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The Measurement of Dental Disease in a Correctional Setting: The Importance to Functional Service Delivery

Walter S. Ormes
Western Michigan University

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THE MEASUREMENT OF DENTAL DISEASE IN A CORRECTIONAL SETTING: THE IMPORTANCE TO FUNCTIONAL SERVICE DELIVERY

by

Walter S. Ormes

A Dissertation
Submitted to the
Faculty of The Graduate College
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requirements for the
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School of Public Affairs and Administration

Western Michigan University
Kalamazoo, Michigan
December 1996
The purpose of this study was to describe the prevalence of decayed, missing and filled teeth and periodontal disease among male, non-camp, non-psychiatric inmates in the Michigan Department of Corrections (MDOC) and to assess the impact of age, race, security level, and years of incarceration on these parameters of oral health. Additionally, this study was designed to determine the emergent, urgent or routine dental treatment needs of this same population and to compare the ability of the existing Michigan Department of Corrections dental program to meet these needs. A representative sample of 251 inmates was randomly selected from thirteen geographically diverse MDOC institutions, using a three-stage area probability sampling design. The data collected in the study were the by-product of an examination procedure which utilized radiographs, mirrors, explorers, reflected light and periodontal explorers.

Results showed a mean Decayed, Missing, Filled Teeth Index (DMFT) of 11.52 for inmates ages 18 - 24, 19.25 for inmates aged 35 - 44, and 24.70 for inmates ages 45 and older. The number of missing teeth increased significantly with age (p<0.0005) and there were fewer filled teeth in the 45 year and older age
group than in the other age categories of 18 - 34 or 35 - 44 years (p < .05). Periodontal disease increased with age (p < .0005). Whites had a higher DMFT score than blacks in the 18 - 34 age group (p < .05). No differences were found between security levels with respect to the number of decayed, missing or filled teeth. Inmates incarcerated 0-2 years had a higher number of decayed teeth than those incarcerated 10.5 - 30 years. Comparison of these findings to NHANES I showed inmates had more decayed teeth than this general population, however, less missing and filled teeth.

The largest treatment need in the inmate population was for routine dental care needs. No differences were found between the inmate's need for emergent, urgent or routine dental services and their level of security. Inmates incarcerated 0 - 2 years had a higher need for routine dental services than those incarcerated 2.1 - 3.8 years (p = .02). The current MDOC dental delivery system could easily satisfy all of the inmates' routine dental care needs. Recommendations for alterations in the current dental delivery system were made which might accommodate this disparity.
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ACKNOWLEDGMENTS

To my parents, who gave me the wisdom to discover the right; to God, who gave me the will to choose it; to my family and friends who gave me the strength to make it endure.

Walter S. Ormes
# TABLE OF CONTENTS

ACKNOWLEDGMENTS .................................................................................. ii  
LIST OF TABLES .......................................................................................... vii  
LIST OF FIGURES .......................................................................................... x  

CHAPTER

I. INTRODUCTION ..................................................................................... 1  
   Statement of the Problem ................................................................. 1  
   Purpose of the Research .................................................................. 3  
   Needs Assessment ............................................................................. 3  
   Delivery Model Synthesis ............................................................... 4  
   Research Objectives ...................................................................... 5  
   Research Questions ......................................................................... 5  
   Outline of Chapters ....................................................................... 5  

II. REVIEW OF THE LITERATURE ....................................................... 7  
   Purpose ............................................................................................... 7  
   The Definition and Measurement of Dental Disease ..................... 7  
      Dental Caries ................................................................................. 8  
      Periodontal Disease ................................................................... 10  
   The Epidemiology of Dental Disease  
      in the General Population ............................................................ 15  
   Summary ............................................................................................. 27  

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Table of Contents–Continued

CHAPTER

The Epidemiology of Dental Disease in the Correctional Setting ................................................................. 30

Summary ...................................................................................... 44

The Evaluation of Dental Delivery .............................................. 49

Dental Delivery in a Correctional Setting .............................. 56

Summary ...................................................................................... 57

III. BACKGROUND - THE MDOC SYSTEM ................................. 58

- Mission Statement - MDOC ..................................................... 58
- Security Levels ...................................................................... 59
- Geography .............................................................................. 59
- Administrative Structure ....................................................... 61
- Dental Services Delivery ......................................................... 61
- Dental Staffing ...................................................................... 62
- Cost of Dental Services ......................................................... 63

IV. RESEARCH METHODOLOGY .................................................. 66

- Overview of the Research Design .......................................... 66
- Ethical Considerations ............................................................ 68
- Method ................................................................................... 69
- Sampling .................................................................................. 69
- Data Collection ...................................................................... 71
Table of Contents—Continued

CHAPTER

Analysis of Data ................................................................. 75

V. FINDINGS ........................................................................ 80

Introduction ........................................................................ 80

Time Frame ......................................................................... 81

Examiner Reliability .......................................................... 81

Demographics ..................................................................... 82

Disease Measurement .......................................................... 86

Periodontal Disease .............................................................. 89

Comparison of Present Findings to Other Studies ............... 92

Treatment Needs ................................................................. 95

Summary of Findings ............................................................ 101

VI. ACTIONABLE FINDINGS .................................................. 104

Actionable Findings ............................................................. 104

Analysis of Actionable Findings .......................................... 106

VII. RECOMMENDATIONS AND CONCLUSIONS .......... 112

Utilization Controls .............................................................. 112

Benefit Limitations ............................................................... 114

Limitations of the Study ......................................................... 115

Suggestions for Future Research ........................................ 116

A Final Word ....................................................................... 117

v
Table of Contents--Continued

APPENDICES

A. Three Letter Acronyms for MDOC Facilities ......................... 119
B. Disease Measurement Survey ............................................. 121
C. Tables .................................................................................. 123
D. Approval Letter From Human Subjects
   Institutional Review Board .................................................. 128

BIBLIOGRAPHY ................................................................. 130
LIST OF TABLES

1. Summary of Decay and Periodontal Disease Indices .................. 16
2. Summary of NHANES I: Decayed, Missing, Filled Index (DMFT) by Age and Sex .................................................... 20
3. Summary of NHANES I: Periodontal Index (PI) by Age ........... 21
4. Iowa Survey of Oral Health: Decay and Periodontal Findings
   Mean Decayed, Missing, Filled Teeth, Their Sum (DMFT) and Standard Deviations (SD)
   by Age, Sex and Geography ...................................................... 23
5. Components of Decayed and Filled Teeth and Percent of
   Persons With Bone Loss > 4mm - Employed
   Persons, Midwest Region .......................................................... 28
6. Components of Decayed and Filled Teeth and Percent
   of Persons With Bone Loss > 4mm - Seniors, Midwest Region .... 29
7. Summary of Research Designs of Listed Epidemiological
   Studies on Dental Disease in the General
   Population of United States .................................................... 31
8. Summary of Research Designs of Epidemiological Studies
   on Dental Disease in Correctional Setting ................................. 45
9. Summary of Research Findings of Epidemiological Studies
   on DMFT, by Age, in Correctional Setting as
   Compared to National Study on US Males ................................. 46
10. Summary of Research Findings of Epidemiological Studies
    on DMFT, by Age and Race, in Correctional Setting ................. 47
11. Frequencies (%) of Periodontal Treatment Needs From
    Studies on Periodontal Disease in Correctional Setting ............ 48
12. Frequencies (%) of Prosthetic Treatment Needs
    From Studies in Correctional Setting ....................................... 49
List of Tables—Continued

13. Relative Value Units Used to Track Productivity in the Michigan Department of Corrections ......................... 52

14. Time (Minutes) to Perform Differing Dental Procedures .......... 54

15. MDOC Dental Staffing by Inmate Population ......................... 63

16. Dental Expenditures - Western Region MDOC ....................... 65

17. Sample Size per Institution and Security Level ....................... 72

18. Comparison of Characteristics of the Study Subjects and the Institutionalized State Male Inmate Population, July, 1995 .... 84

19. Comparison of Study Sample to MDOC Male Population by Security Level ....................................................... 85

20. Mean Decayed (D), Missing (M), Filled (F) Teeth, Their Sum (DMFT) and Standard Deviation (SD) by Age and Race ...... 87

21. Mean Decayed (D), Missing (M), Filled (F) Teeth, Their Sum (DMFT) and Standard Deviations (SD) by Security Level ....... 88

22. Mean Decayed (D), Missing (M), and Filled (F) Teeth Their Sum (DMFT) and Standard Deviation by Years of Incarceration ................................................... 89

23. Periodontal Status: Number and Percentage of PSR Sextants by Age and Race ....................................................... 90

24. Number and Percentage of PSR Sextants by Security Level ........ 91

25. Comparison of Mean Decayed (D), Missing (M), Filled (F), DMFT and Percent of Decayed to Decayed and Filled Teeth (%D/DFT) for the Present Study and Other Studies ........................................ 93

26. Number and Percentages of Sampled Inmates Needing Various Priorities of Basic Treatments (n = 251) ................................. 96
List of Tables—Continued

27. Means and Overall Standard Deviations of Inmate Dental Service Needs by Age and Race ........................................... 124

28. Means and Overall Standard Deviations of Inmate Dental Treatment Needs by Years of Incarceration .......................... 125

29. Means and Overall Standard Deviations of Inmate Dental Treatment Needs by Security Levels .................................. 126

30. Emergency, Urgent and Routine Treatment Needs of MDOC Inmate Population .................................................. 127

31. Comparison of Dental Need to Dental Staffing by Level of Treatment Needed .................................................. 99

32. Summary of Significant Findings .......................................................... 103
LIST OF FIGURES

1. Geographic Distribution of MDOC Facilities by Region .......... 60

2. Flow Chart for Accessing Routine Versus Emergency Dental Services .......................... 110
CHAPTER I

INTRODUCTION

Statement of the Problem

Inmates entering prisons arrive with large medical and dental needs (Berg, 1987). Apart from the sequelae of fractures, gunshot wounds and other traumatic injuries that must be treated, inmates have significant histories of hypertension, hepatitis, venereal disease and asthma (Raba & Orbis, 1983). Compounding these findings, inmates have higher health care utilization rates than the general population (Sheps, 1987).

Dental disease is also present in the inmate population. While studies on the amount of dental disease in an inmate population are not sparse, they are generally anecdotal and do not involve randomized samples. This lack of a sound informational base on the dental needs of the inmate population prevents decision makers from delivering dental services within correctional systems in an optimal manner. Since the amount and nature of inmate dental disease is not known, it is not possible to structure delivery systems or implement operational policies that are responsive to changing political and fiscal environments, not to mention changing inmate profiles.

In correctional health care, like most public health care, demand is
inelastic because services do not depend on price. Services are provided at no cost to the inmate. Hence, the quantity of services rendered will depend on the supply that can be made available, rather than the amount of services that are needed. This creates unbridled demand, which is exactly the point of importance with regard to the provision of such services. When service delivery is population-based, residence is the only requirement.

A delivery system based solely on the size of the inmate population, such as Michigan's correctional system, indicates to inmates, and to the Courts, that a menu of complete coverage will be rendered to all inmates upon request. Conversely, a needs-based service delivery system, which first defines the population's needs through the measurement of disease, then accommodates those needs through policy, sends the message that need, not demand, will dictate the allocation of scarce resources. Additionally, from the political standpoint, taxpayers paid $117 million for inmate health care in the Michigan Department of Corrections for Fiscal Year 1993 (State of Michigan, 1994), while local health departments were cutting staff and services to the general public. Under these circumstances, the blind provision of services to inmates no longer becomes the issue; the definition of success, as explained to taxpayers, does.

The present dental service delivery model for the Michigan Department of Corrections is generally predicated on the number of inmates per institution to guide the allocation of staffing and other resources. Outcome is evaluated by tallying the number of inmate visits to clinics, tracking the length of inmate
waiting lists at institutions or, counting the number of inmate grievances or lawsuits. The Michigan system prioritizes dental treatment by addressing emergencies situations first and then providing routine dental care as time and staff are available. Patients waiting for dental care are often placed on waiting lists which are long. This renders the Michigan system very susceptible to supervised neglect.

Consequently, the problems addressed in this study are: (a) to add to the body of knowledge concerning the amount of dental disease in a correctional setting, and (b) to use this information to design a more effective dental delivery system in this environment.

Purpose of the Research

The purpose of this research is to document the amount of dental disease of male inmates in the Michigan Department of Corrections (MDOC) and to use this information to suggest a needs-based delivery system for dental services in Michigan and other state prisons. This research is grounded on the assumption that the present dental service delivery system in the MDOC, or in any state system, cannot address the dental needs of the inmate population, if it does not know what they are. The study is divided into two parts, a needs assessment and the proposed delivery model.

Needs Assessment

The needs assessment was performed by measuring the amount of dental
disease in the MDOC male inmate population. Disease was evaluated by measuring dental decay, using the Decayed Missing Filled Teeth Index (DMFT), and periodontal disease, using the Periodontal Screening and Recording System (PSR). The inmate sample was selected using a systematic random sample of inmates from institutions stratified by security level. Analysis of the data is descriptive and inferential with respect to differences among and between differing security groups.

**Delivery Model Synthesis**

The delivery model is based on the premise that the delivery of health care should be based primarily on patient need, rather than population size. From information obtained for the needs assessment, the amount of dental disease is delineated. Relative Value Units (RVU) were then assigned to the frequency of each service needed, as Barnes and Rosenstein did in separate studies in 1988. Relative Value Units represent the time it takes for a provider, on average, to perform varying dental procedures (Parker, 1982). Multiplying the frequency of the amount of disease by the average amount of time it takes to perform the various procedures identifies the amount of time it takes to meet the existing need. Comparing this number to the availability of facilities and staffing illustrates the degree to which need can be met. Based on these comparisons, the present system will then be evaluated as to the degree that inmate dental needs may or may not be met. Alternative delivery methods are then suggested.
The research objectives in this study are in large part indicative of the contribution it hopes to make to the larger correctional community:

**Research Objectives**

1. To add to the existing body of knowledge with respect to the documentation of dental disease in a correctional setting.
2. To develop a needs-based service delivery model for the allocation of dental services in state prisons.

The realization of these broader goals will be accomplished through the focusing questions listed below.

**Research Questions**

1. What is the amount of dental disease of male inmates in the Michigan Department of Corrections?
2. Is there an optimum service delivery model for dental care in the Michigan correctional setting, given a defined level of need?

**Outline of Chapters**

Chapter I in this study discusses the problem which the research seeks to address. It lists the research objectives and the research questions and outlines how the subsequent chapters will be presented. Chapter II provides a review of the literature. It also acquaints the reader with the tools used to evaluate dental
disease and discuss the epidemiology of dental disease in varying populations as documented in past studies. Chapter III gives background information on the Michigan Department of Corrections, its health care administrative structure and its dental health care delivery system. Chapter IV discusses the research methodology. The purpose of this chapter is to explain how the research problem was studied. It has two sections. The first section discusses the assessment of dental disease in the Michigan Department of Corrections (MDOC) inmate population. This assessment of dental disease reflects the dental need of this inmate population. The second section focuses on how the MDOC dental delivery system can be analyzed, based on its ability to meet the dental need. Chapter V lists the findings from the data that has been accumulated, and Chapter VI summarizes the research findings. Chapter VII offers conclusions and recommendations.
CHAPTER II

REVIEW OF THE LITERATURE

Purpose

The purpose of this research is to document the amount of dental disease of inmates in the Michigan Department of Corrections (MDOC) and to use this information to develop a needs-based model for the allocation of dental services in Michigan and other state prisons. To that end, this literature review focuses on the measurement of dental disease and the assessment of dental delivery. The review is divided into four parts: (1) the definition of dental diseases and how they are measured, (2) a review of epidemiological dental disease surveys in the general population and their findings, (3) a review of epidemiological dental disease surveys in correctional settings and their findings, and (4) a review of methods to evaluate dental delivery systems.

