

NOTE TO USERS

This reproduction is the best copy available.

UMI

**COMPARING DENTAL CARE PRESCRIBED BY PRIVATE PRACTITIONERS
AND BY DENTAL DIRECTORS EXPOSED TO CONTINUING EDUCATION IN
EVIDENCE-BASED GUIDELINES**

by

Elizabeth Rolland

**A thesis submitted in conformity with the requirements for the degree of
Master of Science
Graduate Department of Community Health
University of Toronto**

© Copyright by Elizabeth Rolland (2001)



National Library
of Canada

Acquisitions and
Bibliographic Services

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale
du Canada

Acquisitions et
services bibliographiques

395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-62933-3

Canada

Abstract

Background: There is a body of literature that concentrates on factors that can contribute to the type and volume of care offered by health care specialists to their patients. For dentists, these factors include whether a dentist has pursued continuing education (Lewis & Main, 1997), age (Gremboswki et al. 1990a) and year of graduation (Bader & Shugars, 1995; Main et al., 1997a,; 1997b), location of training (Bradnock & Rock, 1982), reimbursement scheme Main et al., 1997a), surgical signature (Bader & Shugars, 1995), location of practice (Bader & Shugars, 1995), dentist to patient ratio (Main et al., 1997b), and number of dentists in a practice (Main et al., 1997a). This study attempted to determine whether there was a statistically significant difference between the amount of care proposed by dental directors from four Ontario public health units and the amount of care provided by private practitioners, to children enrolled in the Children in Need of Treatment Program.

Methods: We conducted a prospective cohort study of subjects recruited through the Ontario Children in Need of Treatment (CINOT) Program between October 1998 and March 2000. A total of 70 subjects were recruited in four public health units. Relative value units (RVUs) were used to measure the amount of treatment prescribed by dental directors in public health units exposed to continuing education in evidence-based guidelines, and the amount performed by private practitioners. Paired t-tests of the differences between the two were performed, as well as a stratified analysis by health unit and type of procedure.

Results: We recorded a statistically significant difference in the overall mean difference in RVUs measuring treatment between dental directors and community dentists ($p < .001$). A stratification by health unit showed that these differences were also significant within each health unit. A third analysis stratifying by service type showed a statistically significant difference in diagnostic ($p = .017$), preventive ($p < .001$) and restorative ($p < .001$) services. Conversely, surgical ($p = .440$), endodontic ($p = .271$) and adjunctive ($p = .421$) services showed no statistically significant difference in mean. All services also showed a clinically significant difference in the amount of care proposed/ provided.

Interpretation: Significant statistical difference was established between the care recommended by dental directors and performed by private practitioners. Factors that contribute to this difference could not be assessed due to limitations in the initial study design, which did not include collection of data on dentists or patients. However, differences in financial incentives related to system of remuneration for the two groups merit further investigation. Future research should endeavour to determine the relevance of factors such continuing education, payment scheme, age of dentist, location of training, location of

practice, year of graduation, dentist to patient ratio, and the number of dentists in a practice as contributors to the difference in care reported here.

Table of Contents

I. INTRODUCTION.....	1
Potential Sources of Variation in the Provision of Dental Health Care.....	1
Payment Scheme.....	1
Dentist Age/Year of Graduation.....	2
Location of Dentist's Training.....	4
Surgical Signatures.....	4
Continuing Education.....	5
Geographic Variability.....	6
Dentist to Patient Ratio.....	6
Number of Dentists in Practice.....	6
Patient Age.....	7
Private Insurance.....	7
Thesis Subject.....	8
II. METHODS.....	9
Subjects/Participants.....	9
Background on Children in Need of Treatment Program.....	10
Data Collection.....	13
Variables.....	14
Region.....	15
Relative Value Units.....	17
Service Groups.....	20
Data Analysis.....	21
Comparison at the Public Health Unit Level.....	22
Comparison by Service Type.....	23
General Linear Model Analysis.....	23
Consideration of Clinical Significance.....	24
POWER CALCULATION.....	26
ETHICS.....	28
III. RESULTS.....	29
Enrollment.....	29
Key Outcomes.....	29
Description of Plans Overall and By Health Unit.....	29
Description of Plans by Service Type.....	31
Comparison of Services Between Public Health Units.....	32
Statistical Analyses.....	36
Overall Differences Between Plans.....	36
Difference in Care Patterns by Public Health Unit.....	37
Difference in Care Patterns by Service Type.....	38
General Linear Model Measuring Difference in Care Patterns as a Function of Public Health Unit and Plan.....	39
Clinical Significance.....	40
IV. DISCUSSION.....	41
Findings.....	41
Overall Analysis.....	41

Analysis by Public Health Unit	43
Analysis by Service	44
General Linear Model Analysis	46
Clinical Significance of Findings.....	46
Limitations of This Study.....	48
Internal Validity.....	48
External Validity	50
Content Limitations of This Study	51
Payment Scheme.....	51
Dentist Age/Year of Graduation	57
Location of Dentist's Training.....	57
Surgical Signatures	58
Geography/Dentist:Patient Ratio.....	58
Talent/Skill of Dentist	59
Logistical Issues in Conducting this Study.....	59
Recruitment Issues	60
Larger-Scale Study	61
Future Research.....	63
Policy Implications	65
Educational Policy Issues	65
Policy Issues Related to CINOT Payment Scheme.....	67
V. CONCLUSIONS	70
Further Research Recommendations	70
Other Recommendations.....	71
LITERATURE CITED	72
Appendix A - CINOT Care Decision Tree.....	77
Appendix B - Demographic and Oral Health Background on Participating Public Health Units.....	78
Appendix C – University of Toronto Ethics Review Approval	86
Appendix D – Release of Treatment Information Form	87
Appendix F – Service Types	89
Appendix G – Additional Variables.....	90
Appendix H - Role of Student.....	96

I. INTRODUCTION

All professions that rely on the personal judgment of an individual in assessing the need for care are subject to variations in the type and amount of care. Dentistry is no exception. While this notion is universally accepted and well-documented in medicine, the body of work pertaining to dentistry remains limited. In an effort to contribute to knowledge in this field, the Community Dentistry Health Services Research Unit at the University of Toronto conducted a study to measure differences in planned care between dental directors at four public health units in Ontario and dentists in the general population of the same units who are involved in the treatment of children enrolled in the Ontario-wide “Children in Need of Treatment” (CINOT) program.

There are numerous factors that may contribute to a difference in the provision of care to an individual or group of individuals. Some of the evidence available to suggest these factors is the result of study in the medical field, but can also often be extrapolated to the field of dentistry. An overview of these factors now follows.

Potential Sources of Variation in the Provision of Dental Health Care

Payment Scheme

The first factor that can contribute to a difference in the care provided by a general dentist is the payment scheme. There is substantial literature in medicine and in dentistry on the effects of payment scheme on the type and quantity of care given by a practitioner.

The literature states that there are differences in treatment plans based on whether a dentist is being paid on a capitation, fee-for-service, or salary basis. Capitation payment is “where a payment is made to a primary care provider for every patient for whom they provide care” (Gosden et al., 2001). Fee-for-service payment is “where payment is made to a primary care provider for every item of service or unit of care that they provide” (Gosden et al., 2001). Salary is where a primary care provider is made a payment for practicing dentistry or medicine, and is not pro-rated based on the number of patients seen or amount of care provided.

Hazelkorn and his colleagues have shown that dentists who perform fee-for-service (also known as “piece rate” (Robinson, 2001)) dental procedures tend to provide more than dentists who are paid through capitation payments (Hazelkorn, 1985). Similar findings in dentistry were also reported in the Journal of Commerce (1983), and by Olsen and Chetlat (1979). These findings also apply to medicine (Robinson, 2001).

Given that the dentists in the general population are remunerated on a fee-for-service basis while dental directors are remunerated on a salary basis, it is conceivable that there could be a difference in the type and amount of care offered/proposed to identical subjects by the two groups under study here because of the different payment schemes in effect.

Dentist Age/Year of Graduation

The most well-documented type of variation in dental practice is variation due to a dentist's age or year of graduation (Bader & Shugars, 1995; Grembowski et al., 1990a, 1990b; Main et al., 1997a, 1997b). These researchers

identified an inverse relationship between a dentist's age and level of utilization. In their study, Grembowski et al. (1990a) also classified dental utilization rates for patients for whom records were available. They were recruited from a Washington State public school district list of employees enrolled in a dental insurance plan. Although the reimbursement method was not specified, it was the same for all subjects. Although this could still influence the amount of absolute care offered by dentists in this study, it would have no impact on the relative differences reported in their study. The amount of care was quantified as a rate, defined as "the average number of services provided per patient during the period." Certain services had a range in rate that included zero (endodontic, prosthodontic, oral and adjunctive services) with relatively low maximum values (the largest was a rate of 2.51 recorded for periodontic services). Other services, however, showed unusual variation. For example, for diagnostic services, there was a 350-fold variation between the minimum and the maximum rates (0.01, 3.53). This being said, the actual maximum value was still relatively small. The amount of variation is impressive because of the small size of the minimum value. Restorative services had a smaller range in rates (1.10, 5.13) which resulted in a 5-fold variation, but with the largest maximum utilization rate for any service.

Although they were not able to determine all the factors that contributed to the variation in their study, they asserted that one of the reasons that was responsible for the variation was that "Young providers may have higher service

rates because they have not matured clinically and lack experience in clinical judgment, which implies overutilization by younger adults."

Location of Dentist's Training

In addition to a dentist's age as being a factor in services rendered to patients, the location of a dentist's training is also a significant factor in variation. This was first established by Bradnock and Rock (1982) and has also been documented by Bader and Shugars (1995) and by Porter et al. (1999). It is possible that this would contribute to any possible variation within this study given that there are 2 dental schools within Ontario alone.

Surgical Signatures

A less tangible and more difficult to measure factor of variation is the fact that dentists have their own preferred clinical methods, or "surgical signatures" (Bader and Shugars, 1995). For example, while one dentist will prefer to use a conventional explorer to identify caries in his/her patients, another dentist will prefer to use a more modern piece of equipment such as a light emitting diode laser. Both of these techniques serve the purpose of identifying coronal caries, but one is significantly more expensive than the other. In an example such as this one, a patient going to see the dentist offering coronal caries diagnosis with a laser rather than the more conventionally accepted explorer would find him/herself paying substantially more for what is, in effect, a similar service. Differences may appear in the sensitivity and specificity of both techniques that may warrant the use of one method over another, although this is not systematically the case.

Continuing Education

Through multiple regression analysis, Lewis and Main (1996) found that the amount of continuing education undertaken by a dentist significantly affected the rates of certain preventive measures for patients between the ages of 6 and 11. This evidence showed a significant difference between the services proposed by dental directors (who had taken additional courses) compared to the services provided by dentists (whose post-grad educational status was unknown). It also targeted an age range that falls within the age limits set up by CINOT.

Much of the continuing education currently available to dentists either emphasizes or is based on evidence-based guidelines, whose purpose is to offer care based on the best available evidence. Practitioners are encouraged to critically assess the guidelines they read in professional journals and implement them in their everyday practice. Therefore, related to the issue of continuing education, is the issue of whether some potential difference in care provision could be the result of differential knowledge and implementation of evidence-based guidelines. Just as the educational status of private practitioners is unknown within the context of this study, so also is their understanding and acceptance of evidence-based care. We know that the dental directors participating in this study have followed at least a one-day session in evidence-based guidelines developed by the Community Dentistry Health Services Research Unit (CDHSRU) at the University of Toronto, and have made concerted efforts to implementing them within their respective health units. It is also known that many of them have extensive post-graduate education in the evaluation and implementation of evidence-based care. Because of this, it is important to

acknowledge this as a potential source of difference in care between the study's providers.

Geographic Variability

There is some literature that establishes a significant difference in dental treatments being received by patients in rural versus urban areas (Bader & Shugars, 1995; Locker & Clarke, 1999). For example, Locker and Clarke (1999) established that the amount of services received in metropolitan Toronto was 60% more than the amount of treatment received in Sudbury, a more remote location with a smaller population.

Dentist to Patient Ratio

Because of the lower ratio of dentists to patients in urban areas compared to rural areas, dentists in urban areas may compensate for their lower dentist to patient ratio by establishing what is called "Provider-induced demand." This term means that dentists compensate for their smaller patient population by either increasing fees for services, by prescribing more expensive (and sometimes time-consuming) treatments for their patients, or by decreasing the recommended recall period between appointments. Main et al. (1997b) ascertained that 51.7 per cent of dentists they interviewed in Ontario felt that their practices were less busy than they would like, hence the incentive for compensation mechanisms described above.

Number of Dentists in Practice

Main et al. (1997a) found that the number of dentists in a practice would influence the extent to which certain treatments were offered to patients. In their example, they found that dentists in a partnership were more likely to use

sealants, which was found to be consistent with the results seen by Faine and Dennen (1986). The authors contend that this is because the more dentists are present in a practice, the more total experience there is, and the more communication about treatment there is. In other words, more dentists mean more exposure to more diverse treatments. It could also be contended that this could be related to the fact that the more dentists there are in a practice, the fewer patients there are per dentist, therefore pushing them towards prescribing more care to their patients.

Patient Age

Rouse & Hamilton (1991) have found through their research that a patient's age was directly correlated with the age of his/her provider. As it is already known that there is some variation based on the age of a dentist, it can be extrapolated that younger patients receive treatment from younger dentists which, as was already mentioned, also results in a higher level of utilization than older patients who frequent older dentists.

Private Insurance

Finally, whether an individual has private insurance or not will also affect the level of utilization. There are several possible explanations for this variation. Individuals without private insurance may go to dentists who charge less and who keep services to a minimum, or dentists, within their practices, may offer two levels of services and charge two different sets of fees based on whether a patient has private insurance or not. A third and final possibility could be that insured patients request additional care if it is covered by their insurance. Regardless of whether the variation comes from within a practice or from

between practices, the fact of the matter is that variation occurs because of a patient's insurance status (Main et al., 1997a). The type and extent of variation related to this factor is not measured within the scope of this study as the treatment provided to all of this study's subjects is covered by CINOT.

Thesis Subject

The subject of this thesis will be to determine whether this study identifies a significant difference in the care proposed by dental directors exposed to continuing education in evidence-based guidelines at four participating public health units and that performed by practitioners in the general population, for children enrolled in the "Children in Need of Treatment" program. Guidance will also be offered for other studies with a similar goal or methodological structure.

II. METHODS

Subjects/Participants

This prospective cohort study was conducted between October 1998 and March 2000 by the Community Dentistry Health Services Research Unit (CDHSRU) at the University of Toronto (please refer to Appendix H for role of student).

