                 |         |
| Immigrant                     | 0.39 (0.22-0.68)       | 0.001   | 0.57 (0.32-1.03)     | 0.063   |

| Lifetime duration of homelessness: |                      |         |                      |         |
| 2 years or less                | Ref.                   |         | Ref.                 |         |
| More than 2 years              | 2.06 (1.32-3.21)       | 0.001   | 1.51 (0.94-2.42)     | 0.087   |

| Smoke:                        |                        |         |                      |         |
| No                            | Ref.                   |         | Ref.                 |         |
| Yes                           | 3.71 (1.90-7.25)       | < 0.001 | 2.61 (1.30-5.24)     | 0.007   |

| Drug problem:                 |                        |         |                      |         |
| No                            | Ref.                   |         |                      |         |
| Yes                           | 2.03 (1.33-3.10)       | 0.001   |                      |         |

| Chronic health condition:     |                        |         |                      |         |
| No                            | Ref.                   |         |                      |         |
| Yes                           | 1.66 (1.05-2.62)       | 0.031   |                      |         |
4.5 Discussion

This study examined the utilization of EDs by homeless individuals for dental problems not associated with trauma. Our findings demonstrate that utilization of EDs for dental problems is significantly higher among homeless individuals compared to a low-income control group. The number of ED visits for dental problems showed little variation over a four-year observation period. The dental problems observed suggest significant impact on individual well-being and quality of life; over 80% of the ED visits were caused by odontogenic infections associated with pain. Furthermore, 46% of homeless individuals who visited the ED for dental problems had more than one such visit during the observation period. These repeat ED visits suggest that dental problems had a significant impact on these homeless individuals, and that they had difficulty accessing appropriate dental care in the community. In Toronto, the adult population, which is the most frequent users of EDs for dental problems, has very limited access to free dental care services, even for urgent care (21). Nevertheless, the extent to which economic and other personal barriers contribute to individuals choosing the ED as a source of dental care in Toronto is still a subject of investigation and cannot be determined by this analysis.

The health care system as it relates to dentistry and medicine is distinctive as the fields are completely independent of each other. For dentistry, the professional training and work settings are exclusive to oral health care. However, these differences are not always recognized by the general population. Even though most hospitals are not structured for dental treatment, dental problems are still a part of the health services sought in hospitals (18, 32). Definitive treatment for most non-traumatic dental emergencies involves procedures that are only performed by dentists in a properly equipped dental care setting. ED settings are meant to
provide health care for acute illness and injuries, which may be life threatening and need immediate attention. Dental problems at this level of severity are not very common (18, 59). Nonetheless, although the degree of morbidity caused by odontogenic infections is generally non-life threatening, untreated dental conditions do not resolve spontaneously and grow progressively worse without appropriate care. The inappropriateness of ED settings to treat dental problems limits physician procedures to only pharmacotherapy in the majority of cases, which in turn leads to treatment postponement, which then ends up being more extensive and costly. This ineffective pattern of palliative dental care in EDs also impacts the important concept of preventive care and dental rehabilitation, factors that greatly influence the oral health status of individuals in both the short- and long-term (60).

4.6 Limitations

Our analysis included only ED visits that had a dental problem as a main diagnosis, so the number of dental problems seen in EDs maybe underestimated. The sampling strategy excluded homeless individuals who do not use either shelters or meal programs. However, prior research suggests that the unsheltered homeless population in Toronto is very small (61). Another limitation is that although all study participants were homeless at the time of enrollment, their housing status is expected to have fluctuated over the course of the 4-year observation period. Furthermore, health care utilization was assessed using administrative data that are provincial in scope; as such, ED encounters that occurred outside the province of Ontario would have been missed. Homeless participants were required to have a valid provincial health number
in order to be eligible for this study, which may have also biased our sample towards individuals who have better health care access.

### 4.7 Conclusion

The findings of this study provide evidence that the utilization of EDs for dental problems is a common occurrence for homeless individuals (8, 18, 31, 59). ED visits for dental problems represent an inefficient and potentially avoidable use of health care system resources (32, 59, 60). The ED should not be used as a routine source of dental care, just as it should not serve as a substitute for primary medical care (59, 60, 62). Planning and implementing a dental program for the homeless population will, however, require significant political will (24). The development of new public health policy initiatives that provide more comprehensive dental care services to the population is necessary. The proposition does not require universal dental care benefits; however, the provision of public dental care services to attend to in-need populations for urgent dental problems should be part of an immediate public health action. Urgent intervention is required for the improvement of well-being and quality of life of disadvantage minorities concerning their oral health, as well as to more wisely use public health resources. The findings of this study reinforce previous evidence representing strong arguments that advocate for homeless populations concerning the lack of dental public health services in Canada. This information has the potential to guide health authorities and policy makers to structure a more effective dental care delivery system for vulnerable populations.
4.8 References


24. Falvo N. Homelessness, program responses, and an assessment of Toronto’s streets to homes program. Carleton University, 2009.


5  Final Conclusions

This project identified significant coding misclassification concerning ED visits for dental problems not associated with trauma. Although the overall misclassification of the dental codes was much higher than for general medical conditions, most of the discrepancies of the dental codes identified were considered minor according to the literature (56). The discrepancies in dental codes were generally related to the formulation of explicit discharge diagnoses and not related to medical knowledge of identification of the dental problems, as per the description reported in the medical charts. In only 2% of the cases were dental problems associated with trauma incorrectly identified as dental problems not associated with trauma. These results suggest that despite a high rate of inaccuracy for specific dental codes, dental problems not associated with trauma are identified accurately as a general category of ED visits. The causes of and potential solutions for these coding inaccuracies have been suggested in the literature (56, 63). However, for dental problems not associated with trauma seen in EDs, the most effective and definitive resolution would arguably be to improve the accessibility of dental care provided in primary care settings. To be sure, “[the] use of ED for dental problems is a marker for disparities in dental care quality and access” (64), and these visits may represent a potentially avoidable waste of health care resources.