The Definition and Measurement of Dental Disease

Oral disease may be sorted into the following categories: (a) dental decay, which is also called dental caries; (b) gum or periodontal disease; (c) oral cancer; (d) cleft lip and palate; and (e) malocclusions (Striffler, Young & Burt, 1983). Among these groups, dental caries and periodontal disease are stated to be the
Dental Caries

Dental caries is a localized, progressively destructive process that starts at the external surface of the tooth (usually the enamel) and proceeds by the dissolution of the inorganic components of this surface with organic acids. These acids are produced by the enzymatic action of masses of microorganisms, specifically, Streptococcus mutans. The initial destruction of enamel is followed by cavitation and bacterial invasion into the softer and more protein rich understructure of the tooth called dentin. Destruction of the dentinal matrix, by bacteria, occurs more rapidly than in enamel and finalizes by bacterial invasion of the pulp. From this point, pulpal necrosis and death result for the tooth, with the resulting sequelae of pain, abscess and cellulitis (Shafer, Hine & Levy, 1974).

The first systematic index used to measure dental decay was formulated by Klein, Palmer and Knutson in 1938. In a study of the dental status of Maryland elementary school children, these researchers produced the DMF index. This is the most widely accepted method of measuring dental caries (Spolsky, Kamberg, Lohr, & Feldman, 1983). There are two major variations of the DMF index, the DMFT index and the DMFS index.

Both the DMFT and DMFS are irreversible indices generated on a ratio scale and are used with the permanent dentition, where "D" describes the number of existing decayed teeth, "M" describes the number of missing teeth due to caries
and "F" describes the number of teeth which have been previously filled. However, in the DMFT Index (the "T" stands for teeth), each component is mutually exclusive, e.g., a tooth may be either decayed or filled or is missing. If a tooth has a filling and is decayed, it is classed as one decayed tooth. Therefore, the three components may only range from 0-32. The DMFT is used to document existing disease and need, as opposed to the DMFS index, which is sensitive to decay changes over time.

In the DMFS index (the "S" stands for surfaces), each component is not mutually exclusive. A tooth may generate more than one number. For example, if a tooth has a two-surface filling and is decayed on one surface, it is scored, 1 under the decay component and 2 under the filling component. If at a later date, the one surface decay becomes a two surface decay, it is then scored 2 under the decay component. The DMFS index differentiates between the number of potential surfaces on anterior versus posterior teeth. Posterior teeth are defined as all teeth behind the cuspids or eye-teeth. Anterior teeth are all teeth in front of the cuspids, inclusive of the cuspids. Front teeth (antennors) have four surfaces and there are normally twelve of these teeth in the mouth. Back teeth (posteriors) have five surfaces and there are normally 20 of these teeth in the mouth. Therefore, the DMFS index may range from 0 to 148 (20x5 + 12x4). The DMFS index is usually used in clinical trials to track the effectiveness of new products on caries incidence.

Interpretation of the DMFT and the DMFS is limited in that both indices
only allow calculation through a simple count. There is no denominator in such an index. As a result, Burt suggests the index does not give an indication as to the intensity of the caries attack (Striffler, Young & Burt, 1983). For example, two people, one aged 10 and the other aged 30, each with a DMFT of 5, portend different meanings. The younger individual has fewer permanent teeth, hence, the intensity of the caries attack is much more rampant than the older individual with all 32 teeth. Additionally, the "M" component of the index must be interpreted differently as individuals get older. As age increases, teeth may be lost from other reasons than decay, such as periodontal disease, trauma or orthodontic treatment. Lastly, differences between dentists as to what constitutes decay between cavitation and the absence of decay varies widely. Interexaminer variation is a major factor in the reliability of this index.

**Periodontal Disease**

Periodontal disease is a slowly progressive inflammatory disease that begins with the inflammation of the gingival or gum tissues, which is called gingivitis. Gingivitis is followed by the gradual contamination and destruction of alveolar bone which supports the teeth. As the alveolar bone is destroyed, the distance between the crest of the gingiva around a tooth and the crest of the alveolar bone, or periodontal attachment, around the same tooth increases. The normal distance between these two anatomical landmarks is 3 millimeters (mm). If this distance is between 4-6 mm, it is termed moderate periodontal disease. If this
distance is greater than 6 mm, it is termed advanced or severe periodontal disease. The loss of alveolar bone around teeth causes them to become loose, temperature sensitive and non-functional. The primary cause of periodontal disease is poor oral hygiene, which results in the prolonged contact of plaque and/or tartar against the teeth and gingival structures.

The American Dental Association has defined the different stages of periodontal disease and categorized the appropriate therapies for each stage as follows (American Dental Association, 1976, p. 649):

**Type 0 - Health** - no bleeding, no bone loss, firm pink tissue, resists probe, knife edge gingival margins

**Type I - Gingivitis** - gingival bleeding, no bone loss, blunted, boggy, erythematous and swollen gingival tissues

Treatment:
1. training in personal preventive dental care
2. routine prophylaxis and finishing procedures

**Type II - Early Periodontitis** - moderate pockets, minor to moderate bone loss, gingivitis may be present

Treatment:
1. training in personal preventive dental care
2. occlusal adjustment
3. surgical procedures usually involving curettage and/or gingivectomy
4. routine prophylaxis and finishing procedures

**Type III - Moderate Periodontitis** - moderate to deep pockets, moderate to severe bone loss, gingivitis likely

Treatment:
1. training in personal preventive dental care
2. occlusal adjustment
3. surgical procedures involving flap entry and osseous procedures
4. routine prophylaxis and finishing procedures
Type IV - Advanced Periodontitis - deep pockets, severe bone loss, advanced mobility patterns (usually cases involving missing teeth and reconstruction)

Treatment:
1. training in personal preventive dental care
2. occlusal adjustment
3. surgical procedures usually involving complex techniques
4. routine prophylaxis and finishing procedures

These definitions and categorizations illustrate that different treatments are used with differing categories of gingivitis and periodontal disease. However, all entail the treatment of oral prophylaxis which is defined by Wilkins as, "those specific treatment procedures aimed at removing local irritants to the gingiva, including complete tartar removal followed by root planing" (Wilkins, 1989, p.427). The removal of tartar is performed by scraping the tartar from the tooth with scalers, until the tooth surface is smooth. If the tartar has progressed onto the root surface, the removal of this tartar is called root planing.

For the most part, removal of tartar is performed blindly. The deposits are felt by the dental provider using probing instruments, then removed with scalers. However, as the tartar progresses deeper along the root surface, it is increasingly more difficult to rely on only feel and still be certain all of the deposits are removed. In these instances, the gingival tissues are surgically reflected away from the bone, or flapped back. This results in the complete visualization of the entire root surface, making complete removal of calculus possible.

As the type of gingivitis or periodontitis progresses from Type I to Type IV, more time is needed by the dental provider to provide the necessary
treatment. Dental prophylaxis is the standard for all periodontal treatment. Variations in dental prophylaxis occur as a result of the amount and location of tartar.

There are many more indices available to measure periodontal disease and gingivitis, then there are to measure dental decay. One of the most widely used indexes to measure both periodontal disease and gingivitis has been the Periodontal Index (PI) developed by Russell in 1956. The Periodontal Index has attained wide usage since its creation because of its ease of use and reliability. It was created for group surveys, not for the diagnosis of disease in individual patients. This index is a reversible index, because it measures pathology that may heal, such as gingivitis, and an irreversible index, because it measures changes in the periodontium that will not heal, such as alveolar bone loss. This index records measurements on all teeth and is calibrated on an interval scale, where normal (the absence of disease) is scored 0, mild gingival inflammation is scored 1, generalized gingival inflammation which completely circumscribes the tooth is scored 2, gingival inflammation with bone loss is scored 6, and severe bone loss is scored 8. The weakness of the Periodontal Index is that no periodontal probe is used to measure bone loss. Therefore, this index is not as sensitive as some other indices in diagnosing early bone loss.

Another widely used index which measures gingivitis and periodontal disease is the Periodontal Disease Index (PDI) developed by Ramfjord in 1959. This index, according to its author, is more suitable for clinical trials than for surveys of populations. The PDI uses a periodontal probe to measure bone loss,
hence it is more sensitive to this change, as compared to the PI, and is more time consuming. This index takes measurements on six specific teeth and scores them on a scale from 0-6. A score of zero indicates the absence of inflammation or disease. A score of one indicates mild to moderate inflammation not extending completely around the tooth, while a score of two indicates inflammation extending completely around the tooth. A score of three indicates severe inflammation characterized by a tendency to bleed and ulceration. A score of four indicates a gingival crevice of not more than 3mm, a score of five indicates a gingival crevice between 3mm-6mm and a score of six indicates a crevice of more than 6mm.

The wide use and reliability of periodontal indices are enhanced when used in conjunction with a measure of the patient's overall oral hygiene status (Spolsky, 1983). One such measure of oral hygiene is the Simplified Oral Hygiene Index (OHI-S), created by Greene and Vermillion (1960). This measure is mostly used in large scale epidemiological surveys and is applied to four posterior and two anterior surfaces in the mouth. Two scores are given for each tooth examined, one for the amount of debris and the other for the amount of tartar. Both scores are scored on a scale of 0-3 and the two are added together to give the total OHI-S score.

A more recent measure to screen periodontal disease and gingivitis is the Periodontal Screening and Recording System (PSR) developed in 1992 by the American Dental Association in conjunction with the American Academy of Periodontology. This system is an adaptation of O'Leary's Gingival Periodontal
Index (GPI) which was created to screen Air Force personnel in 1967. The PSR is an ordinal index which screens gingivitis and bone loss in six segments of the mouth, with 0 being normal or the absence of disease; 1, gingivitis; 2, gingivitis plus visible tartar formation; 3, bone loss less than 5.5 millimeters in depth and 4, bone loss greater than 5.5 millimeters in depth. The PSR is a screening system and is meant for the early detection and interception of periodontal disease. As with all measures of oral disease, examiner variation plays an important part in the accuracy and reproducibility of the indices.

Table 1 is a summary of the differing DMF and periodontal indices and a listing of representative studies.

The Epidemiology of Dental Disease in the General Population

National studies of dental disease utilize the above indices to document the oral health of Americans. One of the earliest and most extensive studies involving oral disease in the United States was part of the National Health and Nutrition Examination Survey (NHANES I) which was conducted between 1971-74. Among other health conditions studied, this survey examined the dental disease and dental needs of 20,749 civilian noninstitutionalized Americans, aged 1-74 years at 65 locations, using ten dentist examiners. The study was divided into two portions. The first portion had participants fill out health questionnaires that surveyed their overall attitudes toward health and nutrition. Subsequent to the completion of the questionnaire, the second portion of the study conducted physical
<table>
<thead>
<tr>
<th>Index</th>
<th>Range of Scale</th>
<th>Used in Survey</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMFT</td>
<td>0-32</td>
<td>NHANES NIH IOWA GILMORE ROSS CUNNINGHAM MIXSON SALIVE</td>
<td>- systematic - universally accepted - records existing decay</td>
<td>- simple count, no denominator - &quot;m&quot; interpretation - examiner variation</td>
</tr>
<tr>
<td>DMFS</td>
<td>0-148</td>
<td>NIH</td>
<td>- widely used - universally accepted - records new decay over time</td>
<td>- same as DMFT</td>
</tr>
<tr>
<td>PI</td>
<td>0,1,2,6,8</td>
<td>NHANES</td>
<td>- widely used - ease of use - reliable - all teeth examined</td>
<td>- no periodontal probe - no detection of early bone loss</td>
</tr>
<tr>
<td>PDI</td>
<td>0,1,2,3,4,5,6</td>
<td>IOWA</td>
<td>- sensitive vs. Pi - useful in clinical trials - periodontal probe used</td>
<td>- time consuming - only six teeth examined - examiner variation</td>
</tr>
<tr>
<td>PSR (GSI)</td>
<td>0,1,2,3,4</td>
<td>NIH ROSS</td>
<td>- ease of use - all teeth examined - periodontal probe used - useful as screening tool</td>
<td>- examiner variation</td>
</tr>
</tbody>
</table>
examinations of the participants.

This was a descriptive study using survey research methods. The sample design used in this research was a three stage stratified probability sample of loose clusters of persons living in the continental United States. The first stage consisted of the geographical division of the territorial United States into 1900 Primary Sampling Units (PSU) based on the 1960 decennial census.

A PSU was made up of either a standard metropolitan statistical area (SMSA), a county, or two or three contiguous counties. PSUs were then stratified into 357 groups, according to the National Health Examination Surveys of 1963-65 and 1966-70. These 357 strata were then collapsed into 40 superstrata. The 40 superstrata were then sorted into 15 PSU's that contained a single large metropolitan area of more than two million people. The remaining 25 superstrata were formed relative to population density and geographic region. Two PSU's were selected from each of these strata. In this manner, a total first stage sample of 65 PSU's was selected. The second stage consisted of the selection of segments in each PSU through systematic sampling. These segments were then stratified by enumeration districts depending on whether the household was above or below the poverty line. A systematic sample of six to eight households or segments were selected from compact clusters of 18 households within each PSU. The third stage consisted of listing all household addresses within segments and then registering each household member, stratified further by age and sex. Persons were then selected for the NHANES I study using a systematic random
sample from each age-sex group on this register.

This sampling strategy in the 65 PSU's of the general sample of NHANES I resulted in the selection of 28,043 sample persons 1-74 years of age. However, while 98 percent of the target sample were willing to complete the household questionnaire, only 74 percent of this sample were willing to participate in the subsequent examinations. This left the final sample at 20,749 persons aged 1-74 years. The study stated that this nonresponse rate represents a potential source of bias because the exact probability of nonparticipation was never known, hence the possibility that the participants and non-participants differed with respect to other characteristics under examination.

Instruments to measure dental disease utilized the DMFT and PI indexes. Analysis of dental data utilized descriptive statistics to present the data and inferential statistics to test relationships between groups, with regard to DMFT or PI, and the demographic variables of age, sex and socioeconomic levels. Regression analysis was then applied to determine if age, sex or socioeconomic level was predictive of the dental diseases of caries and periodontitis.

The dental findings of the NHANES I study showed that 65 percent of the population required some type of dental treatment. Forty percent of the sample needed at least one filling and 5 percent needed at least one tooth extracted. Fifteen percent of the adult population aged 18-74 had lost all of their permanent teeth. Whites registered higher total DMFT scores than blacks, 19.1 to 13.4, respectively. This was because even though blacks had higher decay rates than
whites, 2.3 to 1.2 respectively for men and 2.3 to .9 respectively for women, there was a large difference between the "F" component of blacks and whites. For example, black males had a mean of 1.9 teeth filled and whites had a mean of 7.4 teeth filled. The NHANES study also showed that the severity and prevalence of periodontal disease increases with age, with blacks consistently having higher PI scores than whites and males consistently having higher PI scores than females. Some of the composite results are summarized in Tables 2 and 3.

A more localized non-national study was performed in Iowa by the University of Iowa College of Dentistry in 1980. This study focused on households within the State and stratified the sample by age and type of community. This was a descriptive study using survey research methods.