The purpose of this study was to determine whether private practitioners offer similar care to the care proposed by the dental directors at the four public health units that agreed to participate in this study. The subjects for this study were recruited from the CINOT population within each of the four public health units in question (see below for a description of this population).

In order to recruit subjects for this study, parents of CINOT-eligible children were approached face-to-face by the Dental Director of the participating public health units. If parents agreed to the enrollment of their child, they were required to sign an informed consent form (Appendix E) as well as a release of treatment information form (Appendix D). The release of treatment information form was then attached to a letter addressed to the subject's dentist requesting treatment information and x-rays for each subject.

The dental directors were responsible for the collection of all consent and release of treatment information forms from all subjects in their public health unit. As part of their participation in the study, they were also required to contact all dentists in order to get access to radiographs and treatment plans. The next step was to have the dental director conduct a clinical examination of each subject

and prepare a treatment proposal using the radiographs submitted by the dentist in addition to the dental director's clinical exam (Plan 3).

The following inclusion criteria were used:

- Subject had been identified as needing urgent care;
- Parents had declared care would be a financial burden;
- Parents consented to have their child included in the study;
- The invoice for complete dental care under CINOT was received;
- The diagnostic dental radiographs were received by the public health unit;

The following exclusion criteria were used:

- Children for whom consent was not given;
- Children with incomplete dental care as determined from the CINOT claim form;

Background on Children in Need of Treatment Program

Despite significant advances in oral health made in Canada in the past 50 years, the 1993/1994 Ontario Dental Indices Survey estimated that 4% of 11 year olds and 10% of 7 year olds show signs of urgent dental problems (Bennett, 1996). It is statistics like these that illustrate the need for an infrastructure to deal with these urgent, unmet needs.

Ontario, as part of its Mandatory Health Programs and Services Guidelines (1997) attempts to meet these needs through a variety of programs, including CINOT (http://www.childsec.gov.on.ca:80/3_resources/childrens_pathfinder/programs/cinot.htm).

CINOT was implemented in 1987 as a result of the findings of the Advisory Committee on Dental Care for Ontario Children (Bennett & Burry, 1999). Before December 1997, CINOT was primarily responsible for covering urgent dental health care needs for children whose families stated dental care would be a financial burden. In addition, because of restricted levels of services covered under the welfare programs, CINOT sometimes covered additional services for children whose families received General Welfare Assistance (GWA) or Family Benefits Allowances (FBA). The cost of this coverage was recovered (at the Ministry of Health level) through an agreement between the Ministry of Health and the Ministry of Community and Social Services.

After December 1997, changes came into place that modified the population using CINOT. Recipients of the Family Benefits Allowance (FBA) and General Welfare Program changed to Ontario Works; a new Ontario Disability Support Program (ODSP) was introduced; and CINOT financing was passed down to the municipal level as a result of the government's health services restructuring. While the previous system offered two levels of financial coverage based on whether a family was enrolled in the FBA or the GWA, these legislative changes resulted in all ODSP and OW children receiving the same level of care coverage (Bennett & Burry, 1999). This meant that rather than having two levels of care based on a family's type of social assistance, all children on any type of social assistance (whether it be ODSP or OW) were now entitled to the same type of dental care, namely mandatory basic dental care as an ongoing benefit.

CINOT continues to cover a range of basic and extended dental care services for eligible children, (i.e. those with urgent unmet dental needs and financial hardship, see below) which include fillings, extractions and examinations (Muskoka Parry-Sound Health Unit, 2000). Management of the program is incumbent upon the Dental Directors and staff of the health units. Preventive services such as cleanings and fluoride treatments are not covered by CINOT as these services are provided free of charge by the public health units as part of their dental health programs. Furthermore, CINOT provides only one course of treatment in order to restore the oral health of a child to a reasonable level. However, a child can be re-assessed by Health Unit staff and can be re-enrolled if he/she requires subsequent urgent dental health care.

The following eligibility criteria are used to enroll children in the CINOT program:

1. Child must be an Ontario resident up to and including the age of 13 or the last school day of his/her eighth grade, depending on which comes last;
2. Child has a dental condition requiring urgent care;
3. Child's parent/guardian has no dental insurance and they have signed a Parent Notification Form stating that the cost of dental treatment would cause financial hardship.

Children are screened by health unit dental staff through the screening program in elementary schools or following parental request, referral by a family dentist or teacher. Children are screened weekly in health unit locations by dental staff of the health unit.

Eligible children must have their parents fill out a "Parent Notification" form that states that they are unable to pay for treatment; sometimes additional financial information is required before a child will be enrolled in the CINOT

program. Once the "Parent Notification" form and optional financial information are collected, enrolled children are issued a specific claim form that states that they qualify for CINOT. This form can be presented to a dental office who would then be paid by the health unit, within stated guidelines, for the services rendered; the reimbursement rate is usually approximately 75% of the Ontario Dental Association's 1998 recommended fee (Main, 2001). The decision tree in Appendix A contains a more detailed description of the CINOT enrollment process.

Data Collection

In order to answer the study question, it was necessary to collect detailed information on the treatment proposed by the dental directors and that which was planned and actually provided by the private practitioners. Information on the different treatments was collected and classified as follows:

- A proposed treatment plan listing the procedure and tooth code based on the dental director's clinical examination and radiographs or letters of expertise submitted after the treatment is provided by the treatment dentist [Plan 3] (done after child goes to treatment dentist , but independent of the treating dentist's examination or treatment plan)
- A copy of the dentist's claim form showing the treatment provided and billed to CINOT [Plan 4].
- A record of care provided by the treating dentist but not billed to CINOT [Plan 5]
- A record of care that was planned by the treating dentist but not provided [Plan 6]

Variables

The data collected for each plan are illustrated in Table 2.1. The research associate entered the data in an Epi-Info (Atlanta, USA: CDC, 2000) database designed specifically for this study. Once entered into the database, all paper records were filed in a locked filing cabinet in a room with limited access to ensure the security of the records.

Table 2.1. Variables collected in study.

Field	Description	Data Format	Coding
Region	Region of participation; each number corresponds to a public health unit	Numeric, categorical	1 = HU X 2 = HU Y 3 = HU Z, etc.
IDNum	Participant identification number 1 st digit refers to region of origin, next three digits refers to person's id number within HU records, eg. #302 means that this particular individual is the second subject from HU Z. This number is unique to each subject.	Numeric, categorical	
Plan	Plan number	Numeric, categorical	1-digit number
Date	Day of assessment	Date	dd/mm/yyyy
Procode	Procedure Code	Numeric, categorical	5 digit number taken from ODA Fee guide
Tooth	Tooth code	Numeric, categorical	2-digit number
Surface	Tooth surface procedure was performed on (if applicable)	Text	Free-form text permitting inclusion of multiple tooth surface codes
Comments	Additional comments made by dentist	Text	Free-form text permitting inclusion of practitioner notes regarding subject, e.g. alternate procedure

In order to get a better understanding of the analyses that are to follow, it is important to understand what each Plan entailed, and what type of data was collected as part of it.

Plan 3 was the proposed plan devised by the dental director based on their own clinical exam and the radiographs forwarded by the private practitioner. This plan was collected as it is developed using the same tools used by the private practitioner when preparing a treatment plan for the patient he/she is about to treat.

Plan 4 captures the treatment offered by private practitioners to their subjects and for which they subsequently requested reimbursement from CINOT.

Information on care that was provided but not billed to CINOT (Plan 5), and care that was planned but not provided (Plan 6) was also collected. The services contained in these plans were collected to be aggregated (in the analysis) with the services in Plan 4 to better quantify each dentist's care patterns, had he/she not been limited by CINOT coverage rules. The belief was that by doing so, it would "prevent an unfair comparison between what the public health unit dentist planned (Plan 3) and the private dentist planned but was unable to provide because either the parent refused (Plan 5) or CINOT did not cover (Plan 6)." (Leake, 2000b). The rationale for comparing Plan 3 and Plan 4 was that these two plans were most similar in their purpose and in the tools that were used to devise them. Both plans were proposed/provided based on a clinical examination comprised of a visual examination and radiographs. Furthermore, these two plans were the plans that were proposed/provided by graduates of a dental school, specifically for coverage under the CINOT program. While other plans combined some of these elements, plan 3 and plan 4 were the only two plans that could be considered similar in design and in purpose. This is why they were compared.

The purpose of comparing Plan 3 to Plan 4+5+6 was that Plan 4+5+6 would capture the amount and type of treatment a private practitioner would have prescribed under non-CINOT conditions, for a patient with insurance coverage. The amalgamation of Plans 4, 5, and 6 would best represent the total care the

dentist would prescribe if not limited by CINOT conditions. However, comparing Plan 3 only to the care billed to CINOT provides the most conservative measure of the difference between the two care provider groups.

Relative Value Units

In order to compare the different treatments recorded as part of this study, it was elected to quantify all treatment plans by using relative value units.

An RVU is a unit of measurement developed and used by the Ontario Dental Association to attribute a value to each and every procedure performed by a general practice dentist. The basic unit of service used to calculate RVUs is an occlusal amalgam restoration on a bicuspid tooth (ODA, 1990). The rationale behind the RVU system is that this system “embodies information respecting current methods and practices in the delivery of dental care which have a bearing on the resulting time and responsibility.” (Arison, 1997).

The formula used to calculate an RVU is:

$$\text{RVU} = T \times R$$

where,

T = time, which includes the time spent providing the services found in the fee guide, as well as any time spent by the dentist preparing for the service, whether it be before or after the actual service is performed (Begg, 1997). This is measurable in ¼ hour increments (ODA, 1990).

R = the complexity and responsibility of performing a service. There are 3 dimensions to R (Begg, 1997):

- professional knowledge and judgment;
- technical skill;
- risk.

Why choose to use RVUs instead of other methods of measuring the services rendered? Other potential methods might have included counts, total time spent, total cost. All of these methods may offer some insight into a dentist's practice patterns, but don't offer a complete or easily comparable view.

Using RVUs permits us to:

- standardize collected information across all dentists;
- determine a composite measure of:
 - time, and
 - complexity/responsibilityof a procedure;
- establish a monetary value of the services rendered;
- compare similar and dissimilar services.

This is not a foolproof way of collecting service information; however, RVUs combine all of the advantages of the other mentioned methods and, as such, serve this study's purpose best.

In order to establish a suggested fee for a service, a dollar conversion factor (f) needs to be determined. Once a value for f has been adopted, a suggested fee becomes the product of RVU and f .

f should be in line with:

- the present specific methods of practice;
- the present socio-economic conditions;
- the present fees of related professions.

However, this suggested fee does not take into account commercial, laboratory or infrastructural costs. These additional costs that are incurred as part of running a dental practice are traditionally added to the suggested fee formula as such:

$$(T \times R \times f) + L$$

where,

L = commercial and/or in-office lab costs.

Although this is beyond the scope of this study's use of RVUs, it is important to understand the system in order to appreciate its subtleties in this and other studies.

With the aim of giving the reader a better idea of the amount of work an RVU represents, here are a few examples of commonly offered services in a dentist's office with their respective relative value units:

◆	Sealant =	0.63 RVU
◆	X-ray =	0.64 RVU
●	Oral exam =	0.75 RVU
◆	Uncomplicated tooth extraction =	0.75 RVU
◆	Uncomplicated filling =	1.00 RVU
◆	Uncomplicated root canal =	1.25 RVU
◆	Complicated filling =	2.81 RVU

To clarify RVUs further, an average visit to the dentist would represent 3.99 RVUs, classified in the following manner:

●	Exam =	0.75 RVU
◆	X-ray =	0.64 RVU
◆	½ hour cleaning =	2.00 RVU
◆	Topical fluoride =	0.60 RVU

Service Groups

All procedures performed and recorded as part of this study can be classified as a specific service. In order to better understand what the different procedures are and under what service type they fall, this section will give an overview of them (a complete list of services can be found in Appendix F).

For the purpose of this study, dental procedures were divided into 8 categories – diagnostic, preventive, restorative, surgical, endodontic, periodontic, orthodontic, and adjunctive. These categories are also used by the Ontario Dental Association to classify services. However, no periodontic or orthodontic services were proposed/offered to the subjects in this study.

Diagnostic services include procedures to determine whether caries or other oral conditions are present in a patient, as well as treatment planning and consultation. This includes all types of oral exams, radiographs (x-rays), as well as treatment planning and consultation.

Preventive services are services that are offered in order to prevent the development of a variety of oral health conditions. They include topical fluoride, sealants, oral hygiene instruction and discing and recontouring of teeth.

Restorative services include services to repair damaged teeth or teeth with caries, as well as replacing lost teeth. There are four main types of restorative materials that are used as part of the procedures included in this

service type. They include metals, composite resins, ceramics and glass ionomers (ODA, 2001).

Dental materials are further classified as direct or indirect. Direct materials are commonly used in a single appointment and are placed directly into the cavity – this is what is commonly referred to as a “filling.” Indirect materials include crowns or dental implants that have to be made in a laboratory – these types of procedures usually require 2 or more appointments.

Surgical services include the removal of teeth and any other type of surgical procedure performed on the teeth or surrounding material (such as gums).

Endodontic services are also commonly referred to as “root canal treatment” (ODA, 2001). These include “removing infected, injured, or dead pulp from a tooth. Pulp, the soft tissue containing nerves and blood vessels, runs through the centre or root canal of a tooth.” (ODA, 2001).

Adjunctive services include all other services that do not fall within the aforementioned ones – this includes anesthesia, pain control, and all lab procedures.

Data Analysis

The dependent variable in this study was the individual difference in relative value units for each subject enrolled in this study, both overall, by public health unit, and by service category. The RVUs were based on the proposed/provided treatment plans received for each subject. It should be emphasized that all data were paired; in other words, all analyses were designed to look at the difference in care recorded in Plan 4 (or Plan 4+5+6) with the care

proposed in Plan 3 for each individual. The logic behind performing this analysis was that this was the best way to determine whether there was a statistically significant difference in the care patterns proposed by dental directors in the public health units and those provided by private practitioners for children enrolled in the CINOT program.

Before the analysis stage of this study could be completed, it was determined that the data had a normal distribution. Therefore, parametric statistics were deemed appropriate for this dataset. All statistical analyses were performed using SPSS for Windows Version 10.0.5 (November 1999). A level of significance of $p < 0.05$ was used for all tests.

The first step of the analysis included a set of paired t-tests comparing the dental director's treatment plan using x-rays (Plan 3) with 1) Plan 4; and 2) Plan 4+5+6. The purpose of performing this analysis was to get a first view of possible trends displayed by the data. This analysis would permit the author to state whether dentists in the general population showed similar care patterns as dental directors in public health units overall.