Although any effort to improve the quality of coding system should be taken into account, Part 1 of this project provides the credibility that was necessary to validate the findings concerning ED visits for dental problems by the homeless in Toronto investigated in Part 2. Part 2 of this project provided evidence that the utilization of EDs for dental problems is a common and much higher occurrence among homeless individuals in Toronto compared to a low-income
control group. For the homeless group investigated in this study the percentage of ED visits for dental problems (2.1%) was statistically significant higher compared to their low-income controls (0.9%). Eighty percent of the ED visits were caused by odontogenic infections associated with pain, problems that should be treated by dentists at dental offices. In addition, the 46% of homeless individuals with repeated visits to EDs for dental problems suggests a significant impact of these dental problems on daily life in terms of well-being and quality of life, as well as difficulty in accessing appropriate and timely dental care in primary care settings.

Among low-income controls, the frequency of ED visits for dental problems not associated with trauma (0.9%) was comparable to the ED visits realized by the general population in Ontario (0.9%), reported in 2009 (18). This percentage of ED visits for dental problems observed in the general population was surprisingly higher than for diabetes or hypertensive disease complications. However, the infrastructure and setting of EDs are arguably not best used as a routine source of dental care, just as they should not serve as a substitute for primary medical care (59, 60, 62). ED visits for dental problems represent an inefficient and potentially avoidable use of health care resources (32, 59, 60). Definitive treatment for most non-traumatic dental emergencies involves procedures that are only performed by dentists in a properly equipped dental care setting. ED settings are meant to provide health care for acute illness and injuries, which may be life threatening and need immediate attention. Dental problems at this level of severity are not very common.

Improving the effectiveness and efficiency of health services has constantly been an agenda item for health authorities and policy makers across Canada (8, 18, 31). In this regard, the utilization of EDs for non-urgent health conditions that could otherwise be handled in primary care settings has been a keen concern. Inappropriate utilization of EDs not only poses a possible economic burden on the health care system but also affects the quality of care delivered. A high
load of non-urgent visits diverts resources, which can be better utilized for life-threatening conditions (29, 30, 49). Acknowledging this, health policy makers have continually advocated for improved access to dental care for vulnerable populations (8, 18, 31). They argue that if ED settings are not used for dental problems, health care dollars can be saved. A case can then be made to allocate those savings specifically to improve access to care.

Dental problems are only efficiently and effectively treated by dental professionals in dental offices. Planning and implementing a dental program for the homeless population will, however, require significant political will (24). The development of new public health policy initiatives that provide more comprehensive dental care services to the population is necessary. In Canada, the current dental care delivery system should consider a better approach to the five dimensions of access (availability, accessibility, affordability, accommodation, and acceptability), which greatly influences the course of the health-seeking process (65).

Nonetheless, urgent intervention is required for the improvement of well-being and quality of life in disadvantage minorities in regards to their oral health, as well as a more wise use of public health resources. With the fiscal challenges that exist today in the acute care sector, there is no doubt that the inappropriate utilization of EDs for dental problems represents an unnecessary waste of precious health care resources. The findings of this project reinforce previous evidence representing strong arguments that advocate for homeless populations concerning the lack of dental public health services in Canada. This information has the potential to guide health authorities and policy makers to structure a more effective dental care delivery system for vulnerable populations.
6 Policy Considerations

In Toronto, poor access to dental care for homeless people represents a significant challenge. Having dental care services available, at least for urgent dental problems, will greatly impact people’s health and quality of life. Moreover, it is likely that the current lack of access to dental care helps to sustain existing social and health disparities. Secondly, the utilization of EDs for dental problems represents unnecessary and avoidable costs for the healthcare system. EDs are not appropriate or prepared to provide treatment for dental problems.

Dental care services for socio-economically disadvantaged sub-groups of the population should be the outcome of collaboration between provincial and municipal health authorities. A reasonable and viable proposition to address the number of dental problems seen in EDs would be to initiate accessibility to the treatment of urgent dental problems, toothache and infections. This can be achieved by expanding community-based dental health services, services that are already provided by public health units to eligible beneficiaries. Using the existing infrastructure to provide treatment for urgent dental problems might be cost-effective and can greatly address the dental problems of economically disadvantaged individuals, as well as avoid the inappropriate utilization of ED for dental problems not associated with trauma. In addition, the literature suggests that a dental clinic designated for socio-economically disadvantaged individuals has some benefits over the delivery of dental care services in private practices (14, 66). Avoiding discrimination and increasing the commitment of these individuals with the health care delivery system are among the most important reasons supporting community-based health services.
Another local policy initiative might be the increase of the dental professional workforce by creating service partnerships, an example of which would be the University of Toronto’s Faculty of Dentistry. Dental students would benefit from the training and public health experience and the population will benefit from the services provided. This concept of partnership is not a new one. In the 1970s, Toronto West Central Community Health Centres used this alliance for training dentists (67, 68).

Alternatively, mobile dental clinics might be another possibility for treatment of urgent dental problems. Mobile clinics have the advantage of being where there is a high demand for care. However, this model is more appropriate for small communities where the demand for services does not justify the installation or sustainability of public dental clinics.

Finally, this study has identified additional important points worthy of investigation. For example, an economic evaluation concerning the costs of ED visits for dental problems not associated with trauma would be helpful in guiding health policy decisions. The evaluation should include the impact of these dental visits on the already busy ED settings, and on the individuals suffering from these preventable conditions so that they can receive an appropriate treatment.
7 References


24. Falvo N. Homelessness, program responses, and an assessment of Toronto’s streets to homes program. Carleton University, 2009.