The sampling design of this study began with dividing the State of Iowa into three geographic regions based on the geographic distribution of communities, income levels, and educational levels. Within each region, communities were grouped as standard metropolitan statistical areas (SMSA), towns between 10,000-15,000 in population, towns between 2,500-10,000 in population and rural areas with less than 2,500 people. The proportion of the sample from the differing community sizes were projected using the 1980 Iowa Census. Rural samples were randomly distributed by counties within the three regions of the State, as were the smaller non-rural towns. As a result of the small number of SMSA's, some counties were assigned into the sample because they contained a SMSA. This stratification for community size resulted in each region having 10 sampling sites.
### Table 2
Summary of NHANES I: Decayed, Missing, Filled Index (DMFT) by Age and Sex

<table>
<thead>
<tr>
<th>Age</th>
<th>DMFT</th>
<th>Decayed</th>
<th>Missing</th>
<th>Filled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24 Years</td>
<td>10.5</td>
<td>2.2</td>
<td>1.7</td>
<td>6.6</td>
</tr>
<tr>
<td>25-34 Years</td>
<td>14.9</td>
<td>1.8</td>
<td>4.1</td>
<td>9.0</td>
</tr>
<tr>
<td>35-44 Years</td>
<td>18.4</td>
<td>1.2</td>
<td>8.4</td>
<td>8.8</td>
</tr>
<tr>
<td>45-54 Years</td>
<td>19.2</td>
<td>1.0</td>
<td>9.9</td>
<td>8.3</td>
</tr>
<tr>
<td>55-64 Years</td>
<td>20.7</td>
<td>1.0</td>
<td>12.4</td>
<td>7.3</td>
</tr>
<tr>
<td>65-74 Years</td>
<td>21.8</td>
<td>.7</td>
<td>15.6</td>
<td>5.5</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24 Years</td>
<td>11.0</td>
<td>1.9</td>
<td>1.8</td>
<td>7.3</td>
</tr>
<tr>
<td>25-34 Years</td>
<td>15.8</td>
<td>1.7</td>
<td>4.9</td>
<td>9.2</td>
</tr>
<tr>
<td>35-44 Years</td>
<td>20.1</td>
<td>1.1</td>
<td>9.8</td>
<td>9.2</td>
</tr>
<tr>
<td>45-54 Years</td>
<td>20.5</td>
<td>.9</td>
<td>11.1</td>
<td>8.5</td>
</tr>
<tr>
<td>55-64 Years</td>
<td>21.5</td>
<td>.8</td>
<td>12.6</td>
<td>8.1</td>
</tr>
<tr>
<td>65-74 Years</td>
<td>22.4</td>
<td>.5</td>
<td>14.7</td>
<td>7.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>DMFT</th>
<th>Decayed</th>
<th>Missing</th>
<th>Filled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Races</td>
<td>18.5 (.17)</td>
<td>1.3 (.06)</td>
<td>10.4 (.24)</td>
<td>6.8 (.18)</td>
</tr>
<tr>
<td>White</td>
<td>19.1 (.18)</td>
<td>1.2 (.06)</td>
<td>10.6 (.26)</td>
<td>7.4 (.20)</td>
</tr>
<tr>
<td>Black</td>
<td>13.4 (.59)</td>
<td>2.3 (.21)</td>
<td>9.2 (.47)</td>
<td>1.9 (.25)</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Races</td>
<td>19.8 (.18)</td>
<td>1.1 (.05)</td>
<td>11.6 (.22)</td>
<td>7.1 (.16)</td>
</tr>
<tr>
<td>White</td>
<td>20.2 (.18)</td>
<td>.9 (.04)</td>
<td>11.6 (.23)</td>
<td>7.2 (.18)</td>
</tr>
<tr>
<td>Black</td>
<td>16.3 (.43)</td>
<td>2.3 (.18)</td>
<td>11.8 (.45)</td>
<td>2.2 (.17)</td>
</tr>
</tbody>
</table>

( ) represents standard error of the mean


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Table 3

Summary of NHANES I: Periodontal Index (PI) by Age

<table>
<thead>
<tr>
<th>Percent Distribution by Age</th>
<th>Years</th>
<th>No Disease</th>
<th>Gingivitis</th>
<th>1-3 Teeth Bone Loss</th>
<th>&gt;4 Teeth Bone Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Ages</td>
<td>53.7</td>
<td>27.8</td>
<td>4.5</td>
<td>14.1</td>
<td></td>
</tr>
<tr>
<td>18-44</td>
<td>49.8</td>
<td>33.2</td>
<td>4.7</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>38.8</td>
<td>19.8</td>
<td>8.7</td>
<td>32.7</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>27.8</td>
<td>13.1</td>
<td>11.5</td>
<td>47.6</td>
<td></td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Ages</td>
<td>63.8</td>
<td>21.5</td>
<td>4.5</td>
<td>10.1</td>
<td></td>
</tr>
<tr>
<td>18-44</td>
<td>62.7</td>
<td>24.5</td>
<td>4.3</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>47.8</td>
<td>20.1</td>
<td>9.8</td>
<td>22.3</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>43.2</td>
<td>13.8</td>
<td>9.7</td>
<td>33.2</td>
<td></td>
</tr>
</tbody>
</table>


Sample size was then determined using an error rate of .07 with 95% confidence. It was determined that 196 people would be needed. However, since there were five age groups and three urban/rural characteristics desired (urban, small town and rural), the minimum sample became 15 x 196 or 2,940. However, to accommodate for an anticipated poor response from people aged 65 years and older, the sample was increased to 3,600 people. The 1980 Iowa Census indicated
that an average of three persons occupy an household, therefore, the 3,600 subjects resulted in a sample size of 1,200 households. This meant 400 households per region in the study would be sampled. As each region had ten sampling sites, 40 households would be sampled at each regional site. Specific household samples were determined from a computer generated list of random numbers based on telephone directories.

The DMFT and DMFS indices were used to study decay and the Periodontal Disease Index (PDI) was used to accomplished the periodontal assessment. The findings of this study indicate that 21 percent of the population had periodontal pockets, or bone loss, of 3 - 5.9 millimeters (mm) around teeth, which is the equivalent of moderate periodontal disease. Only 1.4 percent of the population had bone loss around teeth that exceeded 6 mm. This is severe periodontal disease. As with the NHANES I study, as age increases, the proportion of people with bone loss increases. This finding is mollified in the older age groups because there are fewer teeth. Also consistent with the NHANES I study is that males are more likely to have bone loss around teeth than females. The Iowa study also found that residents of small towns are more likely to have bone loss around several teeth than residents in urban or rural communities.

The DMFT and periodontal findings are listed in Table 4. It should be noted that the age specific decay findings are presented as DMFS, not DMFT. The gender and geographic findings are listed as DMFT. Age specific findings were available as DMFT, but only in graphic form, and not accompanied by
<table>
<thead>
<tr>
<th></th>
<th>DMFT</th>
<th>Decayed</th>
<th>Missing</th>
<th>Filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>11.8 (10.10)</td>
<td>1.0 (2.28)</td>
<td>5.1 (9.91)</td>
<td>5.7 (6.10)</td>
</tr>
<tr>
<td>Women</td>
<td>12.1 (9.78)</td>
<td>.8 (1.98)</td>
<td>4.6 (9.05)</td>
<td>6.7 (6.51)</td>
</tr>
<tr>
<td>Rural</td>
<td>11.6 (10.21)</td>
<td>.8 (2.23)</td>
<td>4.3 (9.83)</td>
<td>6.5 (6.29)</td>
</tr>
<tr>
<td>Small Town</td>
<td>13.1 (9.18)</td>
<td>1.4 (2.52)</td>
<td>4.5 (9.06)</td>
<td>7.3 (6.17)</td>
</tr>
<tr>
<td>Urban</td>
<td>12.0 (9.65)</td>
<td>.9 (1.66)</td>
<td>5.2 (8.92)</td>
<td>5.9 (6.43)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DMFS</th>
<th>Years</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18-44</td>
<td>37.9 (37.5)</td>
<td>1.5 (3.1)</td>
<td>16.6 (38.6)</td>
<td>19.5 (16.4)</td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>75.3 (48.5)</td>
<td>1.3 (3.8)</td>
<td>50.4 (58.6)</td>
<td>23.6 (21.1)</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>94.3 (50.6)</td>
<td>1.1 (4.9)</td>
<td>77.8 (61.0)</td>
<td>15.4 (18.8)</td>
<td></td>
</tr>
<tr>
<td>75+</td>
<td>96.9 (50.0)</td>
<td>.5 (1.4)</td>
<td>83.2 (59.6)</td>
<td>13.2 (17.5)</td>
<td></td>
</tr>
</tbody>
</table>

Periodontal Findings as Percent of Population With 3-6 mm Pockets

<table>
<thead>
<tr>
<th>By Age</th>
<th>18-44 Years</th>
<th>45-64 Yrs</th>
<th>65-74 Years</th>
<th>75+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.9</td>
<td>26.4</td>
<td>23.4</td>
<td>16.7</td>
</tr>
</tbody>
</table>

By Demographics

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th>Rural</th>
<th>Small Town</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17.3</td>
<td>15.9</td>
<td>16.1</td>
<td>22.0</td>
<td>11.9</td>
</tr>
</tbody>
</table>

Source: The Iowa survey of dental health, 1980 (pp. 20, 21, 22, 23, 44) University of Iowa College of Dentistry (1982). Iowa City: University of Iowa.
standard deviation figures.

The problem with this study, as with NHANES I is the external validity. Both studies assess the population through the sampling of civilian households. Therefore, these findings can only be indicative of those groups. Generalizations concerning institutionalized populations cannot be made.

Another, more recent study of dental disease in the general population was conducted by the National Institutes of Health (NIH) in 1988. This cross-sectional survey examined the dental disease and dental needs of 20,818 United States employed and retired adults, aged 5-84+ years, stratified by seven geographic regions and five year age ranges, using nine dentist examiners. This was a descriptive study using survey research methods.

There were two design components to this research, one involving employed adults and a second involving seniors. The sampling frames are different in each component, as are the stratification variables. In the first component of the study, which involved employed adults, a cross-sectional approach was used to identify United States employed adults. Economic activity in the United States was divided into ten major economic divisions. These divisions were consistent with the Standard Industrial Classifications developed by the U.S. Government, along with U.S. businesses. The classifications are: agriculture, forestry, fishing; mining; construction; manufacturing; transportation, communication and public utilities; wholesale trade; retail trade; finance, insurance and real estate services; business services; and health/social services and public administration. The study
excluded agriculture, mining and household domestics because of access or economic reasons.

The sample of employed adults was selected through the use of a five stage sample design. After the seven regions were formed, they were stratified by Standard Metropolitan Statistical Areas (SMSA) versus non-SMSA, urban versus rural, race, income and the proportion of establishments with 100+ employees. The first stage involved assembling counties or groups of contiguous counties within each region. The sampling units in the second stage were drawn by ZIP codes within counties. The sampling units at the third stage were clusters of business establishments, which were accumulated through Duns Marketing Index. The fourth stage involved sampling of establishments within clusters. The fifth stage was a systematic sampling of employees within establishments. The resulting sample for employed adults was 15,132, or 73 percent of the total study sample.

The sampling of seniors also involved a multistage design. The first stage consisted of the same first stage units chosen for the employed adult sample. The second stage was a cluster of senior centers located within the first stage geographic counties. These senior centers were located from information obtained from area agencies on aging. The third stage sampled individuals, aged 65 years and over, who attended these centers on the days the exam teams were present. Unfortunately, with the senior sample, no frame existed with which to draw a sample, because few of the centers kept lists of persons who used the centers.
Therefore, the sample of individuals attending the centers was obtained by recruiting seniors longitudinally, on a first come, first serve basis. Stratification of the senior sample occurred at this stage by age, sex and race. The resulting sample size for seniors was 5,686, or 27% of the total study sample.

The dental examination for dental disease in this study used the DMFS and the DMFT indexes to determine caries. Third molars were not included in the study; therefore, the DMFS index would range from 0-128, not 148 and the DMFT index would range from 0-28, not 32. Periodontal disease was assessed using: (a) a gingival assessment of bleeding or no bleeding, (b) the measurement of bone loss, and (c) the presence or absence of supra or subgingival tartar.

The dental findings of the National Survey of Oral Health in Employed Adults and Seniors were presented as the mean DFT, the %D/DFT and the %F/DFT. The "M" component of the DMFT or DMFS was not listed. This literature review will be specific for the Midwest Region. In this Region, the study showed that only 2.41% of the employed population and 5.96% of seniors had no decayed, missing or filled teeth. The mean DFT of employed individuals is 9.77 for all age groups, with a standard deviation of 5.531. Females had a higher mean DFT than males, 10.34 to 9.45, respectively. The %D/DFT for all age and sex groups was 7.20, with men having a higher overall score in this category than women, 8.74 to 4.69, respectively. The mean DFT for all age and sex groups of seniors was 8.02, with a standard deviation of 5.28. Males had a lower mean DFT score than females, 7.53 (s.d. 4.83) to 8.3 (s.d. 5.49). The cumulative %D/DFT
for males was 10.92, 4.99 for females. Six percent of the employed adult population aged 18-65+ and 39.67 of seniors had lost all of their permanent teeth. There was no breakdown of data by race. The study also shows that the severity and prevalence of periodontal disease increases with age, however, the differences between males and females, which have consistently shown females to have better periodontal health, is not as marked in this study. In all, 14% of employed individuals and roughly the same percentage of seniors had at least 4 millimeters of bone loss, which is diagnosed as moderate periodontal disease. There was no attempt in this study to make statistical inferences concerning the data. The data were presented in a descriptive fashion, some of which is found below in Table 5 for the employed sample and Table 6 for the senior sample.

Summary

The epidemiological study of dental disease in the general population has been presented in the above section using examples of two national surveys and one local survey. Portions of data from each study have followed its discussion. The methods, especially the sampling designs, are structured depending on the stratification variables of interest and are all multistaged. The NHANES study, for example, was interested in all United States civilian households and therefore had to proportionately sample from enumeration districts to form segments in order to attain a reliable result. The NIH study, which dealt only with employed adults and seniors, did not have to proportionately sample according to income,
Table 5

Components of Decayed and Filled Teeth and Percent of Persons With Bone Loss > 4mm - Employed Persons, Midwest Region

<table>
<thead>
<tr>
<th></th>
<th>Mean DFT</th>
<th>St.Dev</th>
<th>%D/DFT</th>
<th>Percent with &gt; 4mm Bone Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Ages</td>
<td>9.45</td>
<td>5.35</td>
<td>8.74</td>
<td>14.86</td>
</tr>
<tr>
<td>20-24</td>
<td>8.06</td>
<td>4.33</td>
<td>1.15</td>
<td>1.95</td>
</tr>
<tr>
<td>30-34</td>
<td>8.89</td>
<td>4.52</td>
<td>7.66</td>
<td>19.15</td>
</tr>
<tr>
<td>45-49</td>
<td>10.62</td>
<td>6.42</td>
<td>5.28</td>
<td>16.21</td>
</tr>
<tr>
<td>60-64+</td>
<td>8.59</td>
<td>5.49</td>
<td>5.76</td>
<td>19.96</td>
</tr>
</tbody>
</table>

| **Women** |          |        |        |                             |
| All Ages 10.34 | 5.80 | 4.69 | 12.23 |                             |
| 20-24     | 8.42 | 5.34 | 9.52 | 4.51  |
| 30-34     | 9.79 | 4.89 | 4.18 | 12.01 |
| 45-49     | 13.54| 6.60 | 1.81 | 18.62 |
| 60-64+    | 10.45| 5.35 | 2.02 | 21.54 |

| Combined Totals | 9.77 | 5.53 | 7.20 | 13.92 |


but did so depending on the size of business establishments at the fourth stage.