Comparison at the Public Health Unit Level

It was acknowledged that some public health units might show larger differences than others, and that the overall analysis could be skewed due to the uneven public health unit sample sizes. It is for this purpose that the second step of this analysis included the stratification of public health units. It was hoped that this would help determine whether the pattern seen at the general level was similar in each public health unit or whether differences could be identified in specific public health units. Failing to perform this analysis would mean that the

weighting nature of the different sample sizes would be ignored. It would also mean that the author was failing to acknowledge that different regions could demonstrate different care patterns.

Comparison by Service Type

The third step included doing a paired t-test for each aggregated service type. The goal of this analysis was to determine whether some services showed statistically significant differences while others did not. The purpose of this analysis was two-fold: 1) to acknowledge and address the issue that different services had different volumes of care and that the results seen at the overall or public health unit level could be produced primarily by a single service type; and 2) that two individuals with identical RVUs could have had very different types of care. For example, subject X could have been proposed/received 3 RVUs of care from both the dental director and the private practitioner, but she might have been proposed an exam (0.75 RVU), and two uncomplicated fillings (2.0 RVU) by the dental director, while the private practitioner might have given her an exam (1 RVU) and a ½ hour cleaning (2 RVU). Overall, there appears to be no difference in the two recorded treatments, but the dental director in this theoretical scenario prescribed 1.0 RVU of diagnostic and 2.0 of restorative services while the private practitioner provided 1.0 RVU of diagnostic and 2.0 RVU of preventive services. Only an analysis by service type could capture these differences.

General Linear Model Analysis

The fourth and final step included performing a general linear model analysis of variance with the difference in RVUs as the dependent value and the

public health unit and plan as the independent values. This analysis included looking at potential interaction terms.

Consideration of Clinical Significance

It is important to note here that these statistical tests only address the statistical importance of this study's results. An additional dimension to these results is the clinical significance of them. Sackett et al. (1991) defined clinical significance as "the *importance* of a difference in clinical outcomes between treated and control patients, and is usually described in terms of the magnitude of a result." In the case of this study, clinical significance would look at the difference in clinical outcomes, if any, between the treatment proposed by dental directors and the treatment provided by private practitioners.

An analysis may not be statistically significant, but may be of very important clinical significance. For example, the analysis may have shown that there was no statistical difference in the amount of diagnostic work planned/performed on a subject, but that the private practitioner performed 20% more diagnostic services RVUs than were planned by the dental director, a difference which may still be clinically significant. It is also possible for results to be statistically significant without being clinically significant, but this is usually the case with very large samples sizes where small absolute differences are considered to be clinically insignificant.

A review of the dental literature did not identify any literature on clinical significance within this context. Therefore, in order to determine clinical significance, an arbitrary value was picked. A 15% difference was picked, based on discussions with different epidemiologists, both in the field of dental

epidemiology (Leake, 2001c) and within the field of public health epidemiology (Pickett, 2001). Also, as discussed earlier, a regular check-up visit to the dentist would result, it is estimated, in approximately 4.0 RVU. A 15% difference on a treatment worth 4.0 RVU would equal 0.6 RVU. In dollar terms, at an equivalency of approximately \$30 per RVU, this would result in a dollar difference of \$18. This may not seem like a large difference within this conservative example. However, with a population of children requiring urgent care (which can be RVU-intensive), this difference seems relevant.

POWER CALCULATION

This study was a small study with a convenience sample of approximately 70 subjects recruited and used in this analysis.

Using the standard deviation (in relative value units) of procedures proposed by dental directors (Plan 3), the following power calculation was performed using the PS Power and Sample Size Calculations program from Vanderbilt University. This calculation is based on a published paper found in the Controlled Clinical Trials Journal (Dupont and Plummer, 1990). It calculates power and sample size for paired data. The equation is as follows:

$$Z_{\beta} = \delta/\sigma ((\sqrt{nr/r+1})-Z_{\alpha/2})$$

where:

δ = the magnitude of difference to be detected between Plan 3 and Plan 4 = **3.0 RVU**

σ = standard deviation in the population for a continuously distributed variable = **8.4 RVU (Leake, 1999)**

n = number of subjects = **70**

r = ratio of subjects in each plan = 1:1 = **1**

$Z_{\alpha/2}$ = significance level = 0.05 = **1.96**

$$Z_{\beta} = 3.0/8.4 ((\sqrt{70/2})-1.96)$$

$$\text{Power} = 83.8\%$$

Our δ , or difference to be detected between Plan 3 and Plan 4 was 3.0 RVU. After discussion, the author decided to choose this value for the power calculation for two reasons. Firstly, it was estimated (Leake, 2001b) that a difference of under 3.0 RVUs between the two treatment groups could be due to chance alone and that, therefore, a difference of 3.0 RVU should be used as this power calculation's difference to be detected. Secondly, 3.0 RVUs represents

approximately \$100 worth of dental services which, in the author's opinion, is a value beyond which all extra dental work should be justified.

In order to have successfully reached a power of 100%, it was estimated that a sample of 253 subjects would have been required. However, a power of 83.8% is considered quite adequate in most studies.

ETHICS

This study was approved by the Human Subjects Review Committee of the University of Toronto (see Appendix C).

As part of this study, the children enrolled into this study were at very similar harm as if they had been to their dentist without participating in this study. As with all other types of medical treatment, there are some risks associated with dental procedures, including infection, nerve damage, and loss of teeth. However, given that the children were in urgent need of care and were provided treatment by a dentist of their parents' choice, the risk was nearly identical to the risk they would have encountered under normal circumstances. The only additional potential risk involved with participating in this study was related to being examined by the dental director. The additional risk is a result of the dental director using a tooth explorer to clean the surface of subjects' teeth for inspection.

There was no additional risk for the parents and dentists of enrolled subjects as their required participation was identical to that with a patient not in the study. Furthermore, all forms forwarded to the author had patient and dentist identifiers removed. Subjects were identified only by their subject number (assigned by the dental director) and public health unit number. This ensured that the anonymity of subjects and dentists was not jeopardized and that their identification did not occur, so they were at no risk of loss of privacy.

III. RESULTS

Enrollment

Although a total of 70 subjects were recruited between October 1998 and March 2000 as part of this study, the initial study size was hoped to be 120 divided evenly across the four participating public health units. In 2000, 22,090 children (0.9% of Ontario children in the relevant age group) submitted claims to CINOT (Bennett, 2001).

Despite the lack of definite numbers quantifying the ratio of individuals whose parents were approached relative to the number enrolled, it is estimated that between 5 and 10 individuals were approached for every enrolled subject. This is largely due to the fact that parents were discouraged by dentists from enrolling their children in the study. However, this was also compounded by the fact that some dentists did not send Plan 4 forms for subjects that had been successfully recruited into the study. Therefore, this study was faced with loss to follow-up at two critical points.

Key Outcomes

Description of Plans Overall and By Health Unit

As presented in Table 5.1, a comparison of Plans 3 and 4 stratified by public health unit showed that Plan 3 had systematically fewer total RVUs than Plan 4 across all public health units. In addition to this, the mean RVU per child was also systematically larger in Plan 4 than in Plan 3. The difference in mean RVU per child varied between 6.31 RVU in public Health Unit C and 15.57 RVU in public Health Unit D.

It is not worthwhile to make a direct comparison of the mean RVU of care per child in Plan 3 versus Plan 5 or Plan 6 given that Plans 5 and 6 are not complete plans. In other words, they are not meant to be compared to a plan such as Plan 3. Their purpose was to offer some insight into what additional services private practitioners performed (Plan 5) or proposed (Plan 6) outside of the confines of CINOT. Therefore, on average, private practitioners performed an additional 2.35 RVU per child, which was paid for by a non-CINOT source. Also, in addition to this, the private practitioner recorded that he/she would have offered, on average, an additional 2.83 RVUs of care per subject if an additional or alternate payment source had been available.

With this information, it can be extrapolated that under unconstrained conditions, the private practitioners in this study would have offered, on average, 26.9 RVUs of care per subject, compared to the 8.24 RVU per child proposed by dental directors.

Table 5.1. RVUs and Counts¹ of Dental Services Provided to Children by Public Health Unit and Plan

Health Unit	Plan 3			Plan 4			Plan 5			Plan 6		
	RVU		Count	RVU		Count	RVU		Count	RVU		Count
	Total	Mean Per Child (range)		Total	Mean per Child (range)		Total	Mean per Child (range)		Total	Mean per Child (range)	
A (n=8)	79.84	9.98 (4.94-18.14)	52	155.44	19.43 (7.92-49.15)	113	46.58	5.82 (0-25.76)	28	22.09	2.76 (0-5.09)	14
B (n=25)	419.63	16.79 (1.25-34.23)	221	656.16	26.25 (3.64-47.70)	377	35.41	1.42 (0-7.8)	32	40.13	1.61 (0-21.57)	19
C (n=23)	231.75	10.08 (1.25-31.01)	139	377.02	16.39 (2.5-56.31)	250	51.22	2.23 (0-4.91)	12	122.75	5.34 (0-44.50)	46
D (n=14)	115.41	8.24 (2.89-12.39)	119	333.33	23.81 (2.87-45.48)	203	31.32	2.24 (0-13.91)	18	13.11	0.94 (0-7.0)	6
Total (n=70)	846.63	12.09 (1.25-34.23)	531	1521.95	21.74 (2.5-56.31)	943	164.53	2.35 (0-25.76)	90	198.08	2.83 (0-44.50)	85

Description of Plans by Service Type

In addition to having a larger overall mean RVU per subject than Plan 3, Plan 4 also had the highest mean RVUs per child for each category of service, with the exception of preventive services. With respect to preventive services, Plan 3 had a total RVU value of 70.37 while Plan 4 had a total RVU value of 46.42. In terms of means, this translated to a mean per child of 1.01 RVUs for Plan 3 and 0.66 RVUs for Plan 4.

Plans 5 or 6 did not display the largest mean RVUs per subject for any service type, but again, when aggregated with Plan 4, increased the total and mean amount of RVU difference between Plan 3 and Plan 4 for all services types

¹ Count is the total number of procedures performed.

and shifted the mean per child RVU for preventive services so that Plan 3 was no longer the larger of the two plans.

Table 5.2. RVUs and Counts of Dental Services Provided to Children by Service Type and Plan

Service	Plan 3			Plan 4			Plan 5			Plan 6		
	RVU		Count	RVU		Count	RVU		Count	RVU		Count
	Total	Mean per Child		Total	Mean per Child		Total	Mean per Child		Total	Mean per Child	
Diagnostic	33.07	0.47	64	152.32	2.18	331	14.24	0.20	23	9.12	0.13	8
Preventive	70.37	1.01	104	46.42	0.66	56	33.13	0.47	27	56.19	0.80	45
Restorative	576.28	8.23	267	1018.26	14.55	389	47.25	0.68	19	76.52	1.09	25
Surgical	62.25	0.89	52	77.00	1.10	59	4.50	0.06	3	3.00	0.04	2
Adjunctive	3.16	0.05	1	88.20	1.26	45	22.66	0.32	13	0.00	0.00	0
Endodontic	101.50	1.45	43	139.75	2.00	63	42.75	0.61	5	53.25	0.76	5
Total	846.63	12.09	531	1521.95	21.74	943	164.53	2.35	90	198.08	2.83	85

Comparison of Services Between Public Health Units

Table 5.3 shows the distribution of services within every public health unit to determine whether the different public health units had a similar distribution of services.

Within Plan 3, 3 of the 4 public health units did not propose diagnostic care. The only public health unit that did propose diagnostic care was public health unit D. Conversely, all public health units prescribed preventive care with the exception of public Health Unit D.

Mean preventive services proposed under Plan 3 varied between 0.00 RVU per child for public Health Unit D and 1.28 RVU per child for public Health Unit B (non-significant). The mean RVU per child for restorative services varied between 4.20 RVU and 12.58 RVU (non-significant); the mean RVU per child for adjunctive services varied between 0.00 RVU and 0.13 RVU (non-significant). The difference in mean RVU per child for surgical and endodontic services for

Plan 3 across all public health units showed a statistically significant difference $p=0.03$ and 0.05 respectively, indicating that service provision did vary regionally.

Restorative services for Plan 3 showed a mean distribution between 4.20 and 12.58 RVU per subject. The range of RVUs for restorative services was nearly three-fold, but separate investigation found that the majority of cases (80%) fell into a narrow range between the 6.03-6.58 RVU range. Thus, while the distribution had some outliers, the majority of cases were displaying similar RVUs.

The range of RVUs for endodontic services for Plan 3 was also relatively large, but were quite small when compared to Plan 4. Their mean RVUs were also 28% smaller than the mean RVUs for Plan 4. Finally, surgical and adjunctive services for Plan 3 showed less variation.

Table 5.3. RVUs and Counts of Dental Services Provided to Children by Public Health Unit, Service Type and Plan

Health Unit	Service	Plan 3			Plan 4		
		RVU		Count	RVU		Count
		Total	Mean per Child		Total	Mean per Child	
(n=8)	A Diagnostic	0.00	0.00	0	11.15	1.39	40
	Preventive	9.42	1.18	15	4.41	0.55	7
	Restorative	51.67	6.46	24	86.26	10.78	38
	Surgical	15.00	1.88	10	14.25	1.78	10
	Adjunctive	0.00	0.00	0	25.60	3.20	7
	Endodontic	3.75	0.47	3	13.75	1.72	11
	Subtotal	79.84	9.98	52	155.44	19.43	113
(n=25)	B Diagnostic	0.00	0.00	0	53.18	2.13	115
	Preventive	32.12	1.28	43	20.61	0.82	24
	Restorative	314.60	12.58	122	505.16	20.21	183
	Surgical	24.75	0.99	23	17.25	0.69	15
	Adjunctive	3.16	0.13	1	15.46	0.62	14
	Endodontic	45.00	1.80	32	44.50	1.78	26
	Subtotal	419.63	16.78	221	656.16	26.25	377
(n=23)	C Diagnostic	0.00	0.00	0	58.57	2.55	111
	Preventive	28.83	1.25	46	16.74	0.73	21
	Restorative	151.17	6.57	83	209.99	9.13	84
	Surgical	9.00	0.39	7	17.75	0.77	12
	Adjunctive	0.00	0.00	0	17.47	0.76	11
	Endodontic	42.75	1.86	3	56.5	2.46	11
	Subtotal	231.75	10.08	139	377.02	16.39	250
(n=14)	D Diagnostic	33.07	2.36	64	29.42	2.10	65
	Preventive	0.00	0.00	0	4.66	0.33	4
	Restorative	58.84	4.20	38	216.83	15.49	84
	Surgical	13.50	0.96	12	27.75	1.98	22
	Adjunctive	0.00	0.00	0	29.67	2.12	13
	Endodontic	10.00	0.71	5	25	1.79	15
	Subtotal	115.41	8.24	119	333.33	23.81	203
(n=70)	OVERALL Diagnostic	33.07	0.47	64	152.32	2.18	331
	Preventive	70.37	1.01	104	46.42	0.66	56
	Restorative	576.28	8.23	267	1018.26	14.55	389
	Surgical	62.25	0.89	52	77.0	1.10	59
	Adjunctive	3.16	0.05	1	88.2	1.26	45
	Endodontic	101.5	1.45	43	139.73	2.00	63
	(n=70) TOTAL	846.63	12.09	531	1521.95	21.74	943

The total mean RVUs per subject for Plan 4 varied between the public health unit areas, from 16.39 to 26.25. Diagnostic services had an almost two-fold variation across public health unit area in mean RVUs per subject: 1.39 to 2.55. Preventive services displayed a similar pattern of having a small absolute

mean difference but large relative mean difference (0.33-0.82), as did surgical services (0.69-1.98). Adjunctive and restorative services had higher values and wider ranges ((0.62-3.20) and (9.13-20.21) respectively). Finally, endodontic had a small absolute and relative variation in mean RVU per subject (1.72-2.46).