40. Canadian Institute of Health Information,
ICD-10-CA, 10th Revision, Volume 1: Tabular List. 2009.


8 Appendices
8.1 Appendix 1: Part 1 - REB Approval (1st)

June 25, 2013

Dr. Stephen Hwang,
Department of Medicine, Division of General Internal Medicine, Centre for Research on Inner City Health Program,
St Michael's Hospital

Dear Dr. Hwang,

Re: REB# 13-140® - The validity of ICD-10-CA used to identify emergency department visits for dental problems not associated with trauma

REB APPROVAL:
| Original Approval Date | June 25, 2013 |
| Annual/Interval Review Date | June 25, 2014 |

Thank you for your application submitted on 23 May, 2013. The above noted study has been reviewed through a delegated process (not by Full Board review). The views of the St. Michael’s Hospital (SMH) Research Ethics Board (REB) have been documented and resolved. Please note that no member of the St. Michael’s Hospital Research Ethics Board associated with this study was involved in its review or approval.

The REB approves the study as it is found to comply with relevant research ethics guidelines, as well as the Ontario Personal Health Information Protection Act (PHIPA), 2004. The REB hereby issues approval for the above named study for a period of 12 months from the date of this letter. Continuation beyond that date will require further review of REB approval. In addition, the following documents have been reviewed and are hereby approved:

2. Data Collection Sheet submitted May 23, 2013

During the course of this investigation, any significant deviations from the approved protocol and/ or unanticipated developments or significant adverse events should immediately be brought to the attention of the REB.

Please note that if a Clinical Trial Agreement is required, it must be submitted to the Office of Research Administration for review and approval. Any additional institutional approvals must be coordinated and approved through the Office of Research Administration prior to initiation of this research. All drug dispensing must be coordinated through the Research Pharmacy at 416-844-3413.

The St. Michael’s Hospital (SMH) Research Ethics Board (REB) operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans, the Ontario Personal Health Information Protection Act, 2004, and ICH Good Clinical Practice Consolidated Guidelines E6, Health Canada Part C Division 5 of the Food and Drug Regulations, Part 4 of the Natural Health Product Regulations, and the Medical Devices regulations. Furthermore, all investigational drug trials at SMH are conducted by Qualified Investigators (as defined in the latter document).

With best wishes

Dr. Bob Hyland
Chair, Research Ethics Board

Dr. Brenda McDowell
Vice Chair, Research Ethics Board

Dr. Stephen Hwang (REB# 13-140)
St. Michael’s Hospital, 30 Bond Street, Toronto, ON M5B 1W8 Canada T.416.360.4000
Fully affiliated with the University of Toronto: stmichaelshospital.com
8.2 Appendix 2: Part 1 - REB Approval (2nd)

Research Ethics Office
Telephone: (416) 864-600 Ext. 2557
Facsimile: (416) 864-8043
E-mail: rateel@smh.toronto.on.ca

June 20, 2014

Dr. Stephen Hwang,
Department of Medicine, Division of General Internal Medicine,
St Michael's Hospital

Dear Dr. Hwang,

Re: REB# 13-140 - The validity of ICD-10-CA used to identify emergency department visits for dental problems not associated with trauma

REB APPROVAL: Original Approval Date June 25, 2013
Annual/Interval Review Date June 25, 2015

Thank you for your communications dated May 6, 2014 regarding the annual review and approval of the above named study.

This letter will serve as an extension of the St. Michael's Hospital (SMH) Research Ethics Board (REB) approval for the study until June 25, 2015. Continuation beyond that date will require further review of REB approval.

The deliberation, review or approval of this submission did not include a Research Ethics Board member involved with this study.

During the course of this investigation, any significant deviations from the approved protocol and/or unanticipated developments or significant adverse events should immediately be brought to the attention of the REB.

The St. Michael's Hospital (SMH) Research Ethics Board (REB) operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans, the Ontario Personal Health Information Protection Act, 2004, and ICH Good Clinical Practice Consolidated Guideline E6, Health Canada Part C Division 5 of the Food and Drug Regulations, Part 4 of the Natural Health Product Regulations, and the Medical Devices regulations. Furthermore, all investigational drug trials at SMH are conducted by Qualified Investigators (as defined in the latter document).

Good luck with your investigations.

With best wishes

Dr. David Mazer
Chair, Research Ethics Board

Dr. Philip Berger
Vice Chair, Research Ethics Board

Dr. Brenda McDowell
Vice Chair, Research Ethics Board
8.3 Appendix 3: Part 1 - Data Collection Form

Data Collection Form: Agreement of descriptive diagnosis and ICD-10-CA codes in ER visits

<table>
<thead>
<tr>
<th>Study ID</th>
<th>SEX</th>
<th>AGE</th>
<th>Residential Status</th>
<th>ICD-10-CA code</th>
<th>Code Description</th>
<th>Initial complaint</th>
<th>Health Condition Observed</th>
<th>Discharge diagnosis</th>
<th>Agreement discharge diag.</th>
<th>Diagnosis suggested</th>
<th>Agreement with code</th>
<th>Code suggested</th>
</tr>
</thead>
</table>

- Study ID – code number designated to the medical record randomly selected for the study.
- Sex – “F” for female and “M” for male of the corresponding patients
- Age – age expressed in years of the patients at the day of the ED visit
- Residential status – homeless or not
- ICD-10-CA code – code chosen by the abstractor after the medical record is scanned to the administrative data base
- Initial complaint – as reported by the patient and recorded on the medical chart
- Health condition observed – as recorded on the medical chart by the physician in charge
- Discharge Diagnosis – as decided by the physician in charge after examining the patient
- Agreement: Discharge Diagnosis – 1 for agree and 2 for disagree with the discharge diagnosis
- Diagnosis suggested – in case of disagreement
- Agreement with the code – 1 for agree and 2 for disagree with the ICD-10-CA code chosen
- Code suggested - in case of disagreement
8.4 Appendix 4: ICD-10-CA Coding Classification

International Statistical Classification of Diseases and Related Health Problems

Tenth Revision

Volume One — Tabular List

Canadian Institute for Health Information
2006
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**Special tabulation lists for mortality and morbidity**

Appendix A - New ICD-10-CA Codes for 2006

Appendix B - Disabled ICD-10-CA Codes for 2006
About the Canadian Institute for Health Information (CIHI)

CIHI is an independent, pan-Canadian, not-for-profit organization working to improve the health of Canadians and the health care system by providing quality, reliable and timely health information.