The above studies illustrate some of the methods used to measure dental disease. Measures, such as the DMFT, DMFS, and various periodontal indices have been shown as used in research involving different populations. However, a potential threat to validity exists with respect to the DMF indices. This is
Table 6

Components of Decayed and Filled Teeth and Percent of Persons With Bone Loss > 4mm - Seniors, Midwest Region

<table>
<thead>
<tr>
<th></th>
<th>Mean DFT</th>
<th>St.Dev</th>
<th>%D/DFT</th>
<th>Percent with &gt; 4mm Bone Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Ages</td>
<td>7.53</td>
<td>4.83</td>
<td>10.92</td>
<td>20.46</td>
</tr>
<tr>
<td>70-74</td>
<td>7.67</td>
<td>4.98</td>
<td>13.52</td>
<td>11.08</td>
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<tr>
<td>75-79</td>
<td>5.17</td>
<td>4.78</td>
<td>10.31</td>
<td>36.76</td>
</tr>
<tr>
<td>80+</td>
<td>5.11</td>
<td>4.30</td>
<td>9.94</td>
<td>14.22</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Ages</td>
<td>8.30</td>
<td>5.49</td>
<td>4.99</td>
<td>11.36</td>
</tr>
<tr>
<td>65-69</td>
<td>9.18</td>
<td>5.76</td>
<td>4.43</td>
<td>12.73</td>
</tr>
<tr>
<td>70-74</td>
<td>9.55</td>
<td>5.38</td>
<td>2.22</td>
<td>10.27</td>
</tr>
<tr>
<td>75-79</td>
<td>7.92</td>
<td>4.83</td>
<td>4.03</td>
<td>13.23</td>
</tr>
<tr>
<td>80+</td>
<td>5.59</td>
<td>4.64</td>
<td>13.40</td>
<td>8.30</td>
</tr>
<tr>
<td><strong>Combined Total</strong></td>
<td>8.02</td>
<td>5.28</td>
<td>6.97</td>
<td>14.55</td>
</tr>
</tbody>
</table>


because as people get older, teeth are also lost to periodontal disease, which will impact the DMF score. Care must be taken in the interpretation of either the DMFT or the DMFS, and this was done in each survey. In fact, the NIH survey detached the missing teeth component of the DMF indices and listed it separately. The overwhelming strength in all the studies was the attention to
randomness.

The weakness of two of the studies stems from the nonresponse rates. In NHANES, while 98.0 percent of the participants were willing to answer the household questionnaires, only 75.0 percent were willing to participate in the actual examinations. In the NIH study of employed adults, response rates varied with respect to the size of business selected and the position of the respondents in the business. For example, the sampled employees in managerial or executive positions was higher in larger facilities, but more difficult to recruit for the examinations. Poor response rates create the potential for sizable bias in the interpretation of a study, in that, the nonrespondents may differ from the sampled persons with respect to the characteristics under examination. Lastly, none of the studies included institutionalized populations, which may have changed the estimates of disease.

A summary of the research designs for each study is given in Table 7.

The Epidemiology of Dental Disease in the Correctional Setting

One of the earliest studies of dental disease in a correctional setting was in Massachusetts in 1973 (Gilmore & Gluck, 1973). This study sampled two separate male prisons in Massachusetts for dental decay and periodontal disease. The DMFT index was used to evaluate dental decay, and frequency distributions were used to describe the amount of periodontal disease in these populations. There was no mention of how periodontal disease was assessed.
Table 7
Summary of Research Designs of Listed Epidemiological Studies on Dental Disease in the General Population of United States

<table>
<thead>
<tr>
<th>Purpose</th>
<th>NHANES I</th>
<th>IOWA</th>
<th>NIH EMPLOYED</th>
<th>NIH SENIORS</th>
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</thead>
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<tr>
<td>Study Design</td>
<td>Descriptive</td>
<td>Descriptive</td>
<td>Descriptive</td>
<td>Descriptive</td>
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<td>Iowa households</td>
<td>US employed adults</td>
<td>US seniors</td>
</tr>
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<td>786</td>
<td>208</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stages Stage 1</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Stage 2</td>
<td>65 psu's/US segments</td>
<td>3 reg./state 10 sites/reg.</td>
<td>7 reg./US 10 counties/reg.</td>
<td>7 reg./US same</td>
</tr>
<tr>
<td>Stage 3</td>
<td>household/segments</td>
<td>40 homes/sites</td>
<td>40 clusters of estab. reg.</td>
<td>@30 seniors centers/reg.</td>
</tr>
<tr>
<td>Stage 4</td>
<td></td>
<td></td>
<td>112 estab./reg.</td>
<td>@812 persons/reg.</td>
</tr>
<tr>
<td>Stage 5</td>
<td></td>
<td></td>
<td>2162 persons/reg.</td>
<td></td>
</tr>
<tr>
<td>Unit of Analysis</td>
<td>Individual</td>
<td>Individual</td>
<td>Individual</td>
<td>Individual</td>
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<td>3,600</td>
<td>15,132</td>
<td>5,686</td>
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<td>- age</td>
<td>- age</td>
<td>- age</td>
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<tr>
<td></td>
<td>- sex</td>
<td>- sex</td>
<td>- sex</td>
<td>- sex</td>
</tr>
<tr>
<td></td>
<td>- income</td>
<td>- community size</td>
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<tr>
<td></td>
<td>- race</td>
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</table>

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This study began with a ten percent sample of inmates (n=142) from both prisons. Seventeen inmates (12%) refused to take part in the study, which resulted in a working sample of 125 inmates, 63 from Walpole Prison and 62 from Norfolk Prison. The sample was not random because of the inclusion of all available inmates over age 50. There were six measurement protocols in the study: (1) an erupted tooth was any tooth that could be touched with an explorer; (2) wisdom teeth were excluded in the study, which meant the total complement of teeth was 28, not 32; (3) caries were diagnosed where a softened cavity floor or breakdown of the enamel could be demonstrated; (4) a tooth that was restored and decayed was considered decayed; (5) a filling was defined as any gold, silicate or temporary restoration; and (6) if the tooth was so severely decayed that it was considered for extraction, it was considered missing. Additionally, the study excluded totally edentulous patients. This was a descriptive study using survey research methods.

The study by Gilmore and Gluck found that the mean DMFT count for inmates is higher than that in the general population, when compared to the National Health Survey 1960-1962, although no statistical test was used to verify this difference. The components of the DMFT index indicated that inmates have more than twice as much decay, about one-third more missing teeth, even though severely decayed teeth were counted as missing, and fewer filled teeth than the general population with which it was compared. The study states that the DMFT index as a single number is of no value in predicting needs for dental care. For
example, a DMFT score of 28 may mean there are 28 missing teeth, 28 filled teeth, or 28 teeth that need restorations. To that end, the study formulated a ratio of the mean number of decayed teeth to the mean number of decayed plus the mean number of filled teeth (D/D+F). The resulting quotient, when multiplied by 100 was called the ratio of Unmet (restorative) Treatment Need (UTN). The unmet restorative treatment need for all U.S. males ranged from 14 to 26 percent (National Center for Health Statistics, 1967), while that of the incarcerated sample ranged from 25 to 63 percent. As a contemporary point of comparison, the study performed by the National Institutes of Health in 1988 found that the percentage of Decayed Teeth to Decayed plus Filled Teeth (%DFT) was 7.2 in employed adults and 6.97 in seniors.

Problems in interpreting the data from the Gilmore and Gluck study are fourfold. First, the sample is not random, it is a convenience sample and sampled only two prisons in the State. Second, the last measurement protocol counts teeth that are severely decayed and scheduled for extraction, as missing, not decayed. This would tend to underestimate the amount of disease resulting from decay and overestimate the number of missing teeth. Third, the measurement of periodontal disease found approximately one-third of the inmates had periodontal disease requiring the skills of a dentist, but the protocols for measuring periodontal disease were not listed. The reader does not know either the criteria used in obtaining these results or what periodontal indexes were used to obtain them. As a result of these problems, no statistical analyses were performed. Fourth, the
exclusion of totally edentulous patients and the formulation of the Unmet (restorative) Treatment Need (UTN) ratio neglects consideration of prisoners who need prosthetic services, such as full and partial dentures.

The study of Gilmore and Gluck concluded that based on the total DMF score, little difference could be detected between this prison population and the U.S. general population. But, when the components of the DMF score were used and the ratio of UTN evaluated, differences in the two populations were reported, with the prison population demonstrating a higher unmet need.

Another study performed in 1977 at the Detroit House of Corrections (DeHoCo) found that 141 minimum security inmates, aged 17-34, had twice as many untreated decayed teeth when compared to the general population (Ross, 1977). The general population comparison group referred to in this study is that described by the United States Public Health Service’s National Center for Health Statistics, 1970-74 (listed above). This is a descriptive study using survey research methods. The DMFT index was used to assess caries and periodontal disease was measured by the Periodontal Disease Index (PDI).

The design of the Ross study (1977) began with a sample of 274 inmates from a total population of 548 minimum security inmates. The study lost a large portion of this original sample, because 133 inmates, or 48 percent of the sample refused to participate in the study. This differs remarkably from the 26 percent refusal rate in the NHANES study or the 12 percent refusal rate in the Gilmore and Gluch study. Nevertheless, the final sample for the Ross study was 141

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inmates between the ages of 17-34. It should be noted that DeHoCo has a total population of between 700-1000 inmates. The sampling frame of this research included only minimum security inmates. The higher security level inmates were excluded from the study, as were inmates over the age of 34 years of age, in order to "narrow the focus of the study" (p. 587). Yet, conclusions were erroneously drawn from this narrow focus to include the entire facility. Additionally, one inmate was excluded "because of the examiner's inability to assess his dental health due to extreme decay" (p. 587). This admission points to a serious flaw in this study, namely that the author is a dental hygienist and cannot, by law, diagnose decay. To compound this problem, caries analysis was made on the basis of examining one-half of each inmate's mouth and then simply doubling that figure to make the data comparable with national statistics. These problems make the internal and external validity of the study highly questionable, which serves to cloud the conclusion that the oral health of this prison population is worse than that of the general population.

However, this study by Ross does question the adequacy of dental services in a correctional setting and attempts to show they are insufficient. Results of the study observed that inmates aged 18-24 had slightly higher levels of periodontal disease than did the national population, which is a valid determination to be made by a dental hygienist. Additionally, inmates in this population had greater numbers of missing teeth and fewer filled teeth than were reported nationally.

A 1985 study of dental disease was performed on medium security male
inmates at an Iowa prison (Cunningham, Glenn, Field & Jakobsen, 1985). Random sampling of the inmate population was not used to select the 99 male residents, aged 18-30 who comprised the total inmate sample. Instead, the sample was self-selected using a pretreatment screening. This screening was offered to all of the 140 inmates, who comprised the sampling frame. Forty-one inmates, or 29%, refused to participate in the study. Ninety-nine inmates agreed to be sampled in return for dental treatment.

The DMFT was used to measure the number of dental caries. Radiographs were not used to augment the diagnosis of decay. Periodontal disease was not evaluated. Descriptively, the study found that the inmate population had three times the number of decayed teeth and half as many filled teeth as the non-prison population, which was defined by data collected in Iowa in 1982. The inmates also had twice as many missing teeth when compared to the non-prison population. However, the differences in missing teeth could also be attributed to many factors outside of caries, e.g. trauma. These DMFT component differences were analyzed using the t-statistic and were found to be statistically significant at the p < .0001 level. Interestingly, there were no statistically significant differences in the total DMFT between the civilian and prison populations, because the "F" component of the DMFT was so much larger in the non-prison population. The study concluded that the prison population demonstrated a significantly higher number of decayed and missing teeth and many fewer filled teeth when compared to a non-prison population in their same state.
A more recent, and better designed, study of the dental need requirements in a prison setting was performed in the Texas Department of Corrections (Barnes, Heid, Parker, Cole, Fultz & Tollefsbol, 1988). The purpose of this study was to determine the dental treatment needs of recently incarcerated Texas Department of Corrections inmates and to compare the time required to satisfy these needs to the dental staff resources available within the Department's dental care system. This is a dental delivery study that longitudinally sampled 637 recently incarcerated inmates upon their entry into the Texas correctional system over a two week period. Every inmate who entered the system over this period was evaluated using clinical examinations by a dentist. Radiographs were also used as an assessment tool.

The operational variables used in the design of this study were divided into three large groups: (1) demographic data, (2) treatment needs data, and (3) dental resource data. The specific demographic data evaluated were ethnic background, intelligence quotient, county of residence and recidivism. The treatment needs data included requirements for routine extractions, removal of impacted teeth, dental restorations, full and partial dentures, certain types of crowns, root canal therapy, minor non-surgical periodontal therapy, preventive treatment, such as cleanings, and diagnostic procedures. The dental resource data consisted of the number of dental staff positions in existence in the Texas Department of Corrections, the number of these positions filled, the usage of vacation time, sick leave, administrative leave, professional education leave, or the measurement of
any time in which staff was unavailable for direct patient care.

The study did not use the DMFT index or any periodontal index. Instead, the study described the data using descriptive statistics which were stratified into four treatment priorities: 0, no treatment required; 1, emergency treatment needed immediately; 2, treatment needed in the near future, but not immediately; and 3, routine care requirements only. Chi-square analysis was utilized to test frequency differences among groups. The study design next assigned treatment time weighing factors, developed by Parker, 1982, to be applied to all treatment requirements. This would demonstrate the amount of time, in minutes, needed to treat the dental needs of this recently incarcerated population. This measure would then be compared to the availability of dental staff, as measured by the dental resource data.

Barnes et al. found that 92.8 percent of the new inmates needed basic preventive care, 81 percent needed at least a one-surface restoration, 44.9 percent needed full or partial dentures and 57.3 percent needed minor non-surgical periodontal therapy. In all, 98.4 percent of the sampled inmates needed some form of dental treatment. When these data were compared to the availability of existing dental positions, it was found that the basic total dental treatment needs of this population were more than can be satisfied by the existing dental staffing available in the Texas Department of Corrections. By using the dental priority system of the study, it was further found that the existing dental staff can satisfy the Priority 1 and 2 needs, but few Priority 3 needs. The study did not include an
assessment of the treatment needs of the resident population and admits to not knowing the additional stresses which would be placed on the Texas system to satisfy their needs. In addition, the study by Barnes proposes that patient demand is an important determinant of the correctional health care provider's workload. The study indicated that supplemental data on dental disease and inmate demand would be useful in determining professional workload and planning dental resource allocation.

This study of recently incarcerated inmates in Texas was preceded by another study by Barnes which emphasized the periodontal treatment requirements of the same inmate population described previously (Barnes, Parker, Fultz, Rees & Lyon, 1987). The focus of the study was the same. Data were collected by classifying the procedure and therapy needs of each inmate into four categories: (1) preventative counseling, or oral hygiene instruction; (2) prophylaxis and calculus removal; (3) Type I: Type II periodontal therapy; and (4) Type III: Type IV periodontal therapy. These classifications are based on the American Dental Association's Code on Dental Procedures and Nomenclature (Council on Dental care Programs, 1976, p. 649). Periodontal probes and radiographs were used to measure the amount of periodontal disease. However, data on Type I (gingivitis) and Type II (early periodontitis) were collected together. Similarly, data on Type III (moderate bone loss) and Type IV (advanced periodontitis) were collected together. Chi-square analysis was utilized to test differences in the frequency data among various demographic variables, such as age, race and type of
crime committed.

The results indicated that 93.0 percent of all inmates surveyed needed counseling in preventive dentistry or, oral hygiene instruction, 93.0 percent needed prophylaxis and tartar removal, 32.0 percent needed Type I and/or Type II periodontal therapy and 12.0 percent needed Type III and/or Type IV periodontal therapy. The study also demonstrated that the need for more rigorous periodontal therapies increased with age.