A weighted univariate analysis of total Plan 4 RVUs across the four public health units did not result in a statistically significant difference. A similar analysis comparing each service separately did result in statistically significant differences. Diagnostic services reported a p-value of 0.017. Preventive services displayed a p-value of 0.035; restorative services displayed a p-value of 0.044; surgical services exhibited a p-value of 0.005; adjunctive services presented a p-value of 0.009; and endodontic services reported a p-value of 0.017. No analysis was performed for diagnostic services as they were recorded in only one health unit.

A comparison of each public health unit's mean RVUs per child for Plan 3 versus Plan 4 shows that, on average, Plan 4 had RVU values 1.8 times as large as Plan 3. A comparison of service types showed that, on average, Plan 4 recorded 25.2 times as many adjunctive services as Plan 3 did. The smallest difference was with surgical services, where Plan 4 was only 1.2 times greater than Plan 3. It should also be noted that there was a higher mean amount of preventive services proposed in Plan 3 than offered in Plan 4.

In addition to absolute differences in RVU means, there is also the issue of clinical differences. For example, while restorative services exhibited values that were large in absolute terms (14.55-8.23=6.23), the relative mean difference

was not very large. Adjunctive services reported a very small absolute mean difference, but this is still a large relative difference. Both of these types of differences may have clinical significance. When look at these results, it is therefore important to consider both the statistical and clinical importance of these differences.

Statistical Analyses

Overall Differences Between Plans

Table 5.4 shows the results of the paired t-test comparing the RVUs for Plan 3 with Plan 4 for all subjects enrolled in the study. This analysis resulted in a statistically significant p-value of $<.001$ ($\alpha=0.05$). The results from this table offer an overview of the results based on all of the recorded observations.

Table 5.4. Comparison of Differences in Total RVUs for Plan 3 and Plan 4

	N	X Diff.	SE	p-value
Plan 3 versus Plan 4	70	-9.3	1.34	<.001

It was deemed unnecessary to repeat this analysis with Plans 5 and 6 added to Plan 4 as this systematically increases the difference between the treatment recorded by the dental director and the treatment recorded by the private practitioner. This would only confirm that care patterns vary significantly between the two groups of dentists.

Given that only one of the four public health units recorded diagnostic procedures, this analysis was repeated without diagnostic services, to determine whether their possible omission by dental directors made a difference in the

overall picture. As can be seen in Table 5.5, the overall difference remained statistically significant, and the standard error was quite similar.

Table 5.5. Comparison of Differences in Total RVUs for Plan 3 and Plan 4 (excluding Diagnostic services)

	N	X Diff.	SE	p-value
Plan 3 versus Plan 4	70	-7.57	1.38	<.001

Difference in Care Patterns by Public Health Unit

Tables 5.4 and 5.5 fail to acknowledge the reality that different public health units have different sample sizes and probably have different care patterns that are not visible at this level of analysis. In order to remedy this, Table 5.6 displays the values obtained when paired t-tests are performed using observations from only one public health unit at a time. For example for the t-test labeled above as HU A, only observations from individuals whose response in the “region” field was 3 were included. It is very apparent here that the different public health units have very different sample sizes – the smallest one (for HU A) was 8, and the largest one (for HU B) was 25. However, despite the different sample sizes, all public health units displayed p-values that were statistically significant ($p < 0.05$), thereby showing that each individual public health unit showed a statistically significant difference in the care patterns proposed/performed by the dental directors and private practitioners within their public health unit.

Table 5.6. Comparison of Total RVUs for Plan 3 and Plan 4 by Public Health Unit

Plan 3 versus Plan 4	N	X Diff.	SE	p-value
HU A	8	-9.5	3.5	.031
HU B	25	-9.5	2.1	<.001
HU C	23	-5.7	2.4	.024
HU D	14	-14.6	3.3	<.001

Difference in Care Patterns by Service Type

It was established in Table 5.6 that each participating public health unit recorded a statistically significant difference in the care proposed/provided in Plan 3 versus Plan 4. The next step was to determine whether all categories of care contributed to this difference, or whether some services did while others did not. In order to do this, the observations recorded for each subject and for each plan were divided into their respective service types. This then facilitated a comparison of the paired difference between Plan 3 and Plan 4 for each subject within each service type individually. This was done for diagnostic, preventive, restorative, surgical, endodontic and adjunctive services. Table 5.7 illustrates the results of these paired t-tests.

All of the t-tests in Table 5.7 included all 70 subjects, with the exception of the diagnostic test which only included the 14 subjects from public Health Unit D. This analysis was performed in this fashion as it would not have been correct to compare missing values in Plan 3 to present values in Plan 4. This would have misrepresented the real difference in diagnostic services across all services. Restorative services showed statistical significance ($p < .001$), while the difference for surgical, endodontic and adjunctive services was not statistically significant ($p > 0.05$). Diagnostic services also showed a statistical difference

($p < 0.001$), but, to reiterate, only one public health unit had values for diagnostic services in Plan 3. Preventive services also showed statistical significance ($p = 0.001$), but the mean difference for this service group, unlike for all other service groups, was positive. This is because, on average, dental directors proposed more preventive services than private practitioners prescribed.

Table 5.7. Comparison of Total RVUs for Plan 3 and Plan 4

Plan 3 versus Plan 4	N	X Diff	SE	p-value
Diagnostic (HU D only)	14	-1.0	0.4	.017
Preventive	70	2.0	0.5	<.001
Restorative	70	-6.3	1.0	<.001
Surgical	70	-0.2	0.3	.440
Endodontic	70	-0.5	0.5	.271
Adjunctive	70	-0.5	0.6	.421

General Linear Model Measuring Difference in Care Patterns as a Function of Public Health Unit and Plan

The next step was to analyse RVU as a function of both public health unit and Plan as shown in Table 5.8. The results showed that the public health unit had no statistically significant impact on the RVU value, but that the plan (and therefore provider) did. The F-value for the plan variable was also robust with a statistically significant value of $< .001$. The author also tested for an interaction, but removed the term when it was determined that this was not statistically significant.

Table 5.8. Comparison of Total RVUs by Plan and by Public Health Unit

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8114.6	4	2028.6	12.4	.000
Intercept	42575.0	1	42575.0	259.3	.000
Plan	7114.3	1	7114.3	43.3	.000
Health Unit	1000.3	3	333.4	2.0	.113
Error	22167.4	135	164.2		
Total	83986.0	140			
Corrected Total	30282.0	139			

Clinical Significance

As discussed in the methods section, lack of statistical significance does not necessarily imply lack of clinical significance. Based on the assumption that a 15% difference in the amount of care (quantified, in this case, with RVUs) is relevant, it appeared that all of our services displayed a clinically significant difference. Table 5.9 shows that some services had smaller differences (for example, surgical services with 24%), but other services had differences of the order of several magnitudes.

Table 5.9. Difference of Statistical and Clinical Significance of Service Groups

Service	Mean Value for Plan 3	Mean Value for Plan 4	Approximate Dollar Difference Per Patient	Percentage Difference	Statistically Significant?	Clinically Significant?
Diagnostic	0.47	2.18	\$51.30	363	Yes	Yes
Preventive	1.01	0.66	\$10.50	53	Yes	Yes
Restorative	8.25	14.55	\$189.00	76	Yes	Yes
Surgical	0.89	1.1	\$6.30	24	No	Yes
Adjunctive	0.05	1.26	\$36.30	2420	No	Yes
Endodontic	1.45	2.0	\$16.50	38	No	Yes
Overall	12.09	21.74	\$289.50	80	Yes	Yes

IV. DISCUSSION

The primary purpose of this study was to determine whether there was a difference between the care proposed by dental directors exposed to continuing education in evidence-based guidelines in public health units and the care performed by dentists in the general population, for children in the CINOT program. The analysis showed that there was a clinically important and statistically significant difference in the care prescribed to the same individuals by the two study groups.

Findings

Overall Analysis

As part of this study, it was determined that there was a statistically significant difference in the care proposed by dental directors and provided by private practitioners to children enrolled in the CINOT program.

As was discussed in the analysis section, the overall analysis was performed twice – both with and without the inclusion of diagnostic services. This was done because three out of four participating dental directors failed to include diagnostic services as part of their proposed treatment plan, and the author was unable to obtain these data. It was not clear whether this omission was intentional or whether they had forgotten to include them. This involuntary omission may have been because they thought diagnostic services were part of the study enrollment process rather than part of the treatment plan.

In reality, this made no difference in terms of whether the analysis remained statistically significant or not, but this possible difference needed to be acknowledged and addressed.

It should also be explained why, by the aforementioned rationale, preventive and adjunctive services (which also had overall values of zero in some public health units) were not removed from the overall model. The two service types should be addressed separately.

Preventive services were not removed from the model because they were not erroneously omitted by the dental director in public Health Unit D. The dental director of this public health unit was successfully contacted, and the author received confirmation that preventive services had not been proposed as part of the treatment plans for subjects assessed by dental directors in this particular public health unit.

Adjunctive services were also not omitted from the overall analysis as it is plausible that no adjunctive services were proposed as part of the dental directors' proposed treatment plans, because of their "adjunctive" or additional nature. It is likely that dental directors following CINOT guidelines did not deem adjunctive services to be warranted under the auspices of "urgent" care. For this reason, adjunctive services were not removed from the overall analysis model.

An additional comparison of the overall paired difference between Plan 3 and Plan 4+5+6 was not required to demonstrate difference in patterns of care because the analysis of the overall paired difference between Plan 3 and Plan 4 was already statistically significant, and adding Plans 5 and 6 to Plan 4 would

only increase the difference between patterns of care proposed by the two groups of dentists for each subject.

Using the aggregation of Plans 4, 5 and 6 in the overall analysis and in subsequent analyses would have allowed for a more complete grasp of the care that a private practitioner would provide under non-CINOT conditions. However, given that dental directors were expected to draw up their treatment plans while keeping in mind CINOT's limitations, a comparison of the paired differences between Plan 3 and Plan 4+5+6 would have amplified the difference between the two plans and perhaps displayed statistically significant differences in specific services while a straight comparison of the paired difference between plan 3 and plan 4 alone would not have.

Analysis by Public Health Unit

The analysis of the paired difference between Plan 3 and Plan 4 stratified by public health unit showed that, despite the different sample sizes, the statistical significance seen in the overall analysis was replicated within each public health unit. The purpose of this analysis was to ensure that the overall results were not being overshadowed by the results from larger public health units while not displaying the results related to the public health units with smaller sample sizes.

An issue related to this analysis is the range of RVUs within Plan 3. This is likely due to unstable variability related to the small sample size used in this study. It is quite possible that in a larger study, these values would be less scattered.

Analysis by Service

The main reason for performing an analysis of the paired difference between Plan 3 and Plan 4 by service was discussed in the methods section but will be reiterated here. While the overall analysis and the analysis stratified by public health unit showed a statistically significant value for the paired differences between Plan 3 and Plan 4, it looked at an aggregate of all RVUs, not distinguishing between services. This analysis method did not acknowledge that very different services may have had very similar total RVUs. Therefore, it may have occurred that the difference between Plan 3 and Plan 4 for a particular subject (or overall) was small, but that the two plans being compared may have been comprised of very different service types. An analysis by service type controls for this. Furthermore, as was the case with public health units, certain services may be over represented in an overall or public health unit analysis. Performing an analysis by service ensures that the author was not comparing proverbial apples and oranges.

The analysis by service type showed that only three of the six services recorded as part of this study showed a statistical significance. Diagnostic and restorative services showed a negative mean difference, which states that the mean per subject for these two services was higher in Plan 4 than in Plan 3. Conversely, Plan 3 had a larger mean difference for preventive services than Plan 4, which resulted in a positive mean difference. This means that, on average, dental directors proposed more preventive services than were performed by private practitioners. This may be the case because private practitioners are aware that preventive services are routinely offered by public

health units and did not deem it necessary to record them while dental directors, because they operate within the public health units, deemed it important to include preventive services in their proposed treatment plan.

A weighted univariate analysis comparing all services recorded in Plan 3 by health unit was performed. It was noted that only surgical and endodontic services displayed a statistically significant difference. This could reflect differences in the dentists across the different public health units (whether it be different dental schools, different ages or different years of graduation), or differences in patient populations (different needs, different ages), or both.

A similar analysis was performed for all services in Plan 4. In the case of Plan 4, all services displayed a statistically significant difference. The reasons behind these differences could be the same as the ones discussed for Plan 3. However, given that no dentist information was available, it is impossible to come to a conclusion regarding the reason(s) behind these differences.

The paired difference between Plan 3 and Plan 4 for surgical, endodontic and adjunctive services was not statistically significant. This may be because these services, especially surgical and endodontic, are the most straightforward procedures in dentistry, at least in terms of diagnosis. Either a tooth needs to be extracted, or it does not. This may, at least in part, explain the lack of a statistically significant paired difference for these services.

Restorative services represented 68.1% of all RVUs in Plan 3, and 66.9% of all RVUs in Plan 4. This may largely explain the statistically significant

difference overall and at the public health unit level. Had no analysis by service been performed, this would not have been acknowledged.