CIHI is governed by a Board of Directors whose 16 members create a balance among health sectors and regions of Canada. The Board provides strategic guidance to the Institute as well as the Health Statistics Division of Statistics Canada. In addition, the Board maintains strong links with the Conference of Deputy Ministers of Health, advising them on health information matters.

MANDATE

CIHI’s mandate was established jointly by federal and provincial/territorial ministers of health:
- to coordinate the development and maintenance of a comprehensive and integrated approach to health information in Canada;
- and
- to provide and coordinate the provision of accurate and timely data and information required for:
  - establishing sound health policy;
  - effectively managing the Canadian health system; and
  - generating public awareness about factors affecting good health.

CORE FUNCTIONS

The Institute’s core functions are to:
- identify and promote national health indicators;
- coordinate and promote the development and maintenance of national health information standards;
- develop and manage health databases and registries;
- conduct analysis and special studies and participate in research;
- publish reports and disseminate health information; and
- coordinate and conduct education sessions and conferences.
CHAPTER XI

Diseases of the digestive system (K00-K93)

Excludes: certain:
- conditions originating in the perinatal period (P00-P96)
- infectious and parasitic diseases (A00-B99)
- complications of pregnancy, childbirth and the puerperium (O00-O99)
- congenital malformations, deformations and chromosomal abnormalities (Q00-Q99)
- endocrine, nutritional and metabolic diseases (E00-E90)
- injury, poisoning and certain other consequences of external causes (S00-T98)
- neoplasms (C00-D48)
symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)

This chapter contains the following blocks:

K00-K14 Diseases of oral cavity, salivary glands and jaws
K20-K31 Diseases of oesophagus, stomach and duodenum
K35-K38 Diseases of appendix
K40-K46 Hernia
K50-K52 Noninfective enteritis and colitis
K55-K63 Other diseases of intestines
K65-K67 Diseases of peritoneum
K70-K77 Diseases of liver
K80-K87 Disorders of gallbladder, biliary tract and pancreas
K90-K93 Other diseases of the digestive system

Asterisk categories for this chapter are provided as follows:

K23* Disorders of oesophagus in diseases classified elsewhere
K67* Disorders of peritoneum in infectious diseases classified elsewhere
K77* Liver disorders in diseases classified elsewhere
K87* Disorders of gallbladder, biliary tract and pancreas in diseases classified elsewhere
K93* Disorders of other digestive organs in diseases classified elsewhere

Diseases of oral cavity, salivary glands and jaws (K00-K14)

K00 Disorders of tooth development and eruption

K00.0 Anodontia

Includes: Hypodontia
Oligodontia

K00.1 Supernumerary teeth

Includes: Distomolar
Fourth molar
Mesiodens
Paramolar
Supplementary teeth
INTERNATIONAL CLASSIFICATION OF DISEASES

K00.2 Abnormalities of size and form of teeth

Includes:
- Congenital fusion
- Gemination
- Dens evaginatus
- Dens in dente
- Enamel pearls
- Microdontia
- Peg-shaped [conical] teeth
- Tandemodontism
- Tuberculum paramolare

Excludes:
- Tuberculosis Carabelli, which is regarded as a normal variation and should not be coded

K00.3 Mottled teeth

Includes:
- Dental fluorosis
- Mottling of enamel
- Non-fluoride enamel opacities

Excludes:
- Deposits [accretions] on teeth (K03.6)

K00.4 Disturbances in tooth formation

Includes:
- Aplasia and hypoplasia of cementum
- Dilaceration of tooth
- Enamel hypoplasia (neonatal)(postnatal)(prenatal)
- Regional odontodysplasia
- Turner's tooth

Excludes:
- Hutchinson's teeth and mulberry molars in congenital syphilis (A50.5)
- Mottled teeth (K00.3)

K00.5 Hereditary disturbances in tooth structure, not elsewhere classified

Includes:
- Amelogenesis imperfecta
- Dentinal dysplasia
- Dentinogenesis imperfecta
- Odontogenesis imperfecta
- Shell teeth

K00.6 Disturbances in tooth eruption

Includes:
- Denta praecox
- Natal tooth
- Neonatal tooth
- Prematurity:
  - eruption of tooth
  - shedding of primary [deciduous] tooth
- Retained [persistent] primary tooth

K00.7 Teething syndrome

K00.8 Other disorders of tooth development

Includes:
- Colour changes during tooth formation
- Intrinsic staining of teeth NOS

K00.9 Disorder of tooth development, unspecified

Includes:
- Disorder of odontogenesis NOS

K01 Embedded and impacted teeth

Excludes:
- Embedded and impacted teeth with abnormal position of such tooth or adjacent teeth (K07.3)

K01.0 Embedded teeth

Includes:
- An embedded tooth is a tooth that has failed to erupt without obstruction by another tooth.
DISEASES OF THE DIGESTIVE SYSTEM (K00-K93)

K01.1  Impacted teeth
Includes: An impacted tooth is a tooth that has failed to erupt because of obstruction by another tooth.