Finally, using the same recently incarcerated Texas inmate population as listed previously, Parker and Barnes studied the removable prosthodontic needs of prison inmates (Parker, Barnes, & Fultz, 1987). They found that among all recently incarcerated men, 5.80 percent exhibited a need for complete dentures and 5.30 percent needed one or more removable partial dentures. The greatest need for complete dentures was exhibited by inmates over 52 years. White men exhibited a significantly greater need for complete dentures than black or Hispanic men (p < .05). The greatest need for removable partial dentures occurred in the age group 41-52 years. Hispanic men required fewer partial dentures than black men or white men.

Another study which measured the amount of dental disease in a State correctional system involved a 1800 man medium security prison in Maryland (Salive, Carolla & Brewer, 1989). This was a cross-sectional study that routinely examined inmates as they transferred into the new 1800 bed facility from other State of Maryland correctional facilities. Inmates entering into the new facility
had to have served at least six months of their sentence, have been sentenced for at least five years, be a minimal security risk, and have no medical or psychological illness that would result in an emergency need for services. A sample of 178 male inmates were examined by a single dentist, who used the DMFT index to investigate the prevalence of decayed, missing and filled teeth in the sample. Radiographs, in the form of panoramic films, were used in diagnosis. Periodontal findings were not collected as part of the study. The findings of the study were then linked to the demographic variables of age, race, type of offense, length of sentence, length of stay and jurisdiction of commitment. Chi-square analysis indicated that no significant differences were found between the study sample population and the State male inmate population. The study lasted four months.

The study found a mean DMFT of 10.5 for inmates aged 18-29, 17.1 for inmates aged 30-44 and 22.4 for inmates over age 44. White inmates had a significantly greater number of filled teeth than black inmates (p < .005), aged 18-29. A similar difference was seen in the 30-44 age group, however, it was not statistically significant. The number of missing teeth increased with age, from 3.4, in age group 18-29, to 8.6, in age group 30-44, to 16.7, in age group 45 and above (p < .001). Young white inmates had more missing teeth than young black inmates (p < .06). The study used simple linear regression to determine that the number of decayed teeth declined over the time of incarceration, by .22 teeth/year of age (p < .05). A comparison of the results of this study with US employed adults, standardized to the study population, showed that inmates had more missing teeth at
every age, and a greater percentage of unmet dental need, as defined by the percentage of decayed teeth divided by the number of decayed and filled teeth.

The largest drawback to this study is that it is not apparent how the sample of 178 inmates are selected out of the 1800 total inmate population. Whether all the inmates arriving over the four month period were examined, or a percentage of them, is not clear. The randomness of the sample is questionable. Additionally, while the study demonstrates the similarity between the sample and the State inmate population, with respect to age and racial composition, it admits the inmates entering into the study site were previously screened to assignment based on their health status and security classification. Therefore, selection bias exists. Inmates could have been lost to the study who had a higher or lower security classification, ill health or dental problems which required emergency dental services. This confounds the finding that the number of decayed teeth declined over the time of incarceration. Lastly, inmates in prison for greater than six months, are likely to have obtained some sort of dental treatment. Hence, associations made between the DMFT and incarceration may be biased by the treatment effect. A follow-up of a longitudinally based study on incoming inmates into the Maryland correctional system would be needed to better assess the effect of incarceration on the DMFT index. To their credit, Salive et al. called for such follow-up research, and additionally thought that supplemental studies in other State, county and Federal systems were necessary.

Such a study on the amount of dental disease in a Federal correctional
institution was performed shortly thereafter at the United States Penitentiary at Leavenworth, Kansas (Mixson, Eplee, Fell, Jones & Rico, 1990). The study investigated the prevalence of decayed, missing and filled teeth among 191 randomly selected federal prisoners aged 21-75 years. The original sample size for the study was 299 inmates. However, 104 did not show for the examination and four refused for personal reasons. Periodontal status was not studied and radiographs were not used. The number of decayed, missing and filled teeth were analyzed according to age, race, number of years incarcerated and dental utilization, as calculated by the number of the visits to the dental facility divided by the number of years incarcerated. Chi-square analysis indicated no statistical difference between the sample and the total inmate population based on age and race, somewhat reducing a charge of bias due to non-respondents.

The results of the study showed a mean DMFT of 12.9 for inmates aged 20-34, 16.4 for inmates aged 35-44 and 22.1 for inmates 45 and older. White inmates had significantly fewer decayed teeth than black inmates for ages 20-34 ($p < .05$). The number of missing teeth increased with age ($p < .01$) and most significantly ($p < .001$), inmates incarcerated less than two years had a much lower utilization rate of dental services, than inmates incarcerated for a longer period of time. Not surprisingly, inmates who made greater use of the available dental services had fewer decayed teeth. Utilization was high, with 69.70 percent of surveyed inmates demonstrating at least one visit to the dentist per year. Mixson et al., as the Salive et al. study (1989), found that the number of decayed
teeth was inversely related to the length of incarceration. However, neither study found a corresponding increase in missing or filled teeth. Treatment effects could again account for this finding.

The study reports its primary weakness as the large number of inmates (108 of 299) that did not report to the clinic for examination. As stated in the study, this may indicate a sample bias against those inmates who had low utilization rates. This may serve to confound the finding of a lower number of decayed teeth when there is a higher utilization rate.

Summary

Table 8 provides a summary of the research characteristics of the correctional studies discussed above. All, except the studies by Mixson et al. (1990) and possibly Salive et al. (1989), consist of non-random samples. The work by Gilmore and Gluck (1973) was the only study that involved more than one setting. Comparability to other prisons in the respective states in which the studies were conducted is limited, with the exception of the Barnes et al. study in Texas (1983). Additionally, some of the study protocols, such as the total exclusion or inclusion of inmates over a certain age, Ross (1977), or counting severely decayed teeth, which are to be extracted, as missing, rather than decayed (Gilmore & Gluck, 1973), create a background of bias. The study by Cunningham et al. (1985) in Iowa uses a comparison group of the general population in the same State. Other studies were forced to use national studies, such as NHANES (1979) or the
Table 8
Summary of Research Designs of Epidemiological Studies on Dental Disease in Correctional Setting

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<tr>
<th></th>
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<td>Survey</td>
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<td>Survey</td>
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<td>ADA</td>
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<td>-minimum security</td>
<td>-race</td>
<td>-IQ</td>
<td>-crime</td>
<td>-length of stay</td>
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</table>

Survey on Employed Adults (1988), as comparisons for inmate dental disease data.

Tables 9, 10, 11 and 12 list the dental disease findings of the varying
Table 9

Summary of Research Findings of Epidemiological Studies on DMFT, by Age, in Correctional Setting as Compared to National Study on US Males

<table>
<thead>
<tr>
<th>Ages</th>
<th>NHANES</th>
<th>Gilmore &amp; Gluck</th>
<th>Ross</th>
<th>Cunningham et al.</th>
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<tr>
<td>Decayed</td>
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<td></td>
<td></td>
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<tr>
<td>18-24</td>
<td>2.2</td>
<td>5.0</td>
<td>6.4</td>
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<tr>
<td>25-34</td>
<td>1.8</td>
<td>4.0</td>
<td>6.4</td>
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<tr>
<td>18-30</td>
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<td></td>
<td>3.07(3.75)</td>
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<tr>
<td>35-44</td>
<td>1.2</td>
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<td>3.0</td>
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<td>55-64</td>
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<td>3.0</td>
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<td>65-74</td>
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<tr>
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<td>1.7</td>
<td>8.0</td>
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<tr>
<td>25-34</td>
<td>4.1</td>
<td>12.0</td>
<td>7.3</td>
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<tr>
<td>18-30</td>
<td></td>
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<td>1.76(2.90)</td>
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<td>35-44</td>
<td>8.4</td>
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<td>45-54</td>
<td>9.9</td>
<td>13.0</td>
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<td>55-64</td>
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<td>65-74</td>
<td>15.6</td>
<td>16.0</td>
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<td>6.6</td>
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<td>25-34</td>
<td>9.0</td>
<td>4.0</td>
<td>1.9</td>
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<tr>
<td>18-30</td>
<td></td>
<td></td>
<td></td>
<td>5.69(4.35)</td>
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<tr>
<td>35-44</td>
<td>8.8</td>
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<td>DMFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>10.5</td>
<td>16.0</td>
<td>14.1</td>
<td></td>
</tr>
<tr>
<td>18-30</td>
<td></td>
<td></td>
<td></td>
<td>10.53(5.97)</td>
</tr>
<tr>
<td>25-34</td>
<td>14.9</td>
<td>20.0</td>
<td>15.6</td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>18.4</td>
<td>21.0</td>
<td></td>
<td></td>
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<tr>
<td>45-54</td>
<td>19.2</td>
<td>20.0</td>
<td></td>
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<tr>
<td>55-64</td>
<td>20.7</td>
<td>19.0</td>
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<tr>
<td>65-74</td>
<td>21.8</td>
<td>22.0</td>
<td></td>
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Table 10
Summary of Research Findings of Epidemiological Studies on DMFT, by Age and Race, in Correctional Setting

<table>
<thead>
<tr>
<th></th>
<th>Decayed (SD)</th>
<th>Missing (SD)</th>
<th>Filled (SD)</th>
<th>DMFT (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Salive et al.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages: 18-29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2.1</td>
<td>2.9</td>
<td>4.0</td>
<td>9.0</td>
</tr>
<tr>
<td>White</td>
<td>2.5</td>
<td>4.7</td>
<td>7.0</td>
<td>14.1</td>
</tr>
<tr>
<td>Total</td>
<td>2.2 (2.6)</td>
<td>3.4 (4.2)</td>
<td>4.9 (4.2)</td>
<td>10.5</td>
</tr>
<tr>
<td><strong>Mixson et al.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages: 20-34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>3.7 (3.2)</td>
<td>3.2 (3.3)</td>
<td>5.5 (4.1)</td>
<td>12.5 (6.3)</td>
</tr>
<tr>
<td>White</td>
<td>2.1 (2.5)</td>
<td>2.8 (2.7)</td>
<td>8.4 (4.7)</td>
<td>13.3 (5.9)</td>
</tr>
<tr>
<td>Total</td>
<td>3.1 (3.2)</td>
<td>3.0 (3.3)</td>
<td>6.8 (4.4)</td>
<td>12.9 (6.0)</td>
</tr>
<tr>
<td><strong>Salive et al.</strong></td>
<td></td>
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<tr>
<td>Ages: 30-44</td>
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<td>Black</td>
<td>3.2</td>
<td>8.4</td>
<td>4.8</td>
<td>16.4</td>
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<tr>
<td>White</td>
<td>4.0</td>
<td>9.0</td>
<td>5.9</td>
<td>18.8</td>
</tr>
<tr>
<td>Total</td>
<td>3.4 (3.3)</td>
<td>8.6 (6.4)</td>
<td>5.1 (4.4)</td>
<td>17.1</td>
</tr>
<tr>
<td><strong>Mixson et al.</strong></td>
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<td></td>
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<tr>
<td>Ages: 35-44</td>
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<tr>
<td>Black</td>
<td>2.8 (3.3)</td>
<td>7.1 (7.1)</td>
<td>5.5 (4.2)</td>
<td>15.4 (6.7)</td>
</tr>
<tr>
<td>White</td>
<td>1.8 (2.5)</td>
<td>9.2 (8.2)</td>
<td>6.4 (4.0)</td>
<td>17.5 (6.9)</td>
</tr>
<tr>
<td>Total</td>
<td>2.3 (3.0)</td>
<td>8.0 (7.6)</td>
<td>6.2 (4.4)</td>
<td>16.4 (6.8)</td>
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<td><strong>Salive et al. &amp; Mixson et al.</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages: 45+</td>
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<td></td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salive</td>
<td>1.4</td>
<td>16.4</td>
<td>1.7</td>
<td>19.5</td>
</tr>
<tr>
<td>Mixson</td>
<td>3.0 (4.8)</td>
<td>12.0 (7.7)</td>
<td>4.3 (1.3)</td>
<td>19.3 (8.8)</td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salive</td>
<td>4.0</td>
<td>17.0</td>
<td>5.2</td>
<td>26.2</td>
</tr>
<tr>
<td>Mixson</td>
<td>1.3 (2.2)</td>
<td>14.3 (10.5)</td>
<td>6.9 (6.6)</td>
<td>22.4 (4.9)</td>
</tr>
<tr>
<td>Total</td>
<td>2.5 (3.3)</td>
<td>16.7 (7.9)</td>
<td>3.2 (5.1)</td>
<td>22.4</td>
</tr>
<tr>
<td><strong>Mixson et al.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages: 45+</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salive</td>
<td>1.5</td>
<td>14.0 (10.2)</td>
<td>6.6 (6.3)</td>
<td>22.1 (5.4)</td>
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Table 11

Frequencies (%) of Periodontal Treatment Needs From Studies on Periodontal Disease in Correctional Setting

<table>
<thead>
<tr>
<th>Studies Ages</th>
<th>None Needed</th>
<th>Oral Hygiene Instruction only</th>
<th>Prophylaxis</th>
<th>Type I/II</th>
<th>Type III/IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilmore &amp; Gluck</td>
<td>20.0</td>
<td>50.0</td>
<td>33.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ross 18-24</td>
<td>71.0</td>
<td>18.0</td>
<td>11.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>61.5</td>
<td>22.2</td>
<td>16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barnes et al. 17-28</td>
<td>96.0</td>
<td>98.0</td>
<td>25.0</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>29-40</td>
<td>94.0</td>
<td>94.0</td>
<td>39.0</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>41-52</td>
<td>82.0</td>
<td>75.0</td>
<td>40.0</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>53+</td>
<td>52.0</td>
<td>57.0</td>
<td>48.0</td>
<td>19.0</td>
<td></td>
</tr>
<tr>
<td>All Ages</td>
<td>93.0</td>
<td>93.0</td>
<td>32.0</td>
<td>12.0</td>
<td></td>
</tr>
</tbody>
</table>


These tables are categorized by the type of dental disease or need and the pertinent studies in the correctional setting. Table 10 is provided because the Salive et al. (1989) and Mixson et al. (1990) studies include race as one of the variables against which the DMFT is described. The difficulty in comparisons
Table 12

Frequencies (%) of Prosthetic Treatment Needs From Studies in Correctional Setting

<table>
<thead>
<tr>
<th>Inmates Needing</th>
<th>Inmates Needing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Dentures</td>
<td>Partial Dentures</td>
</tr>
</tbody>
</table>

*Parker et al.*

**Ages**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Full Dentures</th>
<th>Partial Dentures</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-28</td>
<td>1.1</td>
<td>1.8</td>
</tr>
<tr>
<td>29-40</td>
<td>5.0</td>
<td>7.2</td>
</tr>
<tr>
<td>41-52</td>
<td>27.3</td>
<td>18.2</td>
</tr>
<tr>
<td>53+</td>
<td>33.3</td>
<td>9.5</td>
</tr>
<tr>
<td>All Ages</td>
<td>5.8</td>
<td>5.3</td>
</tr>
</tbody>
</table>

**Race**

<table>
<thead>
<tr>
<th>Race</th>
<th>Full Dentures</th>
<th>Partial Dentures</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>8.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Black</td>
<td>3.7</td>
<td>7.5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.4</td>
<td>1.7</td>
</tr>
</tbody>
</table>


between the correctional studies is the lack of consistency between age groupings. Only two studies, Salive et al. and Mixson et al., alluded to the length of incarceration as a variable in analysis.

The Evaluation of Dental Delivery

The delivery of health care, regardless of discipline, may be as varied as the intent of countless designers, who rationally construct systems to accommodate their distinctive needs. However, within the evaluation of dental delivery
systems, Relative Value Units (RVU) have played an important role in demonstrating the actual capabilities of dental clinics to meet the demand for dental services, as shown in the above study by Barnes (1988).