General Linear Model Analysis

The general linear model analysis that was performed as part of this study confirmed the results seen in our paired t-test analyses, namely that the public health unit did not contribute to the variation in the difference between Plan 3 and 4, but that the plan did. The latter observation reiterates this study's finding that there was a statistically significant difference in the care prescribed for CINOT children by dental directors and by private practitioners.

As part of this analysis, an interaction term was also included to determine whether the public health unit and plan interacted in any way. There was no statistically significant indication of this, therefore the difference reported can be assumed to be the result of the difference in treatment plan alone. It is possible that any of a number of factors (presented in the introduction and discussed at greater length later on in this section) contributed to this difference, but determining which factors and the extent to which they contributed cannot be achieved in this study due to the limited variables collected.

Clinical Significance of Findings

As discussed in the methods section, after discussion with different epidemiologists, a difference of 15% between Plan 3 and Plan 4 was used to determine clinical significance.

In the case of this study, and more particularly in the case of the different service types that were analysed, all services displayed a clinically significant difference. But what does this tell us? It tells us that there is a difference in RVUs

of more than 15% between the treatment plans devised by the dental directors and the private practitioners. The question becomes, which of these proposed patterns of care is more appropriate?

There is evidence that dental directors knew what they were doing. All of them had followed extensive training in evidence-based care, and were very familiar with the population under study and their needs. Based on this information, it would be appropriate to state that there was a clinically significant difference in the care proposed by dental directors exposed to continuing education in evidence-based guidelines and the care provided by private practitioners.

In financial terms, some services showed differences that translated into small dollar values. For example, surgical services, on average, showed a dollar value difference of only \$6.30 per child. However, other services showed, on average, as much as an \$189.00 difference per child.

Overall, these clinically significant differences resulted, on average, in a difference in care costs of approximately \$289.50. Multiplied by the number of children enrolled in this study, the difference in care resulted in an additional financial burden on the municipalities of \$20,265.

It cannot be challenged that these clinical differences are obvious and are important. However, being aware of these differences would be more useful if the factors causing them could be determined. But, as discussed previously, it is not possible in the present study to determine the factors that would contribute to this clinical significance. Nonetheless, the dollar value of these differences puts into

perspective what has been thus far a theoretical discussion of differences in dental care provision.

Although it is beyond the scope of this study, some research should be pursued in the hopes of identifying what constitutes a clinically significant difference in dental care. This could be achieved by surveying experts as well as practitioners in the field and using the results of this survey to come to a conclusion on what would constitute a clinically significant difference in dental care. This would better allow future researchers to measure their clinical outcomes in terms of clinical significance.

Limitations of This Study

Although these results demonstrate a clear difference in care provision between dental directors and private practitioners who treat CINOT children, this study has a number of validity issues and limitations. The next sections will deal with internal validity, external validity, content limitations, and logistical issues related to this study.

Internal Validity

This study determined that there is a statistically significant difference between the two paired treatment plans. However, there are some issues relating to internal validity that may mitigate the results that have been discussed.

Recruitment issues must be examined in considering the internal validity within this study, both in terms of the subjects who were recruited, as well as the dentists who performed care on them. With respect to the subjects, given that families were discouraged by private practitioners from enrolling their children in

this study, it is possible that the children enrolled within the study are not representative of the general CINOT population. However, although the recruited subjects were a small, very specific group, there is no reason to believe that this would bias the issue of difference between the two groups of dentists, although it might perhaps affect the absolute amount of services prescribed.

In addition to this, the private practitioners who agreed to participate in this study may also be different from the dentists who did not agree to participate. It is possible that their age is different, that their amount of experience is different, that they work in different sized practices, or perhaps practice in different geographic regions than non-participating dentists providing care to CINOT children. This being said, it is very likely that even if there was some difference, the dentists who did agree to participate are likely to be those who think that they are providing good and appropriate care, otherwise they would not have participated. In other words, if this is the case, then the difference seen in this study would likely have been larger if we had included non-participating dentists who, by the above-mentioned rationale, might have offered care which would differ even more from the dental directors' plans.

No information on the participating dentists and no information other than the gender (and in some instances, age) of the subjects was received from the public health units. Therefore, attempting to determine whether the characteristics of the enrolled subjects and participating dentists pool were different cannot be achieved. However, there are reasons to believe that any differences do not necessarily compromise the internal validity of the study, as

outlined above. At the same time, the fact that these results may not be representative of the treatment received by all the children enrolled in CINOT needs to be considered in interpreting this study.

External Validity

It is questionable whether the results seen in this study could be applied to the larger context of Ontario dental patients for a number of reasons. These include: the narrow age range of subjects in this study, the similar socio-economic status of the subjects, and the urgent need of these subjects. If this study were to be performed across the general population of Ontario, the study population would change substantially: the age range of the subjects would increase from 0-13 to 0 until death, all income brackets would be represented, and the dental care needs would vary from nil to extensive. In no way would this study's population be comparable to the general population. The broader population would undoubtedly see large ranges, and practice patterns would certainly emerge. The literature supports the argument that there is substantial variation in the treatments offered by dentists in the general population (Bader & Shugars, 1995; MacDonald, 1998), but that is not sufficient to state that this study would be successfully reproducible in the general Ontario population.

This does not affect the relevance of findings for the CINOT population used as part of this study. Furthermore, CINOT children tend to have very defined needs – urgent care – which should display less variation than the care that would be offered in the general population. The needs of 70 children all requiring urgent dental care will undoubtedly be more similar than the care of a

much larger population of individuals with needs varying from no needs to extreme needs. Therefore, it is likely that the variations seen in this study are more conservative than the ones that would be seen in the general population.

Content Limitations of This Study

In addition to the internal and external validity issues, a number of factors that could potentially contribute to the variation seen here were introduced in the first chapter and will be discussed at more length here within the context of this study's results.

Payment Scheme

As mentioned in the introduction, Hazelkorn and numerous other researchers found that patients treated under a fee-for-service scheme were offered more care than patients treated under a capitation or salary payment scheme. These researchers' findings are interesting to us if this study is put within a payment scheme context. The dentists who performed care on the CINOT children were all working on a fee-for-service basis – each procedure was recorded and reimbursed according to a percentage of ODA payment guidelines. Fee-for-service is the usual practice in Ontario. What is unusual is that the dental directors who independently developed treatment plans for this study's subjects were not being paid on a fee-for-service basis. They were salaried employees of the public health unit with which they were affiliated.

What Hazelkorn and his colleagues have found in dentistry, and what others have also found in medicine (Renaud et al., 1980), is that “delivering treatment by a prepayment system is less expensive than delivering treatment by

a fee-for service system.” (Hazelkorn, 1985). This is because, according to Robinson (2001), “a piece rate induces the agent to increase the quantity of services provided beyond the minimum necessary to achieve the principal’s goal.”

However, a commentary on capitation that appeared in the *New England Journal of Medicine* (Pearson et al., 1998) resulted in a number of letters criticising the paper and the capitation system of payment itself. One letter went as far as to state that “capitation is intrinsically unethical because it creates incentives which can transform the physician from the patient’s advocate to the patient’s adversary.” (Robbins, 1999).

In 1996, Hazelkorn pushed his capitation versus fee-for-service argument further by comparing these two groups to a third group who were part of an independent practice association (IPA) (Hazelkorn et al., 1996). What characterized dentists who were part of IPAs is that they were able to charge co-payments beyond the basic services covered by their patients’ insurance. This is similar to the practices of some of the dentists who performed care on the CINOT children. In addition to charging CINOT for care covered by the program (Plan 4), they performed additional care that was paid for separately by the parent (Plan 5). Hazelkorn found that dentists enrolled in IPAs provided even more than their fee-for-service counterparts who, in turn, provided more than dentists paid under capitation systems.

Consequently, this body of literature brings to light the possibility that the paired differences in the care proposed/prescribed by dental directors compared

to private practitioners may be influenced by the method in which they were paid, rather than by their skills and knowledge alone.

Dentists providing care under CINOT at the time of the study were reimbursed at a rate of 75% of the ODA's recommended fee. It is conceivable that dentists who are being paid 75% of what their colleagues are being paid for similar procedures (i.e. what they would be able to charge for non-CINOT patients) would try to compensate for this by increasing the amount of services they provide. This practice is also known as creating "supplier-induced demand" (Evans, 1974). Dental directors, on the other hand, because of their salaried status and because of the hypothetical nature of their treatment plans, would reap no financial benefit from offering additional care.

Under less theoretical conditions, it is conceivable that dental directors, because of their salaried status, would not have any incentive to offer the best care, but would be interested in offering minimal care because of the lack of financial incentive to provide more/better care (Gosden, 1999). Robinson (2001) believes that "salary undermines productivity, condones on-the-job leisure and fosters a bureaucratic mentality in which every procedure is someone else's problem." (Robinson, 2001). Again, though, this did not apply to the results in this study, as personally treating the children was never an option for the public health unit dental directors.

However, the reverse could also be true. Because they are not in a position where offering differential care would result in differential income, it can be argued that dental directors would prescribe only the best care they could to

all of their patients because it would not impact on their financial returns. The latter argument has been documented with respect to medical care in Montreal, Quebec by Renaud et al., who state that “physicians practicing in the government-funded clinics spent more time with their patients, took better histories, were more thorough in investigating the patients' complaints, and prescribed less medication than those in the fee-for-service practices.” (Renaud et al., 1980).

As reiterated above, the dental directors in this study were required to make “theoretical” treatment plans. Because their treatment plans were not designed to be executed, it is more likely that the dental directors recorded what they really thought was necessary rather than what they thought they should offer within the limits set out by being a salaried provider.

There are advantages and disadvantages associated with all forms of remuneration. According to Robinson (2001), “It turns out that 2 of the four most important dimensions of physician performance are well served by piece-rate payment, which explains the persistence of fee-for-service; the other 2 are poorly served by piece rates, and hence explain the rise of capitation.” He classifies these four dimensions as:

1 – *Physician productivity and patient service*: fee-for-service encourages physicians to work long hours and see as many patients as possible. Remuneration through a capitation method would not be conducive to successfully promoting this type of professional style.

2 – Risk acceptance: fee-for-service rewards physicians who take on sicker patients as part of their patient load. Sicker patients often come with more numerous and more challenging problems which, in turn, often require more and longer medical attention. These patients are more likely to benefit from “good” care if their doctor is being rewarded for it than if he/she is not.

3 – Efficiency and appropriate scope of practice: fee-for-service, although it undoubtedly benefits those who need more extensive care, also leads to the over-prescribing of care, not necessarily because it is needed, but rather because it means more money to the provider. In this respect, capitation is better.

4 – Cooperation and evidence-based medicine: fee-for-service is not conducive to providing/practicing evidence-based care. As stated by Robinson (2001), “Physicians should be encouraged...to adopt evidence based best practices... fee-for-service is counter productive [to this].”

There may be some validity in the argument that some of the treatment variation seen as part of this study may be the result of differences in remuneration scheme. This could certainly explain the fact that private practitioners, overall, performed approximately 1.8 times as much restorative care as was proposed by the dental directors. This statistically significant difference translates into an additional 442 RVUs of care divided across 70 subjects – this equals an additional 6.3 RVUs per subject in restorative care alone!

In addition to this, the records for Plan 5 and 6 show that if the subjects had been otherwise insured, that the dentists would likely have performed an average of 5.2 additional RVUs per subject. The author believes that this alone solidifies the belief that private practitioners may have responded to financial incentives when providing care to CINOT children.

As was mentioned earlier, it is known that the dental directors who participated in this study received education in evidence-based care; some of the dental directors were even involved in the preparation and dissemination of evidence-based guidelines. Consequently, it is safe to say that, at least to some extent, dental directors performed some evidence-based care.

A Cochrane review of different systems of payment in medical settings (Gosden et al., 2001) assessed studies comparing different payment methods. Despite an impressive body of literature (332 articles were reviewed by the authors), only 4 studies - 2 randomized control trials and 2 before and after – were selected. Their review showed that “there is some evidence to suggest that the quantity of primary care services provided by PCPs [primary care providers] under [fee-for-service] payment was higher than that provided by capitated and salaried PCPs.”

Assuming that different payment structures have impacted on the care patterns described in the results, what can be done to control this in future studies? In studies aimed at assessing the impact of factors other than payment, it would be necessary to have both the dental directors and the private practitioners compensated in a similar fashion so as to ensure that different

remuneration methods did not alter the magnitude or direction of the reported variation. Doing so would seek to ensure that differences in care were the result of differences in other factors.

Dentist Age/Year of Graduation

If identifiers for the dental directors and dentists who proposed/performed care for CINOT children had been available for this study, the author would have been able to determine: 1) whether there was a significant difference in the age/year of graduation of dental directors and participating private practitioners; and 2) whether there was a difference in the age/year of graduation of participating and non-participating private practitioners. This would have helped the author determine whether these two factors contributed to the variation that was reported in this study, as well as determine whether participating and non-participating dentists were indeed different in a way that would jeopardize the external validity of this study. One of the reasons the author was not given identifying information is because the number of participants in this study was quite small and getting access to these identifiers would have resulted in the identification of dentists who agreed to participate provided that their participation would be anonymous.

Location of Dentist's Training

Again, as with the previous variation factor, this information was not available as part of this study and is only speculative. Because no information was available on the dentists involved in this study, it is impossible for us to determine whether this would have any impact on the difference recorded in this study.

Surgical Signatures

As discussed in the introduction, surgical signatures are specific to each health care professional. They can be related to other sources of variation such as a dentist's age, location of training and skill. However, while some of the other factors could potentially cause variation across all service types, surgical signatures apply to specific procedures. In other words, if one of the private practitioners performed his extractions with more anaesthetic than one of the dental directors proposed to, then there would be a larger difference in the paired RVU for the practitioner's patient than might have been recorded if the subject had been treated by another private practitioner with a different surgical signature. Again, unfortunately, it is impossible to judge the extent to which this may have contributed to the variation in this study, but it should be mentioned as a possible cause of variation.

Geography/Dentist:Patient Ratio

The place of residence of a subject may have influenced the dentist he/she chose to receive treatment from. As reported by Locker and Clarke (1999), the location of an individual's place of residence may influence the number of dentists in his/her geographic vicinity which, in turn, may influence the amount and type of care he/she receives. Again, no location information beyond health unit was available on either the dentists or the subjects, so it is not possible to determine whether this had any or how much influence on the variation reported in this study. One may speculate that in some of the more urban regions, it is possible that the care that was given by the private practitioners was influenced by geography – namely, that in more urban areas,

there is a higher concentration of dentists and therefore fewer patients per practitioner. This can lead to provider-induced demand. This also relates to the possible variation related to dentist:patient ratios reported by Main et al. (1997b).