K02  Dental caries
K02.0  Caries limited to enamel
Includes: White spot lesions (initial caries)

K02.1  Caries of dentine

K02.2  Caries of cementum

K02.3  Arrested dental caries

K02.4  Odontoclastia
Includes: Infantile melanodontia
Melanodontoclastia

K02.8  Other dental caries

K02.9  Dental caries, unspecified

K03  Other diseases of hard tissues of teeth
Excludes: bruxism (F45.8)
dental caries (K02.0)
teeth-grinding NOS (F45.8)

K03.0  Excessive attrition of teeth
Includes:
Wear
• approximal
• occlusal

K03.1  Abrasion of teeth
Includes:
Abrasion:
• dentifrice
• habitual
• occupational
• ritual
• traditional
Wedge defect NOS

K03.2  Erosion of teeth
Includes: Erosion of teeth:
• NOS
• due to:
• diet
• drugs and medicaments
• persistent vomiting
• idiopathic
• occupational

K03.3  Pathological resorption of teeth
Includes: Internal granuloma of pulp
Resorption of teeth (external)

K03.4  Hypercementosis
Includes: Cementation hyperplasia

K03.5  Ankylosis of teeth
INTERNATIONAL CLASSIFICATION OF DISEASES

K03.6 Deposits [accretions] on teeth

Includes:
- Dental calculus:
  - subgingival
  - supragingival
- Deposits [accretions] on teeth:
  - betel
  - black
  - green
  - materia alba
  - orange
  - tobacco
  - Staining of teeth:
  - NOS
  - extrinsic NOS

K03.7 Posterior colour changes of dental hard tissues

Excludes:
- deposits [accretions] on teeth (K03.6)

K03.8 Other specified diseases of hard tissues of teeth

Includes:
- Irradiated enamel
- Sensitive dentine

Use additional external cause code (Chapter XX) to identify radiation, if radiation-induced.

K03.9 Disease of hard tissues of teeth, unspecified

K04 Diseases of pulp and periapical tissues

K04.0 Pulpitis

Includes:
- Pulpal:
  - abscess
  - polyp
- Pulpitis:
  - acute
  - chronic (hyperplastic/ulcerative)
  - suppurative

K04.1 Necrosis of pulp

Includes:
- Pulpal gangrene

K04.2 Pulp degeneration

Includes:
- Denticles
  - Pulpal:
    - calcifications
    - stones

K04.3 Abnormal hard tissue formation in pulp

Includes:
- Secondary or irregular dentine

K04.4 Acute apical periodontitis of pulpal origin

Includes:
- Acute apical periodontitis NOS

K04.5 Chronic apical periodontitis

Includes:
- Apical:
  - or periapical granuloma
  - periodontitis NOS

K04.6 Periapical abscess with sinus

Includes:
- Dental
  - Dental/veolar
  - abscess with sinus

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K04.7 Periapical abscess without sinus
   Includes:
   Dental
   Dentoolveolar
   Periapical
   abscess NOS

K04.8 Radicular cyst
   Includes:
   Cyst:
   - apical (periodontal)
   - perapical
   - residual radicular
   Excludes:
   lateral periodontal cyst (K09.0)

K04.9 Other and unspecified diseases of pulp and periapical tissues

K05 Gingivitis and periodontal diseases

K05.0 Acute gingivitis
   Excludes:
   acute necrotizing ulcerative gingivitis (A49.1)
   herpetic [herpes simplex] gingivostomatitis (B00.2)

K05.1 Chronic gingivitis
   Includes:
   Gingivitis (chronic):
   - NOS
   - desquamative
   - hyperplastic
   - simple marginal
   - ulcerative

K05.2 Acute periodontitis
   Includes:
   Acute periodontitis
   Parodontal abscess
   Periodontal abscess
   Excludes:
   acute apical periodontitis (K04.4)
   periapical abscess (K04.7):
   - with sinus (K04.6)

K05.3 Chronic periodontitis
   Includes:
   Chronic periodontitis
   Periodontitis:
   - NOS
   - complex
   - simplex

K05.4 Periodontosis
   Includes:
   Juvenile periodontosis

K05.5 Other periodontal diseases

K05.6 Periodontal disease, unspecified

K06 Other disorders of gingiva and edentulous alveolar ridge
   Excludes:
   atrophy of edentulous alveolar ridge (K08.2)
   gingivitis:
   - NOS (K05.1)
   - acute (K05.0)
   - chronic (K05.1)

K06.0 Gingival recession
   Includes:
   Gingival recession (generalized)(localized)(postinfective)(post-operative)

K06.1 Gingival enlargement
   Includes:
   Gingival fibromatosis
INTERNATIONAL CLASSIFICATION OF DISEASES

K06.2  Gingival and edentulous alveolar ridge lesions associated with trauma
Includes: Irritative hyperplasia of edentulous ridge [denture hyperplasia]
Use additional external cause code (Chapter XX) to identify cause.