Relative Value Units (RVU) originated in the 1950's as a method to standardize and compare fee schedules for health services rendered relative to type, location and specialty (Parks, 1883). RVU's are created through surveying large numbers of health care providers concerning general and specific factors that are necessary to complete individual services. These factors might include knowledge, dexterity, physical and mental effort, or the affect of error. Factors are then weighted through regression analysis and added together to produce relative value units (ADA, 1976). RVU's provide a comprehensive set of interrelated values for assessing the comparative difficulties and time requirements of various healthcare procedures. Longer and more complex procedures were assigned larger values; shorter and simpler procedures were assigned smaller values.

Relative Value Units became a functional management tool through the efforts of researchers such as Ogawa (1969), Lotzkar (1971) and Greenberg (1977) and have been shown to be much more sensitive in evaluating performance and cost than encounter-based systems (Mitry, 1973), particularly when the evaluation involves comparisons between different clinics and varying numbers of dental auxillaries (Parker, 1976). This is because encounter based systems assign equal weight to unequal occasions. A simple dental filling is counted as one dental visit, as is the extraction of an impacted wisdom tooth. Yet, the extraction
requires more time, dexterity and skill. Greenberg (1977) was particularly interested in developing relative value units for a prepaid dental program. This study did not try to recommend or set fees. Rather, it defined a technique for determining RVU's based on the itemization of clinic costs per procedure. Costs were categorized into staffing costs, supply costs, equipment costs and overhead costs, which included such items as utilities, housekeeping and administration. The marginal costs of each procedure were then divided by the marginal cost of a one surface filling to produce the RVU for that procedure. The one surface filling in this instance became the denominator for the calculation of all other RVU's, the rationale being that it is the procedure most frequently performed in dentistry. The information obtained would then be used to examine costs and productivity within and between clinics.

Rosenthal has taken the merits of RVU's, which were created for the private sector to standardize fees, and adapted this system to the public sector (Rosenthal, 1980). In the public sector, fees are not usually collected for services. However, Rosenthal establishes productivity in public sector clinics by measuring RVU's per unit of time, instead of, as in the private sector, using RVU's to establish fees. Expected RVU's of dentists per year, which are arbitrarily set by the funding source and the need for revenue, are then compared to the actual RVU's per year to assess productivity and as a method to create an incentive program. This study also uses RVU's as a method to appraise service profiles, which is a valuable indicator of the appropriateness of care. For example, the number of
RVU's rendered for dentures and other prosthetic services should not be high if the patient pool is primarily younger persons.

Relative value units are currently being used to track productivity in the Michigan Department of Corrections and are assigned from roughly proportionate intervals of time as may be seen in Table 13.

If, for instance, a procedure was performed that took between 41-50 minutes to complete, 18 RVU's would be assigned to the provider. The derivation of these units is obtained by multiplying successive time increments by the 0-5 interval, which is assigned 1 RVU. Hence, the RVU's, within the MDOC are proportionate multiples of the smallest time increment and the approximate medians of successive other time increments.

The importance of RVU's lies in the fact that they are time based.

Table 13

<table>
<thead>
<tr>
<th>Interval (min.)</th>
<th>Assigned (min.)</th>
<th>Relative Value Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5</td>
<td>2.5</td>
<td>1</td>
</tr>
<tr>
<td>6 - 10</td>
<td>7.5</td>
<td>3</td>
</tr>
<tr>
<td>11 - 20</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>21 - 30</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>31 - 40</td>
<td>35</td>
<td>14</td>
</tr>
<tr>
<td>41 - 50</td>
<td>45</td>
<td>18</td>
</tr>
<tr>
<td>51 - 60</td>
<td>55</td>
<td>22</td>
</tr>
</tbody>
</table>

(Compiled from Michigan Department of Corrections Form CHJ 533)
Procedures requiring more skill and dexterity take longer to accomplish than those that do not. In this respect, time, in terms of minutes, may be extrapolated from RVU's. However, there is much ambiguity in this process. As a case in point, Table 14 provides a synopsis of differing studies with respect to the number of minutes required to perform different dental procedures, as compared to that of the MDOC. Each procedure listed in this table is the sum of several different activities. For example, the total number of minutes it takes to make a full denture is the sum of the time it takes for impressions, pouring models, bite registration, try-in, delivery and adjustment. Similarly, the extraction time totals are composed of administering anesthetic, tooth removal and post-operative instructions. Not all studies gave information on every listed procedure.

The Lotzkar study (1971) is the only true time and motion study. The numbers from the Bader & Kaplan (1982) and the Indian Health Service (1987) are obtained from a survey of public service providers, while the Barnes study (1988), which is correctional based and has noticeably higher values, derives its values from Parker (1976). These higher values from the Parker (1976), hence Barnes study (1988), are due to the fact that they are derived from a fee-for-service model which was based on private dentists. Fees begat these values more so than did time. This is important because these values were used to infer the amount of time it would take dental staff to treat inmate need in the Barnes study (1988). Higher relative value units for varying dental procedures translates into longer lengths of chairtime required to complete various dental procedures, hence, less provider availability to treat inmate need, given a fixed amount of
Table 14

Time (Minutes) to Perform Differing Dental Procedures

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
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<td>Diagnostic Exam</td>
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<td>18.7</td>
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<td>Periapical</td>
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<td>4.0</td>
<td>2.0</td>
<td>2.5</td>
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<td>4.0</td>
<td>4.0</td>
<td>5.0</td>
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<tr>
<td>Extractions</td>
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<tr>
<td>Simple</td>
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<td>11.5</td>
<td>37.4</td>
<td>15.0</td>
<td>22.5</td>
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<td>Surgical</td>
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<td>Root Canal Tx.</td>
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<tr>
<td>1-surface</td>
<td>15.6</td>
<td>15.0</td>
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<td>12.0</td>
<td>22.5</td>
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<td>2-surface</td>
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<td>20.0</td>
<td>57.8</td>
<td>18.0</td>
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<tr>
<td>3-surface</td>
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<td>61.2</td>
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<td>Full Denture</td>
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<td>87.0</td>
<td>285.6</td>
<td>160.0</td>
<td>120.0</td>
</tr>
<tr>
<td>Partial Denture</td>
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<td>60.0</td>
<td>108.8</td>
<td>150.0</td>
<td>92.5</td>
</tr>
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<td></td>
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<td>Routine</td>
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<td>35.0</td>
</tr>
<tr>
<td>Periodontal</td>
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<td></td>
<td>60.0</td>
<td></td>
<td>45.0</td>
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</tbody>
</table>

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Relative Value Units were again used in Rosenstein's research that studied the characteristics of successful dental programs in community and migrant health centers (1988). He utilized a case study approach and sampled nine sites, which included rural and urban centers. These sites were selected from as many different regions as possible. The sites were selected from a blue-ribbon panel comprised of community and migrant health center (C/MHC) dental directors. The study collected data using interviews, document analysis, in the form of chart audits, and direct observation in the form of site visits. RVU's were used to analyze the percentage of services that were emergency based (Level I), preventative based (Level II), restorative based (Level III) and rehabilitative based (Level IV). However, the usage of RVU's in this study was only one aspect in a larger analysis to evaluate the delivery of dental services in this setting. Other operational variables used to evaluate this program were: (a) staffing, which included recruitment and retention, compensation, levels, training, and auxiliary utilization; (b) organizational structure, which included charts; (c) clinic operation, which included hours of operation (availability) and procedure manuals; (d) physical layout of facilities, which included equipment description/repair history and clinic square footage; (e) menu of services; and (f) productivity, which included patient visits/FTE, no show rate, patient population/FTE, RVU/FTE/month, filling/extraction ratio, and costs/patient. These variables were replicated in part in studies by Schonfeld in 1979 on the Veterans Administration's dental delivery system and again in 1979 by the Research Triangle Institute's study of dental
delivery in Health Maintenance Organizations.

Dental Delivery in a Correctional Setting

Many of these same indicators are also used in tracking the delivery of dental services within a prison setting. For example, Anno (1991) lists the menu of services provided to inmates, the physical structure of clinics, the availability of care, organizational structure and staffing as important guidelines for the management of an adequate correctional dental delivery system.

She suggests inmates should receive a dental screening to check for potential problems within seven days of entry into prison and a full dental examination, including radiographs, within the first month of incarceration. Based on the results of this examination, a prioritized treatment plan should be accomplished for each patient who desires care. Access to dental care should be unimpeded and formalized through a procedure of either a written sick-call or walk-in system. The prioritization of care suggests that treatment be categorized, similarly to the Barnes study above, in descending order of importance, as follows (Anno, 1991, p. 130):

1. **Emergency/urgent** - Individuals requiring treatment for the relief of acute oral conditions which are likely to worsen without intervention. (Examples are toothaches, abscesses, bleeding, and fractures).

2. **Interceptive Care** - Early treatment for the control of extensive, subacute oral conditions (deep decay that while not hurting, if not restored soon, will result in the loss of the tooth).

3. **Corrective Care** - Routine dental treatment (the restoration of carious
teeth, elective extractions, long term management of periodontal disease, root canal treatment and the fabrication of full and partial dentures, which are needed to retain or restore essential masticatory function).

4. **Elective Care** - Individuals who have none of the treatment needs specified above (patient education).

**Summary**

The delivery of dental care is multifaceted; its description and analysis, therefore, must be so as well. An effort has been made in this section to identify variables used in the evaluation of dental health care delivery in order to form a foundation upon which this service may be evaluated in the MDOC setting.

Much attention was given to the concept of relative value units because dentistry lends itself to the delineation of clinical procedures using time. It is important to recognize that different procedures in dentistry, depending on complexity, require varying amounts of time. As a result, RVU's provide a useful tool in describing the operation of a clinic, with respect to the services it renders and its hours of availability. Examples of Relative Value Units for varying dental procedures were provided in Table 14.

Other factors are also listed that aid in the evaluation of dental delivery. These factors are compiled from quality assurance studies in a variety of private and public healthcare settings. Additionally, as suggested by Anno (1991) and Barnes (1987), an evaluation of a correctional healthcare delivery system should take into account the prioritization of healthcare, with respect to the urgency of the inmate's health status.
CHAPTER III

BACKGROUND - THE MDOC SYSTEM

This is a case study of the Michigan Department of Corrections. A review of its overall mission and administrative structure, with an addendum regarding health care is, therefore, necessary background, given the unusual nature of this setting for dental healthcare delivery. Information on the geographic distribution of correctional facilities and inmate populations within the MDOC are especially important to the upcoming discussion of the research methodology used in this study, particularly its sample design.

Mission Statement - MDOC

The Mission Statement of the Michigan Department of Corrections (MDOC) is as follows:

The Department enhances public safety by recommending sanctions to the courts and, as directed by the courts, carrying out the sentences given to convicted adult felons in a humane, cost-efficient manner which is consistent with sound correctional principles and constitutional standards.

(MDOC, 1994a, p. 1)

The MDOC’s obligation in providing necessary health care to prisoners in its custody includes seeing that adequate medical/surgical, dental and mental health care is provided. To that end, the Standards of the American Correctional Association (1991) were adopted by Michigan and all of its agents. These Standards specify

58
a commitment must be made to cost-effective, comprehensive health care characterized by high quality services, unrestricted access to required care and documentable continuity of care.

Security Levels

The inmate population of correctional departments is segmented by security classifications. These are based on the level of physical restraint determined necessary to reduce escape risk, called the "confinement level", and the level of physical restraint necessary to maintain good institutional order and to protect prisoners and staff from harm, called the "management level". This results in six security classifications. These are, in ascending order of severity: camps, minimum security, medium security, close security, maximum security and administrative segregation. Different correctional facilities around the State of Michigan are assigned differing security levels of inmates. Some facilities are assigned only one type of security level, while others are assigned multiple levels of security classifications.

Geography

The geographic distribution of MDOC facilities, by Region, is included as Figure 1. The four Regions are: the Northern Region, the Western Region, the Central Region and the Eastern Region. Additionally, facilities within the MDOC are assigned facility acronyms, which are included as Appendix A.
Figure 1. Geographic Distribution of MDOC Facilities by Region.
Administrative Structure

The Dental Division of the Michigan Department of Corrections is one of several health care disciplines that is represented in the organizational structure of the Department. Administratively, the MDOC is divided into four regions (see Figure 1). Each region has a separate administrative authority that answers to the Central Office in Lansing. The primary health care authority for each Region is the Regional Health Care Administrator. The State Correctional Health Care Administrator answers directly to a Deputy Director of the MDOC, who in turn answers directly to the Director of Corrections.

The Regional Health Care Administrator is responsible for direct line supervision of the Regional Directors for nursing, medicine, dentistry, psychology and pharmacy. The Regional Dental Director, then, supervises a series of clinics, most of which have one dentist, one dental assistant and the part time services of a dental hygienist.

Dental Services Delivery

All inmates entering the MDOC receive a dental screening. But subsequent treatment is received only upon request. The Dental Division of the Michigan Department of Corrections provides fillings, extractions, root canal treatments, prosthetics (full and partial dentures) and cleanings. However, this care is prioritized. Emergency services, such as fractures, swelling and toothaches, are
recognized as more urgent than routine care needs and therefore are scheduled immediately into clinics. Routine dental care needs, such as the repair of incipient decay and cleanings, are provided to inmates on a first-come, first serve basis. Waiting lists are created for routine services, and inmates are scheduled into clinics in the order that their names appear on these lists. Hence, access to dental care is dependent upon the severity of the inmate’s problem, with emergency needs being given priority over non-emergency needs.

The policies and procedures which describe dental services in the MDOC are modeled after the scope of services in the Medicaid guidelines administered under the auspices of the Michigan Department of Social Services. There are differences between these two Departments as to the scope of services offered, but not as to the eligibility of inmates to receive care. All inmates are not only eligible for care, but also are legally entitled to it, because they are considered wards of the State.

Dental Staffing

As a rule, one dentist and one dental assistant are assigned to each correctional facility. Each of the dental hygienists, who provide cleanings to inmates, is responsible for two or three institutions. The exception to this rule is maximum security and predominantly administrative segregation institutions. Because movement is so restricted in these institutions and their populations are smaller, only half-time dental coverage is provided. In Table 15, the dispersion of dental
staffing, in terms of full-time equivalents (FTE) for thirty-four MDOC institutions is presented. These totals only represent institutions which house male, non-camp, non-psychiatric center, non-reception center inmates.

Cost of Dental Services

The cost of providing dental care to inmates will always be greater than the cost of providing the same service in a community setting. This is because of the limitations of inmate movements throughout the clinic day and the tremendous amount of staff time used for safety and security concerns, instead of the provision of dentistry. Additionally, the inmate population has incentives to overuse the health care system. For example, a visit to the dental clinic can get an inmate

Table 15
MDOC Dental Staffing by Inmate Population

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>8192</td>
<td>7</td>
<td>10.7</td>
<td>12.5</td>
<td>5</td>
<td>765.6</td>
<td>1638.4</td>
</tr>
<tr>
<td>Eastern</td>
<td>7361</td>
<td>8</td>
<td>7.5</td>
<td>7.5</td>
<td>4.5</td>
<td>981.5</td>
<td>1635.8</td>
</tr>
<tr>
<td>Northern</td>
<td>6450</td>
<td>9</td>
<td>7.5</td>
<td>8.5</td>
<td>4.5</td>
<td>860.0</td>
<td>1433.3</td>
</tr>
<tr>
<td>Western</td>
<td>9913</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>5</td>
<td>1101.4</td>
<td>1982.6</td>
</tr>
<tr>
<td>State of Michigan</td>
<td>31,916</td>
<td>34</td>
<td>34.7</td>
<td>38.5</td>
<td>19</td>
<td>919.8</td>
<td>1679.8</td>
</tr>
</tbody>
</table>
out of a work detail, or even punitive segregation. In a draft by Health Management Associates, it stated, "All correctional staff face the constant tension between the need to ensure that prisoners have adequate access to health care, while at the same time limiting unnecessary use of the health care system" (Ellis, 1996, p.13). Further, inmates are quick to sue, which makes health care providers in the correctional setting more likely to err on the side of treatment, rather than non-treatment. Hence, costs are higher.