Talent/Skill of Dentist

Another possible explanation that has not been proposed in the literature is that only less expensive and less talented dentists will take on CINOT patients. This theory is being proposed as CINOT only reimburses approximately 75% of the ODA's recommended fees for specific procedures. However, such a theory is difficult to quantify and measure and will not be confirmed or denied with the limited number of variables offered in this study.

In summary, there are, as demonstrated above, a number of factors that may influence the volume and intensity of services offered and will contribute to the differences seen in the treatment proposed/provided by the two groups of dentists in this study. There is a body of evidence that has begun elucidating which of these factors actually contribute, but further research needs to be undertaken to determine the extent and importance of these factors in explaining the variation seen in this and other study populations.

Logistical Issues in Conducting this Study

Part of being involved in the implementation and running of a study is that logistical issues and limitations of the study and of its design are identified. A particularly important limitation with this study was the lack of available information to ascertain some of the factors that may have contributed to the

reported variation. Ideally, additional variables based on the variation factors discussed above would have been included in the study design. Appendix G lists these variables.

As part of this discussion, it is also important to include an overview of the other logistical issues related to this study, especially if further research is to result from these findings.

Recruitment Issues

Upon implementation of this study, numerous private practitioners expressed concerns about this study and what it was hoping to achieve. Phone calls were made by private practitioners to the Dean of the Faculty of Dentistry and to other individuals questioning the appropriateness of this study. Undoubtedly as a consequence of this, the enrollment of subjects and the collection of data was tedious and slow. The recruitment problems encountered here were not due to the number of patients enrolled in the CINOT program – in 1999, 2,356,400 children were eligible to receive CINOT care if their parents indicated financial need. Of these children, 22,039 children filed CINOT treatment requests, or approximately 1% of the eligible population (Main, 2001). The problem was a different one – dentists in the study populations felt that they were being scrutinized and that their skills and work were being tested. In one of the public health units, dentists made a concerted effort to hinder the progression of the study in varied ways, including not responding to requests for treatment information, not sending in requested radiographs, and/or by discouraging parents from participating. Dental directors attempted to recruit a much larger

number of subjects than was enrolled, but were unsuccessful due to the reasons mentioned above.

Despite private practitioners' concerns, this was not a study designed to point fingers at specific dentists and their work. Rather, the purpose of this study was to determine whether there were differences in the care provision recommended by public health unit dental directors exposed to continuing education in evidence-based guidelines and that provided by private practitioners treating children enrolled in CINOT.

Unfortunately, this point was not properly made to or at least was not satisfactory to dentists practicing in the catchment areas served by the public health units and this is evident when looking at the total number of enrolled subjects. The initial protocol called for 120 subjects – the recruitment was ended at the end of the study period, shy of 50 subjects.

Larger-Scale Study

Given that this study is a small study, some additional questions present themselves, including: is a larger-scale study feasible, worthwhile, and how reproducible would the results from this study be? This is a multi-dimensional question that needs to be addressed as part of this discussion.

In terms of reproducibility, this study targeted a very specific group of subjects – patients enrolled within the CINOT program. These individuals all required urgent dental care, families of all enrolled subjects deemed dental care to be a financial strain, all were from Ontario, and all were between the ages of 3 and 13. If a province-wide study were performed involving CINOT patients,

reproducibility could be an issue given that the author was not able to determine whether the private practitioners who participated in this study were in some way different from the private practitioners who did not participate, nor was the author able to determine whether there was a difference between enrolled and unenrolled CINOT children.

Internal validity is only one factor that may influence the success of a similar, yet larger study. If this study were performed outside of the context of the CINOT program, reproducibility could also be an important issue as the subjects in this study were atypical – they were poorer than the general population; all were young and had specific needs related to their age and socio-economic status. They were also treated by dentists who for whatever reason were willing to treat CINOT children despite being reimbursed at only 75% of the ODA fee schedule. Their treatment patterns are not necessarily representative of the general dentist population in Ontario. One purpose of a large-scale study would be to ascertain the reproducibility of these findings. Clearly, that a larger study which would include the general population would not necessarily result in the reproduction of these results.

Irrespective of the reproducibility issues relating to this study, would a large-scale study with the same design as this study be worthwhile? It does not appear that it would be. This study was successful at determining that there were both clinically important and statistically significant differences between the care provided by the dental directors and private practitioners to a very specific sub-population of Ontario patients. This study gives us limited insight into what may

have caused these differences. A larger study with the same population would likely reinforce this study's findings, but the author does not believe that would be worthwhile for three reasons – 1) the differences were large and clinically important and the t-tests were robust and make us confident that the results would not be different had the study population been larger; 2) this study as it was designed offers no insight into what factors were involved in the reported variation; and 3) the internal and external validity issues discussed earlier would likely continue to apply.

Future Research

To follow up the findings of this study, it would be valuable to conduct a full-scale prospective cohort study using a similar population of subjects but that would also look at the factors that could contribute to this variation. The present study would serve the purpose of supplying the necessary values needed to calculate the required power for a full-scale study. Appendix G includes a list of variables that should be collected in such a study, based on the literature already discussed.

In addition to the variables that should be collected, there are a number of other issues involved in performing a full-scale study.

One of the most important hindrances in enrolling patients in this was that dentists in the general population were under the impression that their specific care patterns were being analysed and criticized. Better communication with the general dentists, letting them know the objectives of the study, informing them on the results of this study, and emphasizing that the full-scale study looks at

dentists as a group rather than as individuals would hopefully help increase enrollment in this study. This could perhaps be done in the form of a letter submitted to the ODA newsletter, as well as by establishing personal contact with the potential participant dentists. This may be very labour-intensive, but could be necessary to avoid recruitment issues. Much of the reticence expressed by dentists in this study may have been the result of the flawed belief that each dentist's treatment plan would be looked at individually. The way the study was designed, and the way the analysis was conducted meant looking at all participating dentists within a public health unit as a group. Arguably, public health units with more participating dentists provided more confidentiality than public health units with fewer participating dentists. However, it was still not possible for the researchers to identify specific dentists even in the health unit with the smallest sample size.

A study with a similar structure as ours, but with a study population that was more representative of the general population would make sense. However, although this could give the power and variables required to conclusively determine the amount of variation resulting from the aforementioned factors, it would not address the possible care provision issues related to differential payment schemes.

A larger study would have to control for payment scheme if the impact of other factors was to be measured. Perhaps a study structure similar to the one used by MacDonald (1998) would be appropriate, where different test subjects could ask for treatment plans from different general dentists and then the

researchers could compare the treatment plans based on all of the available variables. This would control for payment scheme as all dentists would be remunerated in the same fashion.

Obviously, dentists would need to be willing to participate in order to use this treatment information, but at least this study would allow measurement of the effect of the different variation factors as well as whether there indeed was a difference between participating and non-participating dentists.

Realistically, however, the author believes, based on her experience, that this type of study would be difficult to successfully complete, even with better communication with dentists in the general population. Therefore, recruitment issues could severely limit the success of this or other future studies requiring dentist participation.

Policy Implications

While this study showed significant variation in the care proposed by dental directors and prescribed by private practitioners, the external validity issues and lack of insight into what factors contributed to the variation limits certainty about the policy impacts of these findings. On the other hand, this study did bring to light issues that, if replicated in further research, could be of importance to the policies administered by universities, self-regulating boards, and dentists.

Educational Policy Issues

If the variation factors, such as access to continuing education and evidence-based education, discussed in the literature are conclusively shown by

further research to have such an important impact on quality of care, it will be critical that policy makers and university boards continue to push towards more stringent undergraduate and post-graduation evidence-based education requirements. Although some provinces such as Ontario have implemented mandatory continuing dental education (Leake, 2001a), health professionals, including dentists, tend to be overwhelmed by the sheer volume of literature, often do not know how to extract what is of value to them (Anonymous, 1994; Deahl, 1999; Bero et al. 1998; Lomas, 1991; Lomas et al., 1989; Oxman et al., 1995; Davis et al., 1995; Soumerai et al., 1989) and, if they read it, are slow and reticent to adopt it (Niedermann and Badinovac, 1999). How much of the difference seen in this study is due to training or other factors? We cannot be sure but, because it is these boards that are responsible for these individuals once their university training is complete, the onus should be on them to adopt a more stringent post-graduation standard and enforce it (Bero et al., 1998).

The onus is currently on and will also continue to be on university programs to educate their students on the importance of keeping up to date on the literature, and to embrace continuing education programs. While it is often difficult to reach and modify the behaviours of former graduates, there is an important and precious opportunity to reach the graduates of the future. This may require that efforts be made in the realm of curriculum development and implementation, but it can be a worthwhile endeavour, both in terms of population health as well as tax dollar saving.

However, considerations of changing policy should not end here. The relationships between continuing education and clinical outcomes have been established by some (Main et al., 1997a; Main et al., 1997b), and some of the difference in the proposed and provided care in this study might have been the result of this factor. This relationship could be emphasized by encouraging the periodic recertification of dentists. Certain groups such as the Pew Health Professions Commission have been pushing towards mandatory recertification of health care practitioners in order to ensure the health and well-being of patients (Finocchio et al., 1995). They argue that "...the state grants a license based on the individual's demonstrated command of the profession's relevant body of knowledge and fulfillment of entry requirements ... The credential earned at the beginning of a career may have little direct relationship to skills used and required later in practice." (Finocchio et al., 1995). This, in turn, is related to a number of potential variation factors, including age of practitioner, year of graduation, talent and skill of dentist, and surgical signatures.

The issue of recertification is not an easy one to approach and is beyond the scope of this study. There are many levels on which this issue needs to be contemplated and numerous different interest groups need to be represented, including the practitioners themselves.

Policy Issues Related to CINOT Payment Scheme

It is also clear when looking at these results that a closer look needs to be taken at CINOT. Both private practitioners and dental directors were proposing/providing what they deemed to be required, within CINOT guidelines. Then why were there such important differences in the services recorded by

dental directors and private practitioners? Although this study did not determine what are all the contributing factors nor the importance of each individual factor, this study did determine that practicing dentists in this study did not always perform care that was consistent with the care that was proposed by dental directors. Beyond the implications of failing to offer our children the best available care which, in a country such as Canada, is unacceptable, there lies the problem of poorly used taxpayer money. Healthcare is constantly the target of taxpayer fury, especially in Ontario's current political climate. Although health dollars have recently increased, health care is still often seen as underfunded. This reality makes policy leniency such as the one identified with CINOT rather problematic. This is compounded with the fact that CINOT financing is a municipal burden. Shouldn't every effort be made to ensure optimal efficiency of spending?

Realistically, the current CINOT payment scheme as it exists offers the dentists sufficient leniency to charge for procedures that are arguably not necessary. Establishing a cost-effective method of payment for dentists providing care to CINOT patients is a thin line to walk, since it was established earlier that payment scheme can dictate the level and quality of work that is offered to patients. From a purely financial point of view, a capitation system would be most financially viable and would likely work in larger centres where the dentists have fewer patients than in smaller centres and are looking to recruit additional ones. However, in smaller centers where dentists have sufficient patient populations to suit their practices' needs, this system might not work.

An alternate payment system could be a mixed system where certain

services such as surgical services (that showed no significant differences between Plan 3 and Plan 4) could be paid on a fee-for-service basis in addition to a capitation fee for all other procedures. It is possible that this could reduce the costs incurred in the CINOT program and allow these funds to be redirected into other areas of the dental health program where they could be better used.

Needless to say, this proposal would require a study of its own in order to ascertain dentist participation and to determine whether this genuinely results in reduced costs or not.

V. CONCLUSIONS

This study has permitted us to confirm the hypothesis that there is a statistically significant difference in the care proposed by salaried dental directors and by dentists in the general population, for the same patients and based on the same diagnostic information. At the same time, the study design did not include the information necessary to examine the factors which might be responsible for these differences. It is therefore recommended that further research be undertaken to address these factors.

Further Research Recommendations

- A larger study that attempts to look at the extent to which different potential variation factors contribute to a difference in the treatment proposed/provided to children in the CINOT program.
- It is also important to encourage more randomized control and cohort studies into the impact of different types of payment schemes on dental care treatment. As was discussed, there is a large volume of studies looking at this issue, but there are too few strong studies available to conclusively comment on the impact of this topic on the results of this study and on the quality of dental health care in general.
- Surveying experts and clinicians in the field to determine what is considered to be a clinically significant difference in dental care provision, along with efforts to confirm this by measuring treatment outcome differences.
- Efforts must be made to inform dentists of research projects and offer them an avenue for discussion, especially when their participation is required. An

important hindrance in subject recruitment for this study was the misgivings held by dentists as to the purpose of this study and its goals. Establishing dialogue is encouraged and recommended in order to ensure the success of future research projects with this professional group.

Other Recommendations

- The subjects of evidence-based care in dental curricula, continuing education, and recertification are far from being exhausted. These are three important areas that need to be addressed further as there is evidence of their impact on the quality of dental health care. This study does not claim to offer answers to the questions surrounding these areas, but hopefully may contribute to and encourage future discussion.
- Related to payment scheme issues is the issue of whether CINOT dollars are being used in an efficient manner. The purpose of this study was not to test this, but hopefully offers evidence that will be used in further research in this area.
- Finally, the author recommends that the results of this study be disseminated to encourage discussion and reform in dental health care and education, both in Canada and abroad.

LITERATURE CITED

Anonymous. 1994. Implementing Clinical Guidelines: Can Guidelines be Used to Improve Clinical Practice? *Effective Health Care*, 8.

Arison P. 1997. The Suggested Fee Guide Explained. *Ontario Dentist* 74(6):31-32.

Bader JD, Shugars DA. 1995. Variation in Dentists' Clinical Decisions. *Journal of Public Health Dentistry* 55(3):181-188.

Begg R. 1997. The RVU Study and Specialists. *Ontario Dentists* 74(7):21-26.

Bennett S. 1996. Results from the 1993-94 Ontario Dental Indices Survey. *PHERO* 7(8): 355-358.

Bennett S, Burry A. 1999. The Relationship Between the Ministry of Community and Social Services Dental Program and the CINOT Dental Program. *PHERO* 10(2): 5-9.

Bennett S. 2001. Personal Communication.

Bero LA, Grilli R, Grimshaw JM, Harvey E, Oxman AD, Thomson MR. 1998. Closing the Gap Between Research and Practice: An Overview of Systematic Research of Interventions to Promote Implementation of Research Findings. *BMJ* 317:465-468.

Bradnock G, Rock WP. 1982. Factors Influencing the Use of Preventive Products in General Practice. *British Dental Journal* 153(3):105-106.