K06.8  Other specified disorders of gingiva and edentulous alveolar ridge
Includes: Fibrous epulis
         Flabby ridge
         Giant cell epulis
         Peripheral giant cell granuloma
         Pyogenic granuloma of gingiva

K06.9  Disorder of gingiva and edentulous alveolar ridge, unspecified

K07  Dentofacial anomalies [including malocclusion]
Excludes: Hemifacial atrophy or hypertrophy (Q67.4)
         Unilateral condylar hypoplasia or hypoplasia (K19.8)

K07.0  Major anomalies of jaw size
Excludes: Acromegaly (E22.0)
         Hemifacial atrophy or hypertrophy (Q67.4)
         Robin's syndrome (Q87.0)
         Unilateral condylar hypoplasia or hypoplasia (K19.8)

K07.00• Maxillary hyperplasia
Includes: Maxillary macrognathism

K07.01• Mandibular hyperplasia
Includes: Mandibular macrognathism

K07.02• Maxillary and mandibular macrognathia
Includes: Maxognathism:
         • maxillary
         • mandibular

K07.03• Maxillary hypoplasia
Includes: Maxillary micrognathism

K07.04• Mandibular hypoplasia
Includes: Mandibular micrognathism

K07.05• Maxillary and mandibular micrognathia
Includes: Micrognathism:
         • maxillary
         • mandibular

K07.08• Other specified anomalies of jaw size

K07.09• Anomaly of jaw size, unspecified

K07.1  Anomalies of jaw-cranial base relationship

K07.11• Mandibular prognathism

K07.12• Maxillary prognathism

K07.13• Mandibular retrognathism

K07.14• Maxillary retrognathism

K07.18• Other specified anomalies (or asymmetry) of jaw-cranial base relationship

K07.19• Anomaly of jaw-cranial base relationship, unspecified
Anomalies of dental arch relationship
Includes:
- Crossbite (anterior/posterior)
- Distal occlusion
- Mesiolingual occlusion
- Midline deviation of dental arch
- Openbite (anterior/posterior)
- Overbite (excessive):
  - deep
  - horizontal
  - vertical
- Overjet
- Posterior lingual occlusion of mandibular teeth

Anomalies of tooth position
Includes:
- Crowding
- Diastema
- Displacement
- Rotation
- Spacing, abnormal
- Transposition
Excludes:
- Impacted or embedded teeth with abnormal position of such teeth or adjacent teeth
- Embedded and impacted teeth without abnormal position (K01-)

Malocclusion, unspecified

Dentofacial functional abnormalities
Includes:
- Abnormal jaw closure
- Malocclusion due to:
  - abnormal swallowing
  - mouth breathing
  - tongue, lip or finger habits
Excludes:
- Bruxism (F45.8)
- Teeth-grinding NOS (F45.8)

Temporomandibular joint (TMJ) disorders
Excludes:
- Current temporomandibular joint:
  - dislocation (S03.0)
  - strain (S03.4)

Recurrent dislocation of the temporomandibular joint
Excludes:
- Current (acute) dislocation of TMJ (S03.0)

Articular disc disorder of the temporomandibular joint
Includes:
- (Acute) closed lock
- Anterior displacement
- Clicking (snapping)
- Degenerative joint disease
- Disclusion
- Internal derangement

Extracapsular disorder of the temporomandibular joint
Includes:
- Myalgia
- Myofacial pain dysfunction [MPD]
- Myositis
- Myofascial pain
- Occlusal dysfunction
- Trismus
Excludes:
- Temporomandibular joint pain syndrome (K07.63)
INTERNATIONAL CLASSIFICATION OF DISEASES

K07.63 Arthralgia of temporomandibular joint
Includes:
- Temporomandibular joint pain-dysfunction syndrome
- Costen's complex or syndrome

K07.64 Ankylosis of temporomandibular joint
Includes:
- Adhesions of TMJ

K07.68 Other disorders of temporomandibular joint
Includes:
- Arthritis (arthritis)
- Osteoarthritis
- Osteophyte
- Rheumatoid arthritis

of TMJ

K07.69 Temporomandibular joint disorder, unspecified
Includes:
- Temporomandibular joint pain NOS

K07.8 Other dentofacial anomalies

K07.9 Dentofacial anomaly, unspecified

K08 Other disorders of teeth and supporting structures

K08.0 Exfoliation of teeth due to systemic causes

K08.1 Loss of teeth due to accident, extraction or local periodontal disease

K08.2 Atrophy of edentulous alveolar ridge

K08.3 Retained dental root

K08.8 Other specified disorders of teeth and supporting structures
Includes:
- Enlargement of alveolar ridge NOS
- Irregular alveolar process

K08.80 Maxillary alveolar ridge hyperplasia

K08.81 Mandibular alveolar ridge hyperplasia

K08.82 Maxillary alveolar ridge hypoplasia

K08.83 Mandibular alveolar ridge hypoplasia

K08.87 Toothache NOS

K08.88 Other specified disorders of teeth and supporting structures

K08.9 Disorder of teeth and supporting structures, unspecified

K09 Cysts of oral region, not elsewhere classified
Includes:
- Lesions showing histological features both of aneurysmal cyst and of another fibro-osseous lesion
Excludes:
- Radicular cyst (K04.8)

K09.0 Developmental odontogenic cysts
Includes:
- Cyst:
  - dentigerous
  - exudation
  - follicular
  - gingival
  - lateral periodontal
  - primordial
  - Keratocyst
K09.1 Developmental (nonodontogenic) cysts of oral region
Includes: Cyst (of):
  - globeomaxillary
  - incisive canal
  - median palatal
  - nasopalatine
  - palatine papilla

K09.2 Other cysts of jaw
Includes: Cyst of jaw:
  - NOS
  - aneurysmal
  - haemorrhagic
  - traumatic
Excludes: latent bone cyst of jaw (K10.0)
  - Stafne's cyst (K10.0)

K09.8 Other cysts of oral region, not elsewhere classified
Includes:
  - Dermoid
  - Epidermoid
  - Lymphoepithelial
  - Epstein's pearl
  - Nasoalveolar cyst
  - Nasolabial cyst
cyst of mouth

K09.9 Cyst of oral region, unspecified

K10 Other diseases of jaws

K10.0 Developmental disorders of jaws
Includes: Latent bone cyst of jaw
  - Stafne's cyst
  - Torus:
    - mandibularis
    - palatinus