The historical costs of providing dental services to inmates within the MDOC, as a percentage of the total health care Regional budget, is not available for Regions outside of the Western Region. This is because until recently, other Regions did not have a Financial Analyst position, as did the Western Region, to track and segment health care expenditures. Currently, each Region does have a Financial Analyst position, but dental costs, along with other health care disciplines, are not factored out of the total Regional health care budget. Therefore, information provided in this section is unfortunately limited to that of the Western Region, which makes comparisons Statewide impossible. However, this data will give the reader a flavor of the costs of providing dental services in at least a section of the State’s correctional setting.

Table 16 breaks expenditures down into three categories: (1) Personnel expenditures, which is inclusive of salary and wages, annual and sick time usage, overtime, longevity payments, health care insurances, social security and other retirement costs; (2) Services/Supplies expenditures, which is inclusive of non-
Table 16

Dental Expenditures - Western Region MDOC

<table>
<thead>
<tr>
<th></th>
<th>FY 91-92</th>
<th>FY 92-93</th>
<th>FY 93-94</th>
<th>FY 94-95</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Facilities</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>- Inmate Population</td>
<td>6,837</td>
<td>6,823</td>
<td>6,674</td>
<td>9,913</td>
</tr>
<tr>
<td><strong>Dental Expenditures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Personnel</td>
<td>$1,049,650</td>
<td>$1,086,367</td>
<td>$1,053,012</td>
<td>$1,664,539</td>
</tr>
<tr>
<td>- Services/Supplies</td>
<td>$51,175</td>
<td>$46,429</td>
<td>$79,102</td>
<td>$148,757</td>
</tr>
<tr>
<td>- Equipment</td>
<td>$0</td>
<td>$652</td>
<td>$3,505</td>
<td>$17,829</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$1,100,825</td>
<td>$1,133,448</td>
<td>$1,135,619</td>
<td>$1,831,125</td>
</tr>
<tr>
<td><strong>Cost/Inmate</strong></td>
<td>$161.01</td>
<td>$166.12</td>
<td>$170.16</td>
<td>$184.72</td>
</tr>
</tbody>
</table>

-compiled from Ionia Clinical Complex Expenditure Reports

personnel related costs associated with providing dental services, i.e., travel costs, clothing allowances, education costs and equipment repairs, dental, medical and office supply costs; and (3) Equipment expenditures, which is inclusive of all new equipment purchased for the dental clinics. Per capita costs are also given.

From Table 16, it is clear that the majority of costs in the provision of dental care to inmates in this setting are personnel costs. Dental care is labor intensive, with respect to all other costs.
CHAPTER IV

RESEARCH METHODOLOGY

Overview of the Research Design

The purpose of this research was to document the amount of dental disease of male inmates in the Michigan Department of Corrections (MDOC) and to use this information to formulate policy for the delivery of dental services in Michigan and possibly other state prison systems. This study postulated that service delivery must accommodate existing needs to be effective. This was an exploratory study using survey research methods.

The sample in this study was designed to be representative of the Michigan Department of Corrections (MDOC) male inmate population. Therefore, the sampling frame might have been all male inmates in the Michigan Department of Corrections. However, some inmates, such as those in camps or in the psychiatric centers, were not representative of all the other inmates in the system. For example, inmates going to camps are screened for dental urgencies prior to admission into the camp program and may be denied entrance into this program based on the amount of their dental disease. And, because of the camp setting, the provision of dental services is limited. Similarly, inmates in the psychiatric centers do not comply with the requirements for oral hygiene. Inclusion of the camp
population would, nonetheless, cause slightly lower estimates of need because of their pre-screened health, while inclusion of the psychiatric population would inflate the estimate of need. Consequently, exclusion of these sub-groups of the state inmate population controls known directional bias. Only male inmates assigned to minimum security through administrative segregation custody levels were eligible for inclusion in this study. The unit of analysis in this study is the individual inmate.

The research begins with an assessment of dental disease within the MDOC. This portion of the study was a descriptive survey. The assessment of the amount of dental disease was performed through the measurement of decay rates, using the DMFT Index, and periodontal disease, using the Periodontal Screening and Recording System (PSR). Afterwards, an analysis of the MDOC dental delivery system was performed based on its ability to treat the amount of dental disease that was previously assessed. The disease/delivery comparison focused on assigning relative value units to the dental services needed to treat the inmate’s dental disease. This assignment allowed an estimation of the amount of dental staff time necessary to treat the assessed level of disease. These data were then evaluated with respect to whether the existing structure of the dental delivery system, as designed, can accommodate the level of disease found in the inmate population. The analysis of the MDOC delivery system was exploratory in design. Recommendations involving the delivery of dental services are presented in Chapter V.
Ethical Considerations

Because inmates belong to a special class of human subjects, their rights must be particularly protected. The direct beneficiary of this research is the inmate, because this study seeks to improve the delivery of their dental care. This research has taken measures to insure inmate anonymity. The researcher was blind to the identity of the study’s participants. Additionally, data collected in this research was the by-product of an examination procedure routinely performed within the MDOC Dental Division. The participants were not subjected to any procedure that is outside of their customary treatment within the Department. Universal precautions, which are routinely used to protect the inmate and examiner from bacterial and viral contamination, are the standard of care within the MDOC, and were used during the gathering of data. These precautions included the autoclaving of all instruments used to treat inmates and the disinfection of all operative surfaces, such as chairs, units and countertops, between patients. Moreover, dental staff wore gloves, which were changed between patients, masks, gowns and protective eyewear, to reduce the potential for the iatrogenic spread of contagion.

For these reasons, no consent form was sought from individual inmate participants. However, permission to perform the study was obtained prior to the collection of any data from the Michigan Department of Corrections (July 7, 1995) and the Western Michigan University Human Subjects Institutional Review Board.
Method

Inmates in the MDOC have annual health screenings which include a dental examination. The assessment of dental disease in this study was the by-product of this examination procedure which is routinely performed by MDOC dentists. This annual examination entails a visual examination of the hard and soft tissues of the inmate's mouth, which includes a charting of the decayed, missing and filled teeth, the periodontal status and the resulting development of a treatment plan which prioritizes needed care. The dentist examiners, all of whom were employed by the Michigan Department of Corrections, utilize reflected light, mouth mirrors, dental probes and appropriate dental radiographs to perform this examination. To categorize the information obtained from this examination for the study, the Decayed-Missing-Filled Index (DMFT) was used to summarize the number of decayed, missing and filled teeth that had been diagnosed during the examination procedure and the Periodontal Screening and Recording System (PSR) was used to summarize the amount of diagnosed periodontal disease.

Sampling

The sample design of this research was a three-stage, area probability sample of male inmates in the Michigan Department of Corrections. The first stage consisted of cluster sampling institutions within the MDOC. The second stage
consisted of creating a proportionate stratified random sample of the resultant institutions by custody level and the third stage was a systematic random sampling of individual inmates using alphabetically ordered institutional lock sheets as the population list for drawing the sample in institutions. Sample size was determined using the formula:

\[ n = \frac{2}{pq \times \left(\frac{z}{e}\right)} \]

where

- \( n \) = sample size
- \( p \) = probability of dental disease
- \( q \) = probability of no dental disease
- \( z \) = level of significance
- \( s.e \) = tolerable error (Meier and Brudney, 1987, p.173)

This study was designed with a 5% tolerable error and a .05 level of significance \((z = 1.96)\). The probability of having dental disease was assessed from Barnes et al. (1988) of the number of inmates needing at least a one-surface filling, 81 percent. This measure of dental disease was consistent with Greenberg et al. (1977) which used the one-surface filling as the basis for calculating all other RVU's. Consequently, for the purpose of calculating the total sample size, the amount of inmates with some form of dental disease was estimated at 80%. Hence:

\[ n = \frac{2}{(.8)(.2) \times (1.96/0.05)} \]

\[ n = 245.86 \text{ or } 250 \text{ inmates} \]

The sampling frame in this study was the institutionalized male inmate
population of the Michigan Department of Corrections, excluding camp and psychiatric inmates. The population total was 31,916 male inmates. The sampling fraction then became 1:128. Varying this ratio to 20:2560, to accommodate the first stage cluster sampling, produced the following institutional clusters:

<table>
<thead>
<tr>
<th>MBP</th>
<th>HVM</th>
<th>URF</th>
<th>LRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTF</td>
<td>SMI</td>
<td>MTU</td>
<td></td>
</tr>
<tr>
<td>DRF</td>
<td>SMN</td>
<td>ICF</td>
<td></td>
</tr>
<tr>
<td>TCF</td>
<td>STF</td>
<td>MTF</td>
<td></td>
</tr>
</tbody>
</table>

Accordingly, 20 inmates would be selected from each of the above thirteen institutions. The selected institutions were then stratified according to security levels, then, proportioned with respect to security level and the institutional population size to give end-stage sample sizes per security level and institution, as shown in Table 17. Systematic random sampling, from institutional lock-sheets, was then used to select individual inmates from the different security classifications in each institution. These lock-sheets list inmates residing at institutions sequentially in alphabetical order. Further, they discriminate between differing security classifications at the same institution by listing the housing unit within the institution where different security classifications of inmates lock. For example, at Ionia Maximum Security Facility administrative segregation inmates lock in Housing Units 1 - 5 and the medium security inmates lock in Housing Units 6 and 7.

Data Collection

Information was collected in this study from a review of examinations
Table 17
Sample Size per Institution and Security Level

<table>
<thead>
<tr>
<th>Institution</th>
<th>Minimum</th>
<th>Medium</th>
<th>Close</th>
<th>Maximum</th>
<th>Ad.Seg.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBP</td>
<td>8</td>
<td></td>
<td></td>
<td>9</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>KTF</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>URF</td>
<td>3</td>
<td>13</td>
<td>3</td>
<td></td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>TCF</td>
<td></td>
<td>16</td>
<td>4</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>HVM</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>SMI</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>SMN</td>
<td></td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>STF</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>DRF</td>
<td>2</td>
<td>12</td>
<td>6</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>MTU</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>ICF</td>
<td></td>
<td>8</td>
<td></td>
<td>12</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>MTF</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>LRF</td>
<td>2</td>
<td>12</td>
<td>6</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>55</td>
<td>121</td>
<td>55</td>
<td>9</td>
<td>20</td>
<td>260</td>
</tr>
</tbody>
</table>

performed on inmates as part of their annual health screening and a review of radiographs taken at that time. An individual data collection sheet was developed for the collection of information obtained from the inmate’s dental examination, which was completed by the participating facility dentists. The first section of the form gathered demographic information on five variables from the inmate’s file. This section included information as to the correctional facility in which the inmate was located and the inmate’s age, race, security level and length of
incarceration. The second section of the data collection sheet gathered information as to the amount of dental disease. The dental disease section of the data collection sheet had four variables. These included the number of decayed, missing and filled teeth found by the dentist on their clinical examination and the periodontal status of the inmate as defined by the Periodontal Screening and Recording Index (PSR). The third and last section of the data collection sheet was the dental treatment needs section. It had 43 total variables that were arranged into six primary categories of amalgams, resins, extractions, endodontics (root canals), prosthetics and hygiene. It gathered information on the inmate's dental treatment need by breaking down the treatment plan that had been done by the facility dentist. Treatment plans were broken down by the specific dental service the inmate needed, i.e., amalgam or resin fillings, extractions, root canals, partials or full dentures and routine or extensive cleanings.

The data collection sheet then further classified these services as to the priority of their need, i.e., whether the service was an emergency, urgency or routine need. An emergency need was defined as a service that should be performed immediately, or the health of the inmate would be adversely affected. Urgent needs were services that could be performed within six months without otherwise affecting the health of the inmate and routine needs were services that could be performed in a time frame that extended past six months. The data collection survey sheet provided a completely anonymous individual record of the inmate's oral health and dental treatment needs and is included as Appendix B.
After the institutions were chosen and their security levels stratified, as indicated in Table 17, the dentists who provided services to inmates in these facilities were contacted and informed about this study. At this point, this researcher visited these dentists at their respective dental clinics. At these meetings, the facility dentists were given information which introduced them to the survey, including the reasons for its importance. The data collection sheet was then explained to these facility dentists, as was an explanation of the method that was to be used in recording data on the data collection sheets. From the criteria listed above on decayed, missing and filled teeth and periodontal status, the facility dentists and this researcher reviewed the diagnoses of dental disease. Trial data collection sheets were filled out and comparisons made between the facility dentist and this researcher to insure that the facility dentist understood the use of the data collection sheet. The dentists were then informed as to the number and security level type of inmates that were to be surveyed at their institutions and were given information on the technique of systematic random sampling, which the dentists would use to select the individual inmate sample. In order to obtain inmate anonymity for the study, this researcher chose only the starting point to be used in the systematic random sampling. The facility dentist was instructed to retrieve the inmate name that corresponded to the respective interval from the institutional lock-sheet and pull those records for review. Where information could not be collected on a inmate because of parole, transfer or other circumstances, it was recorded as missing data. Data collection sheets were
then delivered to the institutional dentists located at the facilities listed in Table 17.

After the facility dentists reviewed the inmate records and completed all of the data collection sheets for their sample, these sheets were returned to this researcher. The returned sheets were devoid of any information that could identify the inmate. Thirty of the data collection sheets were returned with radiographs that were taken as part of the routine dental examination that was performed. These radiographs were in numbered coin envelopes and were examined anonymously and retrospectively by this researcher to determine examiner reliability by comparing the returned findings on the accompanying data collection sheet to a review of the attached radiographs by this researcher. After review, these radiographs were returned to the facility dentist.

Analysis of Data

The information obtained from the returned data collection sheets were then entered into an SPSS statistical program and analyzed. Analysis of the level of existing dental disease was descriptive, with respect to the demographics of the sampled population and the amount of disease. The number of decayed, missing and filled teeth and the periodontal status of inmates was analyzed and organized using sample means, standard deviations and frequency distributions, according to age groups, race, level of security and years of incarceration. Differences with respect to age, race, level of security and years of incarceration were examined
using chi-square, analysis of variance procedures and the Scheffe multiple comparison test.

After the amount of dental disease within the MDOC inmate population had been defined, treatment needs were then analyzed using descriptive statistics, according to age, race, level of security and years of incarceration. Differences between treatment needs were evaluated using analysis of variance procedures and the Scheffe multiple comparison test.

Analysis of the dental delivery system within the MDOC next occurred by comparing the reported dental treatment needs of inmates, across emergent, urgent and routine levels of need, with the ability of the MDOC dental delivery system to meet these needs. This comparison is similar to the analysis performed by Barnes et al. in the Texas Department of Corrections (1988) and forms a needs-based analysis of the current dental delivery system.

As will be recalled from the data collection sheet, each inmate examination in the disease assessment portion of the current study not only listed the amount of existing disease, but also the amount of the various dental procedures needed to treat the amount of diagnosed disease in each inmate. Further, the need for fillings, extractions, dentures, root canal work or cleaning procedures were classified as to whether these needed procedures were emergency based, urgency based or, routine based. If no dental procedure was needed in a specific category, it was left blank on the survey sheet (see Appendix B).