Cotton C. Recent Developments in Low Income Cutoffs. Income Division Statistics, Ottawa: Statistics Canada, 2001.

Davis DA, Rhomson MA, Oxman AD, Haynes RB. 1995. Changing Physician Performance: A Systematic Review of the Effect of Continuing Medical Education Strategies. *JAMA* 274:700-705.

Deahl ST. 1999. Conditions and Tools for Evidence-Based Practice. *Journal of the American College of Dentists* 66(2):13-16.

Dupont WD, Plummer WD. 1990. Power and Sample Size Calculations: A Review and Computer Program. *Controlled Clinical Trials* 11:116-28.

Dupont WD, Plummer WD. 1997. PS Power and Sample Size Calculations. <http://www.mmc.vanderbilt.edu/prevmed/ps.htm>

Evans R. Supplier induced demand: some empirical evidence and implications. In: Perlman M, ed. *The economics of health and Medical Care*. New York: Stockton Press, 1974.

Faine RC, Dennen TA. 1986. A Survey of Private Dental Practitioners' Utilization of Dental Sealants in Washington State. *ASDC Journal of Dentistry in Children* 53:337-342.

Finocchio L J, Dower C M, McMahon T, Gragnola C M and the Taskforce on Health Care Workforce Regulation. *Reforming Health Care Workforce Regulation: Policy Considerations for the 21st Century*. San Francisco, CA: Pew Health Professions Commission, December 1995.

Gosden T, Pedersen L, Torgerson D. 1999. How Should We Pay Doctors? A Systematic Review of Salary Payments and Their Effect on Doctor Behaviour. *Quarterly Journal of Medicine* 92(1):47-55.

Gosden T, Forland F, Kristiansen IS, Sutton M, Leese B, Giuffrida A, Sergison M, Pedersen L. 2001. Capitation, Salary, Fee-for-service and Mixed Systems of Payment: Effects on the Behaviour of Primary Care Physicians. *The Cochrane Library* 3.

Grembowski D, Milgrom P, Fiset L. 1990. Variation in Dentist Service Rates in a Homogeneous Patient Population. *Journal of Public Health Dentistry* 50(4):235-243.

Grembowski D, Milgrom P, Fiset L. 1990. Factors Influencing Variation in Dentist Service Rates. *Journal of Public Health Dentistry* 50(4):244-250.

Hazelkorn HM. 1985. A Comparison of Dental Treatment Plans Under Different Reimbursement Systems. *Journal of Public Health Policy* 6(2):223-235.

Hazelkorn HM, Jovanovich BD, Macek MD, Chouinard J. 1996. New Assumptions Concerning IPAs and Cost of Dental Care. *Journal of Public Health Dentistry* 56(6): 347-351.

Leake JL. 2000a. Personal Email communication.

Leake JL. 2000b. Personal Email communication.

Leake JL. 2001a. Personal communication.

Leake JL. 2001b. Personal communication.

Leake JL. 2001c. Personal email communication.

Lewis DW, Main PA. 1996. Ontario Dentists' Knowledge and Beliefs About Selected Aspects of Diagnosis, Prevention and Restorative Dentistry. *Canadian Dental Association Journal* 62(4):337-344.

Locker D, Clarke M. 1999. Geographic Variations in Dental Services Provided to Older Adults in Ontario, Canada. *Community Dentistry and Oral Health* 27:275-282.

Lomas J. 1991. Word Without Action? The Production, Dissemination and Impact of Consensus Recommendations. *Annual Review of Public Health*. 12:41-65.

Lomas J, Anderson GM, Domnick-Pierre K, Vayda E, Enkin MW, Hannah WJ. 1989. Do Practice Guidelines Guide Practice: the Effect of a Consensus Statement on the Practice of Physicians. *New England Journal of Medicine*. 321:1306-1311.

MacDonald J. 1998. How Honests Are Dentists? *Readers Digest*: 38-44.

Main P. 2001. Personal Email communication.

Main PA, Lewis DW, Hawkins RJ. 1997. A Survey of General Dentists in Ontario, Part I: Sealant Use and Knowledge. *Canadian Dental Association Journal* 63(7):542-553.

Main PA, Lewis DW, Hawkins RJ. 1997. A Survey of General Dentists in Ontario, Part II: Knowledge and Use of Topical Fluoride and Dental Prophylaxis Practices. *Canadian Dental Association Journal* 63(8):607-617.

Muskoka-Parry Sound Health Unit. Children in Need of Treatment (CINOT) Program. <http://www.mpslu.on.ca/DentalHealth/cinot.htm>

Niedermann R, Badinovac R. 1999. Tradition-based Dental Care and Evidence-Based Dental Care. *Journal of Dental Research*. 78(7):12-88-1291.

Olsen ED, Chetlat GF. 1979. Dental Capitation Programs: A Comparison of Delivery Systems. *Journal of the California Dental Association* 61:47-50.

Ontario Children's Secretariat. 2000. Program Description: Children in Need of Treatment (CINOT).

http://www.childsec.gov.on.ca:80/3_resources/childrens_pathfinder/programs/cinot.htm

Ontario Dental Association. 1990. Suggested Fee Guide. Ottawa: ODA, 1990.

Ontario Dental Association. 2000. Suggested Fee Guide. Ottawa: ODA, 2000.

Ontario Dental Association. 2001. Your Oral Health – Ontario Dental Association. <http://www.oda.on.ca>

Ontario Ministry of Health. 2001. Your Community – Health Services. http://www.gov.on.ca/health/english/contact/phu/phu_mn.html

Ontario Ministry of Health. Mandatory Health Programs and Services Guidelines. Queen's Printers: Ottawa, 1997.

Oxman AD, Thomson MA, Davis DA, Haynes RB. 1995. No Magic Bullets: A systematic Review of 102 Trials of Interventions to Help Health Care Professionals Deliver Services More Effectively or Efficiently. *Canadian Medical Association Journal*. 153:1423-1431.

Pearson SD, Sabin JE, Emanuel EJ. 1998. Ethical Guidelines for Physician Compensation Based on Capitation. *New England Journal of Medicine* 339:689-693.

Pickett W. 2001. Personal communication.

Porter J, Coyte PC, Bamsely J, Croxford R. 1999. The Effects of Fee Bundling on Dental Utilization. *Health Services Research* 34(4):901-921.

Renaud M, Beauchemin J, Lalonde C, Poirier H, Berthiaume S. 1980. Practice Settings and Prescribing Profiles: The Simulation of Tension Headaches to Private practitioners Working in Different Practice Settings in the Montreal Area. *American Journal of Public Health* 70:1068-1072.

Robbins D. 1999. Correspondence. *New England Journal of Medicine* 340:321-323.

Robinson JC. 2001. Theory and Practice in the Design of Physician Payment Incentives. *The Millbank Quarterly* 79(2):149-177.

Rouse RA, Hamilton MA. 1991. Dentists' Technical Competence, Communication and Personality as Predictors of Dental Patient Anxiety. *Journal of Behavioral Medicine* 13(3):307-319.

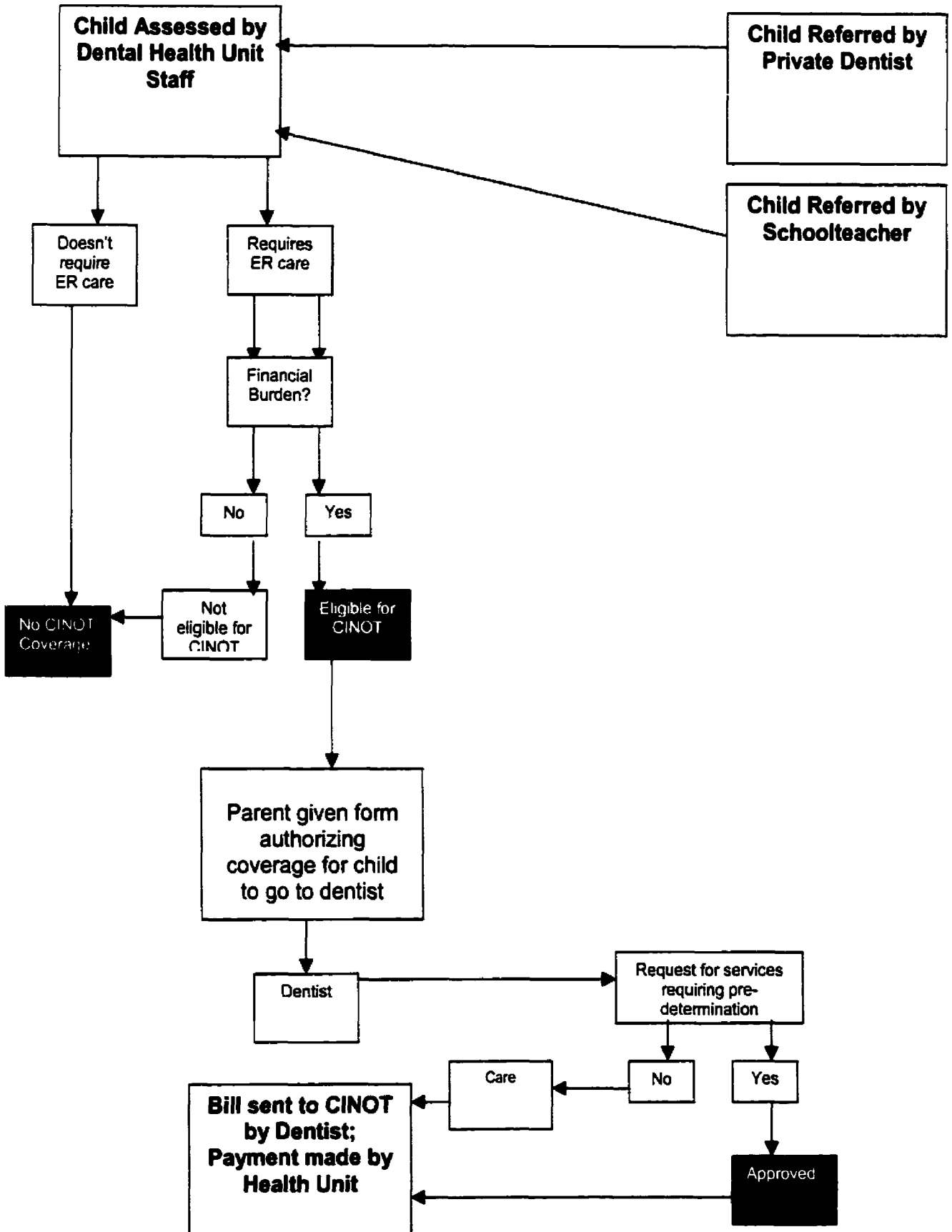
Sackett DL, Hayes RB, Guyatt GH, Tugwell P. *Clinical Epidemiology: A Basic Science for Clinical Medicine*. Boston: Little, Brown & Co., 1991.

Soumerai SB, McLaughlin IJ, Acorn J. 1989. Improving Drug Prescribing in Primary Care: A Critical Analysis of the Experimental Literature. *Milbank Q*. 67:268-317.

Statistics Canada. Profile of Census Divisions and Subdivisions in Ontario: 1996 Census of Population. Ottawa: Statistics Canada, 1999. Volume 1.

Statistics Canada. Profile of Census Divisions and Subdivisions in Ontario: 1996 Census of Population. Ottawa: Statistics Canada, 1999. Volume 2.

Appendix A - CINOT Care Decision Tree



Appendix B - Demographic and Oral Health Background on Participating Public Health Units

CINOT is a program that is offered by all health units to individuals residing within their catchment areas. For the purpose of this study, subjects were recruited and enrolled from four health units:

- Durham
- Haliburton Kawartha Pine-Ridge
- Simcoe
- York

It should be noted here that although demographic information is given in this section, the participating health units will subsequently be referred to as A, B, C and D to assure the confidentiality of participating subjects, dentists and health units.

Demographics

All of these health units are located in the Central East part of Ontario. It should be noted that the region covered by the Haliburton Kawartha Pine-Ridge Health Unit is referred to as “Northumberland” in the Canadian census. In accordance with this, HKPR will be referred to as Northumberland in this section that deals primarily with census data.

Populations in the catchment areas for these four different health units varied substantially. According to the 1996 census, Northumberland had a population of just under 82,000 residents while York had nearly 600,000 residents (Statcan, 1999a, 1999b). Most of these regions showed substantial

population growth in the five years between the 1991 and the 1996 Statistics Canada censuses. The notable exception was the Northumberland region with a more modest population increase of 4.6% (Table B.1).

Table B.1. Demographic Overview of Participating Regions (Statistics Canada, 1999a, 1999b)

	Durham	Northumberland	Simcoe	York
Total Population 1996	458,616	81,792	329,865	592,445
Total Population 1991	409,070	78,224	288,684	504,981
Percentage Change	12.1%	4.6%	14.3%	17.3%
% of Total 15 years+ population with a minimum of a SS Diploma	69.2%	62.1%	46.7%	71.6%
Total Income <\$10,000	4.1%	4.8%	4.2%	7.2%
\$10,000-29,999	18.3%	30.6%	20.1%	39.1%
\$30,000-49,999	19.9%	24.7%	26.8%	15.9%
\$50,000-69,999	21.3%	19.7%	22.8%	14.5%
>=\$70,000	36.4%	20.2%	26.1%	23.3%
Prevalence of low income family ²	12.0%	9.8%	11.1%	11.5%
Population 0 –14	111,455	16,995	74,605	134,915
Percentage Female (0-14)	48.9%	49.0%	48.8%	48.3%
0-14 as Percentage of Total Population	24.3%	20.8%	22.6%	22.8%

All health unit catchment areas showed a slightly higher number of males than females aged between the ages of 0 and 14 (the lowest was in Northumberland with 51.0% and the highest was in Durham with 52.1%).

² Low-income family is defined by Statistics Canada as "A family with an income below the cutoff is counted as low income." (Cotton, 2001). The cutoff is called a "low income cut-off" which is calculated by Statistics Canada. It does not take into consideration a family's power of purchase – it is based exclusively on a family's before-tax income.

As seen in Table B.1, the demography of these regions was quite diverse. The incidence of low family income in Northumberland was 9.8% (the lowest in the four participating health units). However, York had a higher percentage of individuals aged 15 and older who had achieved a minimum of an Ontario Secondary School Diploma than the other regions, yet also had a higher occurrence of low family income (11.5%) than Northumberland or Simcoe. There was evidence of income disparity in regions such as Durham, which had both highest prevalence of low family income and the largest population proportion with an annual income of above \$70,000. The three remaining health unit areas had more modest incomes, with the majority of their populations reporting annual incomes of between \$10,000 and \$50,000.