K10.1 Giant cell granuloma, central
Includes: Giant cell granuloma NOS
Excludes: peripheral giant cell granuloma (K06.8)

K10.2 Inflammatory conditions of jaws
Includes:
  - Osteitis
  - Osteomyelitis (neonatal)
  - Osteoradionecrosis
  - Periostitis
  - Sequestrum of jaw bone
  - of jaw (acute)(chronic) (suppurative)

K10.3 Alveolitis of jaws
Includes:
  - Alveolar osteitis
  - Dry socket

K10.8 Other specified diseases of jaws
Includes:
  - Cherubism
  - Exostosis
  - Fibrous dysplasia
  - Unilateral condylar:
    - hyperplasia
    - hypoplasia

K10.9 Disease of jaws, unspecified
INTERNATIONAL CLASSIFICATION OF DISEASES

K11  Diseases of salivary glands
K11.0  Atrophy of salivary gland
K11.1  Hypertrophy of salivary gland
K11.2  Sialoadenitis
   Excludes:  epidemic parotitis (B26.0-)
              uveoparotid fever [Heerfordt] (D86.8)
K11.3  Abscess of salivary gland
K11.4  Fistula of salivary gland
   Excludes:  congenital fistula of salivary gland (Q38.4)
K11.5  Sialolithiasis
   Includes:
      Calculus  Stone  } of salivary gland or duct
K11.6  Mucocele of salivary gland
   Includes:
      Mucous:  
         extravasation cyst
         retention cyst  } of salivary gland
      Ranula
K11.7  Disturbances of salivary secretion
   Includes:
      Hypoptyalism
      Ptyalism
      Xerostomia
   Excludes:  dry mouth NOS (R68.2)
K11.8  Other diseases of salivary glands
   Includes:
      Benign lymphoepithelial lesion of salivary gland
      Mikulicz disease
      Necrotizing sialometaplasia
      Sialectasia
      Stenosis
      Stricture  } of salivary duct
   Excludes:  sicca syndrome [Sjögren] (M35.0)
K11.9  Disease of salivary gland, unspecified
   Includes:  Sialoadenopathy NOS

K12  Stomatitis and related lesions
   Excludes:  cancrum oris (A69.0-)
              chelitis (K13.0)
              gangreneous stomatitis (A69.0)
              herpetic oral ulcer (B00.2)
              noma (A69.0)
K12.0  Recurrent oral aphthae
   Includes:
      Aphthous stomatitis (major)(minor)
      Bednar's aphthae
      Periodontitis maxillo necrotica recurrens
      Recurrent aphthous ulcer
      Stomatitis herpetiformis
DISEASES OF THE DIGESTIVE SYSTEM (K00-K93)

K12 Other forms of stomatitis
Includes:
- Stomatitis:
  - NOS
  - denture
  - ulcerative
  - vesicular

K12.2 Cellulitis and abscess of mouth
Includes:
- Cellulitis of mouth (floor)
- Submandibular abscess
Excludes:
- abscess (of):
  - periodontal (K05.2)
  - peritonsillar (J36)
  - salivary gland (K11.3)
  - tongue (K14.0)

K13 Other diseases of lip and oral mucosa
Includes:
- epithelial disturbances of tongue
Excludes:
- certain disorders of gingiva and edentulous alveolar ridge (K05-K06)
- cysts of oral region (K09.-)
- diseases of tongue (K14.-)
- stomatitis and related lesions (K12.-)

K13.0 Diseases of lips
Includes:
- cheilitis:
  - NOS
  - angular
  - exfoliative
  - glandular
  - cheilitodynia
  - cheilositis
  - mucocoele of lip
  - perlèche NEC
Excludes:
- arboflavinosis (E53.0)
- cheilitis due to radiation-related disorders (L55-L59)
- perlèche due to:
  - candidiasis (B37.8)
  - riboflavin deficiency (E53.0)

K13.1 Cheek and lip biting

K13.2 Leukoplakia and other disturbances of oral epithelium, including tongue
Includes:
- Erythroplakia
- Leukoedema
- Leukokeratosis nicotina palati
- Smoker's palate
Excludes:
- hairy leukoplakia (K13.3)

K13.3 Hairy leukoplakia

K13.4 Granuloma and granuloma-like lesions of oral mucosa
Includes:
- Eosinophilic granuloma
- Granuloma pyogenicum
- Verruous xanthoma

K13.5 Oral submucous fibrosis
Includes:
- Submucous fibrosis of tongue

K13.6 Irritative hyperplasia of oral mucosa
Excludes:
- irritative hyperplasia of edentulous ridge [denture hyperplasia] (K06.7)
K13.7 Other and unspecified lesions of oral mucosa
Includes: Focal oral mucous

K14 Diseases of tongue
Excludes: erythroleukemia
focal epithelial hyperplasia
leukoedema
leukoplakia
hairy leukoplakia (K13.3)
macroglossia (congenital) (Q38.2)
submucous fibrosis of tongue (K13.5)

K14.0 Glossitis
Includes: Abscess
Ulceration (traumatic)
Mueller’s glossitis
Excludes: atrophic glossitis (K14.4)

K14.1 Geographic tongue
Includes: Benign migratory glossitis
Glossitis areata exfoliativa

K14.2 Median rhomboid glossitis

K14.3 Hypertrophy of tongue papillae
Includes: Black hairy tongue
Coated tongue
Hypertrophy of foliate papillae
Lingua villosa nigra

K14.4 Atrophy of tongue papillae
Includes: Atrophic glossitis

K14.5 Plicated tongue
Includes: Fissured tongue
Furrowed tongue
Serosal tongue
Excludes: fissured tongue, congenital (Q38.3)

K14.6 Glossodynia
Includes: Glossopyrosis
Painful tongue

K14.8 Other diseases of tongue
Includes: Atrophy
Cantated
Enlargement
Hypertrophy