It should be noted that despite having a smaller percentage of individuals with a minimum of a secondary school diploma than in York region, a higher percentage of individuals in Durham had an income of greater than \$30,000. This may be the result of highly paid jobs in factories such as the General Motors factory in Durham – many factory jobs do not have high educational criteria but tend to pay well. It is possible that this would skew expected results.

Based on their demographic differences, it becomes apparent that the different health units had different needs and different volumes of cases, depending on the socio-economic status of their catchment area. However, the needs that CINOT caters to are standardized across the province, which means that although the volumes may vary from health unit to health unit, the needs themselves are most likely to be similar as all cases are deemed to be urgent

cases, and all are from the same income bracket. However, there may be some variation between health units related to the severity of cases, which warrants a macro-level analysis.

Oral Health Status (1993-1994)

An overview of the dental health status of the participating health units is warranted in a study where four different health units are put together in the hopes of drawing general conclusions about the differences in amount and type of care offered to CINOT children by private practitioners relative to the amount and type of care proposed by dental directors trained in evidence-based care. The data are collected by the Ontario Ministry of Health and Long-Term Care (formerly the Ontario Ministry of Health (OMH)) as part of the province's mandatory programs. All of these data are collected by each health unit following a province-wide ministry protocol in order to ensure a consistent standard. These data are entered into a province-wide database, from which information on the oral health status of the health units participating in this study has been extracted.

The first indicator that was looked at was the percentage of individuals within each health unit who were eligible for CINOT care. These numbers do not take into account financial eligibility, as these data are not collected. Consequently, the percentage of the total population eligible for CINOT based on the need for urgent care and financial burden was smaller than what is being reported here. However, these numbers do offer some insight into the oral health

of the respective health units and illustrate the amount of preventive and diagnostic work faced by the different dental health units.

Table B.2. Percentage of 5 and 13 year Olds Requiring Emergency Care in Participating Health Units

	Total Population 5 & 13 Years Surveyed	Population 5 & 13 Years Requiring Urgent Care	% of Total 5 & 13 Years Population Requiring Emergency Care
Durham	1017	13	1.3
HKPR	990	119	12.0
Simcoe	1215	105	8.6
York	1838	104	5.7

It appears that Durham had the fewest number of cases requiring urgent care as well as the smallest percentage. Again, these results reflect only a need for urgent care. Although it can be argued that a larger need for urgent care implies financial need (less money = less likely to go to dentist on a regular basis = more likely need urgent care), there are no variables available here to quantify this speculation. The lower number of cases requiring urgent care in Durham may be the result of reporting differences rather than actual differences in caseload. However, all health units were expected to use CINOT eligibility criteria which are clear and specific. Consequently, it should be assumed that the results are comparable.

A second indicator that was extracted from the OMH database was the percentage of children aged 5 and 13 years who had 0 decayed, missing or filled (DMF) teeth. Data for this variable are offered in Table B.3 in 2 formats: for two specific ages (age 5 and age 13) and overall. The author elected to do so because this gives the reader an indication of oral health at two points in life

rather than 1, thus permitting the analyst and reader to look at whether children stayed caries free as they got older. Age 5 was chosen because it is the age at which children still retain their primary teeth but are most likely to show poor dental health; age 13 was chosen because children at this age tend to no longer retain their primary teeth. Needless to say, this is not a true longitudinal comparison as none of the subjects were followed over time. Rather, this analysis of cross-sectional data only serves as a tool for comparison between health units.

Table B.3. Percentage of Caries-Free Five- and Thirteen Year Old Children in Participating Health Units (Taken from 1993-1994 Dental Indices Survey)

	Durham	HKPR	Simcoe	York
Caries-Free % of Total 5 Year Old Population (n)	78.4 (515)	68.3 (496)	69.4 (661)	76.0 (789)
Caries-Free % of Total 13 Year Old Population (n)	55.8 (502)	48.0 (494)	48.9 (554)	52.9 (1049)

Durham was the region with the highest percentage of people with caries-free teeth, both stratified by age and overall.

The next table looks at the total number of decayed, extracted or filled (def) primary teeth and at the total decayed, missing or filled (DMF) secondary teeth. Again, these are also broken down into two age groups in order to do a comparison of dental disease experience over time between the different health units.

Table B.4. Total def Primary Teeth and DMF Secondary Teeth Stratified by Age and Health Unit

	Durham	HKPR	Simcoe	York
Age 5 (Primary)	0.69	1.15	1.08	0.78
Age 13 (Secondary)	1.10	1.51	1.42	1.28

As can be seen from this table, Durham had the lowest primary def teeth mean (0.69), meaning that the children of the Durham Region had the healthiest primary teeth. In addition, Durham had the lowest secondary DMF teeth mean (1.10), followed by York.

Finally, the last indicator extracted from the OMH database was the total mean deciduous and secondary decayed teeth. The results were as follows:

Table B.5. Mean Deciduous and Secondary Decayed Teeth Among Five- and Thirteen Year Olds by Health Unit

	Mean D&S Decayed Teeth
Durham	0.15
HKPR	0.23
Simcoe	0.22
York	0.23

Once again, Durham had the lowest value for deciduous and secondary decayed teeth. York had the largest mean number of deciduous and secondary teeth with decay.

In order to get a ranking of the oral health statuses in the participating health units, a tabular scoring system was developed where a rank was assigned for each category (1 = best score/percentage, etc.). The results of this ranking

system were that overall Durham had the best oral health among the 5 and 13 year age groups, followed by York, Simcoe and Haliburton Kawartha Pine Ridge.

Appendix C - University of Toronto Ethics Review Approval



University of Toronto

OFFICE OF RESEARCH SERVICES

PROTOCOL REFERENCE #3897

SEP 10 1998

September 3, 1998

Professor J. L. Leake
Community Dentistry
Faculty of Dentistry
124 Edward Street
University of Toronto

Dear Professor Leake:

Re: Protocol entitled "Comparing Evidence-Based Treatment Plans with Actual Care for Children Receiving Services Under CINOT" by Professor J. Leake

We are writing to advise you that a Review Committee composed of Drs. J. Mayhall, D. Mock and Professor A. Brudner has granted approval to the above-named research study.

The approved consent forms are attached. Subjects should receive a copy of their consent form.

During the course of the research, any significant deviations from the approved protocol (that is, any deviation which would lead to an increase in risk or a decrease in benefit to human subjects) and/or any unanticipated developments within the research should be brought to the attention of the Office of Research Services.

Best wishes for the successful completion of your project.

Yours sincerely,

A handwritten signature in cursive script, appearing to read "Susan Pilon".

Susan Pilon
Executive Officer
Human Subjects Review Committee

SP/mr Enclosures
cc: Dean B. J. Sessie

Appendix D - Release of Treatment Information Form

Parent request to release treatment information

I hereby request Dr. _____
to provide the record of dental treatment provided to my child _____
since the date ____ (day) _____ (month), 1998 to Dr _____ at the
_____ Health Unit.

Signed _____
Parent/guardian

Parent request to release treatment information

I hereby request Dr. _____
to provide the record of dental treatment provided to my child _____
since the date ____ (day) _____ (month), 1998 to Dr _____ at the
_____ Health Unit.

Signed _____
Parent/guardian

Appendix E – Parental Consent Form

Parent Permission for Study of Dental Care Needed and Provided

I _____ am the parent/guardian of
_____ and give my permission for him/her to participate in the
Study of Dental Care Needed and Provided as described in the letter I received from Dr.
_____ the Dental Director for the _____ Health Unit.

Date _____

Signed _____

Parent Permission for Study of Dental Care Needed and Provided

I _____ am the parent/guardian of
_____ and give my permission for him/her to participate in the
Study of Dental Care Needed and Provided as described in the letter I received from Dr.
_____ the Dental Director for the _____ Health Unit.

Date _____

Signed _____

Appendix F – Service Types

Treatment Type	Includes
<i>Diagnostic</i>	All types of exams
	Radiographs
	Panoramic x-rays
	Treatment planning and consultation
<i>Preventive</i>	Topical fluoride
	Oral hygiene instruction
	Sealants
	Caries screen and chlorzoin
	Prophys
	Space maintainers
	Discing and recontouring
	Other preventive procedures
<i>Restorative</i>	Amalgam rests in primary teeth
	Amalgam rests in permanent teeth
	Amalgam rests in permanent anterior teeth
	Composites in primary anterior teeth
	Composites in permanent anterior teeth
	Composites in primary posterior teeth
	Composites in permanent posterior teeth
	Crowns
	Prefabricated metal restorations
	Restorative pins
	Other restorative work
<i>Surgical</i>	Extractions and surgery
	Simple extractions
<i>Endodontic</i>	Endodontics
<i>Adjunctive</i>	Pain control
	Anesthesia procedures
	Adjunctive procedures
	Lab procedures

Appendix G – Additional Variables

Variable name	Description	Data Format	Coding	Literature Reference (if relevant)
Region	Region of participation; total number of health units to be determined at a later date	Numeric, categorical	1 = HU X 2 = HU Y 3 = HU Z, etc.	
IDNum	Participant identification number 1 st digit refers to region of origin, next three digits refers to person's id number within HU records, e.g. #3002 means that this particular individual is the second subject from HU Z.	Numeric, categorical		
Procode	Procedure Code	Numeric, categorical	5 digit number taken from ODA Fee guide	
Tooth	Tooth code	Numeric, categorical	2-digit number	
Surface	Tooth surface procedure was performed on (if applicable)	Text	Free-form text permitting inclusion of multiple tooth surface codes	
Comments	Additional comments made by dentist	Text	Free-form text permitting inclusion of practitioner notes regarding subject, e.g.	

Variable name	Description	Data Format	Coding	Literature Reference (if relevant)
			<i>alternate procedure</i>	
Gender	Gender of subject	Numeric, categorical	1= Male 2= Female 99 = unknown	
Age	Age of subject; Will be recorded as continuous to permit stratification, if desired	Numeric, continuous	Blank: unknown	
Prac_loc	Town practitioner located in; 12-character field permitting determination of practice location	Text	Blank: unknown	Bader & Shugars, 1995; Locker & Clarke, 1999
Pop_size	Population size; 7-digit field to enter population of practitioner's area to determine dentist to patient ratio – number of dentists will be extracted elsewhere; population size to be extracted from 1996 Census; can be stratified if required	Numeric, continuous	Blank: unknown	Main et al., 1997b

Variable name	Description	Data Format	Coding	Literature Reference (if relevant)
Dent_prac	Number of dentists in a practice; 3-digit field that captures the number of dentists in a practice – both full-time and part-time; can be stratified if required	Numeric, continuous		Main, 1997a; Faine & Dennen, 1986
Dent_age	Age of dentist at time procedure was performed; 2-digit field that can be categorized at analysis	Numeric, continuous		Grembowski et al., 1990a
Dent_grad	Practitioner year of graduation; 4-digit field that can be categorized at analysis	Numeric		Bader & Shugars, 1995; Main et al., 1997a; Main et al., 1997b; Grembowski et al., 1990b

Variable name	Description	Data Format	Coding	Literature Reference (if relevant)
Dent_train_gen	Undergraduate Dental School	Numeric, Categorical	1 = University of Toronto 2 = University of Western Ontario 3 = Université de Montréal 4 = Université Laval 5 = McGill University 6 = UBC 7 = University of Alberta 8 = University of Saskatchewan 9 = University of Manitoba 10 = Dalhousie University 11 = USA 12 = Europe 13 = Other	Bradnock & Rock, 1982; Bader & Shugars, 1995; Porter et al., 1999
<u>Dent_train_note_gen</u>	If Dent_train is coded as 11, 12, or 13, this permits the collection of University name; Free-form; can be added as additional code to dent_train if analyst deems this worthwhile	Text		

Variable name	Description	Data Format	Coding	Literature Reference (if relevant)
Dent_train_spec	Undergraduate Dental School	Numeric, Categorical	1 = University of Toronto 2 = University of Western Ontario 3 = Université de Montréal 4 = Université Laval 5 = McGill University 6 = UBC 7 = University of Alberta 8 = University of Saskatchewan 9 = University of Manitoba 10 = Dalhousie University 11 = USA 12 = Europe 13 = Other 99 = not applicable	Bradnock & Rock, 1982; Bader & Shugars, 1995; Porter et al., 1999
<u>Dent_train_note_spec</u>	If Dent_train is coded as 11, 12, or 13, this permits the collection of University name; Free-form; can be added as additional code to dent_train if analyst deems this worthwhile	Text		
Dent_genvssc	Stratification of training by whether practitioner has had any specialty training	Numeric, categorical	1 = General 2 = Specialty	

Variable name	Description	Data Format	Coding	Literature Reference (if relevant)
Dent_spec_note	If dent_genvsspec = 2, type of specialty	Text		
Cont_ed	Whether a practitioner has had any continuing ed	Numeric, categorical	1 = Yes 2 = No	Lewis & Main, 1996
Private_ins	Whether a patient or patient's parent/guardian has private insurance	Numeric, categorical	1 = Yes 2 = No 99 = unknown	Main et al., 1997a
Referral	Whether a patient was referred by the HU or self-referred	Numeric, categorical	1 = HU 2 = Self-referred	

Appendix H - Role of Student

My role in this study was initially as research associate. I became involved with the project from the point where data collection began. The protocol design and approval, as well as the necessary ethics approval from the University preceded my involvement with this project.

My first task was the development of the database that would be used to enter all of the incoming treatment information. As described in the body of this thesis, this was done using EpiInfo.

During the data collection phase, my role was to enter all treatment plans, ensure that the data were entered correctly, and to inform Dr. James Leake when data were missing for a subject. It was his responsibility to contact all dental directors for missing treatment plans.

I updated an existing SPSS program file that attributed an RVU value to each procedure code, as well as keeping track of the number of procedures performed. This required some troubleshooting to ensure that all procedure codes were in the program file and that all attributed RVUs were correct.

Following this, I updated an SPSS-based program developed by Dr. J. Leake and G. Woodward that was used to classify each procedure by service type, allocate it its proper RVU (as determined in the program, based on the 2000 ODA Fee Guide), and create a count of procedures by service type for each procedure.

I performed random tests to ensure that the program correctly classified all procedures. Procedure codes entered incorrectly were corrected in the Epi-Info

base file, the Epi-Info plan file and the dbase plan file, and the program was run again. Random tests were performed a second time to identify any unclassified or misclassified procedures.

Following this, I was responsible for the analysis of the collected data and the interpretation of the findings, which is the subject of this thesis.

Upon completion of this thesis, I will not be involved in the development and implementation of further research projects based on these results, but plan to participate in the writing of journal articles to disseminate these results into the pertinent literature.