K14.9 Disease of tongue, unspecified
Includes: Glossopathy NOS
8.5 Appendix 5: Part 2 – REB Approval

Research Ethics Office  
Telephone: (416) 864-6060 Ext. 2957  
Facsimile: (416) 864-5643  
E-mail: recinfo@smh.toronto.on.ca

November 04, 2013

Dr. Stephen Hwang,  
Department of Medicine, Division of General Internal Medicine,  
St Michael’s Hospital

Dear Dr. Hwang,

Re: REB # 03-223 - Health care utilization in homeless people

<table>
<thead>
<tr>
<th>REB APPROVAL:</th>
<th>Original Approval Date</th>
<th>September 12, 2003</th>
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<tbody>
<tr>
<td></td>
<td>Annual/Interval Review Date</td>
<td>September 12, 2014</td>
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</table>

Thank you for your communications dated September 4, 2013 regarding the annual review and approval of the above named study.

This letter will serve as an extension of the St. Michael's Hospital (SMH) Research Ethics Board (REB) approval for the study until September 12, 2014. Continuation beyond that date will require further review of REB approval.

The deliberation, review or approval of this submission did not include a Research Ethics Board member involved with this study.

During the course of this investigation, any significant deviations from the approved protocol and/or unanticipated developments or significant adverse events should immediately be brought to the attention of the REB.

The St. Michael's Hospital (SMH) Research Ethics Board (REB) operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans, the Ontario Personal Health Information Protection Act, 2004, and ICH Good Clinical Practice Consolidated Guideline E6, Health Canada Part C Division 5 of the Food and Drug Regulations, Part 4 of the Natural Health Product Regulations, and the Medical Devices regulations. Furthermore, all investigational drug trials at SMH are conducted by Qualified Investigators (as defined in the latter document).

Good luck with your investigations.

With best wishes

☐ Dr. David Mazer  
Chair, Research Ethics Board

☒ Dr. Brenda McDowell  
Vice Chair, Research Ethics Board
8.6 Appendix 6: Part 2- Analysis Plan

Emergency department use for dental problems among homeless individuals:
A population-based cohort study

Research Question

- How often do homeless adults in Toronto visit emergency departments (ED) for non-traumatic dental problems? -> Objective A
- What factors are associated with ED visits for non-traumatic dental problems among homeless adults in Toronto? -> Objective B
- Do homeless adults in Toronto use ED services for non-traumatic dental problems more often than low income controls (age- and sex-matched) from the general population? -> Objective C

Objectives

A. To measure the overall rate of utilization of ED visits for dental problems not associated with trauma among a population-based sample of homeless adults using administrative health care databases

B. To identify associations between characteristics of homeless adults and the likelihood of having an ED encounter for dental problems not associated with trauma during the study period

C. To compare rates of ED visits for dental health problems of homeless participants to low income controls (age- and sex-matched) from the general population.
Timeframe

The baseline is the date of enrolment of the participants into the study (DATEMAIN) (2004 - 2005) until March 31, 2009.

Data Sources

**Actual ED Use for Dental Problems:** ED visits will be derived based on NACRS datasets using the International Statistical Classification of Diseases and Related Health Problems, ICD-10-CA codes. This project is interested on the ICD-10-CA codes, as the most responsible diagnosis (DX10CODE1), from K00 to K14: Diseases of oral cavity, salivary glands and jaws (e.g., K02.9 – dental caries). (Appendix 1)

Data on actual health care use will be derived from administrative health care utilization databases (NACRS).

Outcome Variables

**ED visits for dental problems not associated with trauma (Objective A):** Refer to Table 1 for outcome variable specifications.

For ED visits, outcome variables will be derived two ways:\(^1\)

1. Binary indicator (yes/no) for presence or absence of ED visit during the study period, from 2004/2005 to 2009 (i.e., POST period)

\(^1\) At some point, we may also derive an ordinal categorical variable based on count variables
2. Count (continuous) of number of visits during the study period, from 2004/2005 to 2009 (i.e., POST period)

Analysis

**ED visits for dental problems not associated with trauma (Objective A):** Rates will be calculated as the number of ED visits for a dental-related problem, as defined using ICD-10-CA codes, divided by the total period under observation. Participants were followed through time from their date of enrolment into the study (2004-2005) until March 31, 2009. Dates of death will be used to adjust person-time of observation, if needed.

**Predictors of self-reported ED for dental problems not associated with trauma (Objective B):** Logistic regression will be used to calculate odds ratios (ORs) and 95% confidence intervals comparing homeless adults with at least one ED visit for dental problems not associated with trauma to those without an ED visit for a dental problem during the study period. Refer to Table 2 for list of explanatory variables for logistic regression.
### Table 1. Outcome Variable Specifications

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<th>Variable</th>
<th>Label</th>
<th>Type</th>
<th>Specifications</th>
<th>Original variables</th>
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<td>Total number of ED visits for dental problems not associated with trauma (K00-K14) during period (2004/2005-2009)</td>
<td>Binary</td>
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**Table 2.** List of explanatory variables for logistic regression analysis

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Requested Outputs

ED visits for dental problems not associated with trauma (Objective A):

1. **Proc means** (mean, SD, median, min, max, sum, n) for continuous outcomes (EDdent_t) (x2 zeros in AND zeros out)
2. **Proc freq** for categorical outcomes (EDdent_td)
3. **Descriptive analyses**: the frequency of each ICD-10CA code (K00 to K14) for dental-related ED visits for homeless and control participants (Appendix 1)

Predictors of self-reported ED for dental problems not associated with trauma (Objective B):

Univariate ORs and 95% CIs for ED visits use (EDdent_td) for each explanatory variable of interest