For example, reporting that a patient had three decayed teeth does not ref-
erence the treatment needed and hence, the clinic time needed, to repair those teeth. The patient might need two 2-surface fillings and an extraction or three extractions to complete treatment. However, each has different time requirements to complete the procedure. The itemization of the needed amount and type of dental treatment procedures were summed, averaged and converted into treatment minutes, by using the relative value units used by the MDOC on Form CHJ-533 (1988). As these units are time based in the MDOC (p.56), they may be summed across all patient examinations to indicate the total time it would take to treat the amount of diagnosed dental disease.

For example, if the arithmetic mean of the study demonstrated that the average inmate in the population required .9 routine one surface amalgam restorations, this would indicate that 28,724.40 (31,916 x .9) restorations of this type were needed to treat the institutionalized male, non-camp, non-psychiatric population within the MDOC. The relative time value attributed to this procedure by the MDOC is 15 minutes. Therefore, 430,860 staff minutes (28,724 x 15), or 7,181 staff hours, would be required to meet the inmate population's need for routine one surface amalgam restorations. Similarly, all dental procedures were tallied to produce their corresponding staff time requirements.

This amount of time was then be compared to the existing availability of staff and clinic time, using the data in Table 15, to determine the portion of the need that can be met and at what treatment level (emergency, urgent or routine). The resources needed to meet inmate need were based on the presence of dental...
clinics and dental staff in the varying institutions. As all MDOC correctional facilities possess dental clinics, staffing and the hours of clinic availability became the primary determinants to meet the inmate’s dental need. However, there is a segregation of responsibilities between dentists and hygienists, particularly with respect to prioritizing care into emergency, urgent and routine care needs. Dental hygienists are predominantly routine care providers. For example, it is infrequent that an inmate requires an emergency cleaning. As dentists may clean teeth, but rarely do so in the MDOC, their availability to impact the inmate’s hygiene needs are minimal. Therefore, for the purpose of analyzing the capacity of the MDOC system to meet existing dental needs, particularly with respect to prioritization, dentists and dental hygienists are separated in this evaluation.

Table 15 demonstrates the number of existing dental positions in the MDOC. Most of these positions are filled. Each dentist and hygienist works an eight hour day, of which 6.5 hours are available to treat patients. This is because from the hours of 11:00 AM to approximately 12:30 PM the prisons take inmate counts and feed prisoners lunch; hence, inmates are not available for treatment at these times. Therefore, the availability of dental staff per week was:

\[
34.7 \text{ dentists} \times (6.5)(5) \text{ hours/week} = 1127.8 \text{ dentist hrs/week}
\]

\[
19.00 \text{ hygienists} \times (6.5)(5) \text{ hours/week} = 617.50 \text{ hygiene hrs/week}
\]

A comparison of the needed staff time requirements, across the three prioritization levels (emergent, urgent and routine), was then approached with
respect to different dental services and the actual availability of dental staff within the MDOC. These comparisons across prioritization levels were then used to assess a needs-based delivery system. The answer to this question was accomplished with a case-study method that systematically reviewed the operational variables of dental delivery. This assessment reviewed delivery with respect to improving the availability of staff, clinic time, modifying disease rates or changing the availability of the menu of services to allow for greater distribution of dental services among inmates, given a static amount of resources.
CHAPTER V

FINDINGS

Introduction

This chapter is divided into three sections based on demographics, the measurement of dental disease and a description of inmate treatment needs. The demographic section will characterize the study sample by age, race, security level and length of incarceration, as compared to the MDOC male, non-camp, non-psychiatric institutionalized population. The disease measurement section will summarize the amount of dental disease found in the inmate sample using the DMFT Index, which examines caries experience, through counting the number of decayed, missing and filled teeth in each patient. This chapter also examines periodontal findings using the PSR Index. Both the DMFT and periodontal findings are analyzed by age, race, security level and years of incarceration. Lastly, the treatment needs section will outline the amount of varying dental treatment needed by the MDOC population. A comparison will subsequently be made in this section between the amount of dental treatment needed by the inmate population and the availability of dental staffing to satisfy these treatment needs.
**Time Frame**

The data from this research was collected from November, 1995 through March, 1996 and consisted of information from 251 randomly selected, male inmates from thirteen correctional institutions. Information could not be collected on nine of the 260 originally selected inmates because of parole or transfer. The sample included inmates from minimum, medium, close, maximum and administrative segregation security levels.

**Examiner Reliability**

Thirteen facility dentists collected data for this study. The reliability of this data was obtained from a comparison of 30 randomly selected data collection sheets and a radiographic review of those sheets by this researcher. Additionally, analysis of variance and multiple comparison procedures were used to determine inter-examiner variation between sets of data from each institution. This analysis showed there were no significant differences, with respect to the disease or need data, between institutional reporting groups at the .05 level. The kappa statistic, which measures agreement between examiners in excess of that due strictly to chance, was used to compare the percentages of observed versus expected agreement between this sample of 30 data collection sheets and this researcher (the reference examiner). Values of kappa range from 0-1; probabilities greater than .5 are considered evidence of adequate examiner reliability (Cohen, 1960).
Interexaminer reliability estimates between the reference examiner and the survey examiners were excellent with respect to the numbers of decayed, missing and filled teeth. Kappa statistics ranged between .81 for decayed teeth, .96 for missing teeth and 1.00 for filled teeth. Differences between examiners on teeth being called, filled or missing were rare. Also rare were inconsistencies of a tooth having one call as missing and one as decayed or of a tooth having one call as filled and one call as missing. Differences between examiners with respect to decayed teeth were also infrequent and were confined to decay on the occlusal surface, as opposed to between the teeth. Larger differences in agreement, however, were found between examiners with respect to whether need was emergent, urgent or routine. The kappa statistic corresponding to agreement between examiners on the level of need was .58. The main difference in agreement here was between teeth diagnosed as having an emergent need and teeth diagnosed as having an urgent need.

Demographics

Among the 251 inmates surveyed, 90 were White (35.9%), 150 were Black (59.8%), and 11 were classified as "other" (4.4%). The "other" classification was comprised of 9 Hispanics (3.6%), 1 Asian (.4%), and 1 American Indian (.4%). The mean age of the study’s population was 33.1 years, while the mean age of the state’s male institutionalized population was 33.0. The average length of incarceration of the sample population was 6.4 years, as compared to 4.5 years for the
state's institutionalized population. This average for the population, however, excludes life sentences from its calculation, while the sample does not. White males comprise 41% of the state's institutionalized population and 36% of the sample population. Black males comprise 56% of the state's institutionalized population and 60% of the sample population, while the "others" race category comprised 3% of the state's institutionalized population and 4% of the sample population. A comparison of the sample and the overall institutionalized male MDOC population, with respect to race and age, is included as Table 18. Chi-square analysis indicated no statistically significant differences between the study sample and the institutionalized population based on age and racial distribution. Due to the small number of inmates in the "Other" category, statistical differences were not calculated for this group.

Table 19 is a comparison of the study sample to the MDOC institutionalized male population by security level (Michigan Department of Corrections, 1995). No significant difference was found between the two groups (p=.16). Medium security inmates form the largest percentage of inmates in the MDOC, while maximum security inmates comprised the smallest.

The years of incarceration of the sample generally increased with security level. The mean years of incarceration and the corresponding standard deviation for minimum, medium, close, maximum and administrative segregation inmates, respectively, was 5.2 (4.90) years, 5.6 (4.7) years, 7.3 (5.2) years, 11.3 (7.5) years and 9.5 (6.6) years. The mean years of incarceration by security level for the
### Table 18
Comparison of Characteristics of the Study Subjects and the Institutionalized State Male Inmate Population, July, 1995

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Study Subjects</th>
<th></th>
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<th></th>
<th></th>
<th>Institutionalized State Male Inmate Population</th>
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<td>50+</td>
<td>18</td>
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<td>2,128</td>
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<td>40-49</td>
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<td>1,334</td>
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<td>2,958</td>
<td>9.27</td>
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<td>734</td>
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<tr>
<td>Total</td>
<td>150</td>
<td>59.8</td>
<td>17,965</td>
<td>56.29</td>
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<td>Other</td>
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</tr>
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<tr>
<td>20-29</td>
<td>4</td>
<td>1.6</td>
<td>347</td>
<td>1.09</td>
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<tr>
<td>30-39</td>
<td>6</td>
<td>2.4</td>
<td>289</td>
<td>.91</td>
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<tr>
<td>40-49</td>
<td>1</td>
<td>.4</td>
<td>158</td>
<td>.50</td>
<td></td>
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<tr>
<td>50+</td>
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<td>0.0</td>
<td>60</td>
<td>.19</td>
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<tr>
<td>Total</td>
<td>11</td>
<td>4.4</td>
<td>899</td>
<td>2.83</td>
<td></td>
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<tr>
<td>Average Age in Years</td>
<td>33.14</td>
<td>33.0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Time Served in Years (mean)</td>
<td>6.4</td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

* Chi-Square = 1.37, p=.84 (not significant)
** Chi-Square = 2.20, p=.69 (not significant)
*** Chi-Square = 4.27, p=.37 (not significant)

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Table 19
Comparison of Study Sample to MDOC Male Population by Security Level

<table>
<thead>
<tr>
<th>Security Level</th>
<th>Study Subjects</th>
<th>MDOC Male Institutionalized Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Total</td>
<td>251</td>
<td>100</td>
</tr>
<tr>
<td>Minimum</td>
<td>49</td>
<td>19.5</td>
</tr>
<tr>
<td>Medium</td>
<td>120</td>
<td>47.8</td>
</tr>
<tr>
<td>Close</td>
<td>55</td>
<td>21.9</td>
</tr>
<tr>
<td>Maximum</td>
<td>9</td>
<td>3.6</td>
</tr>
<tr>
<td>Administrative</td>
<td>18</td>
<td>7.2</td>
</tr>
</tbody>
</table>

Chi-Square = 6.65, P=.16 (not significant)

The state's institutionalized population is too variable to estimate, as transfers in and out of the higher levels of security depend primarily on inmate behavior. Therefore, chi-square is not provided for length of incarceration.

Analysis of variance indicates that differences exist between security levels and the years of inmate incarceration (p=.0002). The Scheffe' multiple comparison procedure identifies these differences to be between the maximum/minimum and maximum/medium security classifications (p=.05).
The means and standard deviations for the number of decayed, missing and filled teeth for the sampled inmates, according to age and race, are indicated in Table 20. Sixteen inmates were completely without teeth or edentulous (6.4%) and one inmate had a DMFT score of zero. All were included in the analysis. The mean numbers of decayed, missing and filled teeth for all ages were 2.5, 6.4 and 6.3, respectively. The overall DMFT score was 15.2. There was a larger number of decayed teeth for blacks as opposed to the "others" category, but this was only significant at the \( p = .08 \) level. No other significant differences were found between age groups or races with respect to the number of decayed teeth. As age increased, there was a significant increase \( (p < .0005) \) in the number of missing teeth. No significant differences were found in the number of missing teeth between races. The number of filled teeth decreased between the age groups of 18-34 years and 45+ years \( (p < .05) \), and also decreased between the age groups of 35-44 and 45+ \( (p < .05) \). The composite DMFT score increased with successive age groups \( (p < .0005) \), with whites having higher DMFT scores than blacks in the 18-34 age group \( (p < .05) \).

The distribution of the DMFT index by security levels is shown in Table 21. Oneway ANOVA using the Scheffe multiple comparison procedure found no significant differences between the number of decayed, missing or filled teeth and the level of inmate security. There was also no significant difference in the
### Table 20

Mean Decayed (D), Missing (M), Filled (F) Teeth, Their Sum (DMFT) and Standard Deviation (SD) by Age and Race

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>D(SD)</th>
<th>M(SD)*</th>
<th>F(SD)**</th>
<th>DMFT(SD)***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>251</td>
<td>2.51 (3.12)</td>
<td>6.35 (7.88)</td>
<td>6.34 (4.64)</td>
<td>15.20 (8.13)</td>
</tr>
<tr>
<td><strong>Ages: 18-34</strong></td>
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<td></td>
</tr>
<tr>
<td>White</td>
<td>47</td>
<td>2.85 (3.34)</td>
<td>3.08 (2.66)</td>
<td>7.04 (4.03)</td>
<td>12.98 (6.30)</td>
</tr>
<tr>
<td>Black</td>
<td>102</td>
<td>2.26 (2.56)</td>
<td>2.73 (2.38)</td>
<td>5.82 (4.16)</td>
<td>10.81 (5.69)</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>3.17 (2.99)</td>
<td>1.83 (1.72)</td>
<td>7.17 (2.79)</td>
<td>12.16 (5.03)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>155</td>
<td>2.48 (2.83)</td>
<td>2.80 (2.45)</td>
<td>6.25 (4.10)</td>
<td>11.52 (5.91)</td>
</tr>
<tr>
<td><strong>Ages: 35-44</strong></td>
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<td></td>
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</tr>
<tr>
<td>White</td>
<td>26</td>
<td>3.19 (4.63)</td>
<td>7.42 (5.13)</td>
<td>8.46 (5.63)</td>
<td>19.07 (6.66)</td>
</tr>
<tr>
<td>Black</td>
<td>32</td>
<td>2.25 (2.39)</td>
<td>9.81 (7.92)</td>
<td>7.44 (4.68)</td>
<td>19.50 (7.01)</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>4.20 (5.12)</td>
<td>7.60 (6.62)</td>
<td>6.80 (4.60)</td>
<td>18.60 (11.06)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>63</td>
<td>2.79 (3.69)</td>
<td>8.65 (6.80)</td>
<td>7.80 (5.04)</td>
<td>19.25 (7.10)</td>
</tr>
<tr>
<td><strong>Ages: 45+</strong></td>
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</tr>
<tr>
<td>White</td>
<td>17</td>
<td>2.35 (4.21)</td>
<td>19.29 (12.85)</td>
<td>4.06 (6.44)</td>
<td>25.71 (8.27)</td>
</tr>
<tr>
<td>Black</td>
<td>16</td>
<td>1.81 (2.04)</td>
<td>17.87 (11.07)</td>
<td>3.94 (3.86)</td>
<td>23.62 (7.21)</td>
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<td>Other</td>
<td>0</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>33</td>
<td>2.09 (3.30)</td>
<td>18.61 (11.86)</td>
<td>4.00 (5.26)</td>
<td>24.70 (7.73)</td>
</tr>
</tbody>
</table>

* p<.0005 for difference between age groups
** p<.05 for difference between age groups 18-34 and 45+
*** p<.05 for difference between age groups 35-44 and 45+

**p<.0005 for differences between age groups**

Table 22 shows the distribution of the DMFT index by years of incarceration. Care should be taken in forming conclusions regarding their relationship, as years of incarceration will co-vary with age. For example, in the NHANES.
Table 21

Mean Decayed (D), Missing (M), Filled (F) Teeth, Their Sum (DMFT) and Standard Deviations (SD) by Security Level

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>D(SD)</th>
<th>M(SD)</th>
<th>F(SD)</th>
<th>DMFT(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>251</td>
<td>2.51 (3.12)</td>
<td>6.35 (7.88)</td>
<td>5.86 (4.64)</td>
<td>15.20 (8.13)</td>
</tr>
<tr>
<td>Minimum</td>
<td>49</td>
<td>2.22 (3.40)</td>
<td>8.43 (10.04)</td>
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<td>16.51 (8.87)</td>
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<tr>
<td>Medium</td>
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<td>2.44 (3.32)</td>
<td>5.97 (8.02)</td>
<td>6.03 (4.62)</td>
<td>14.44 (8.31)</td>
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<tr>
<td>Close</td>
<td>55</td>
<td>3.04 (2.46)</td>
<td>5.78 (5.05)</td>
<td>6.56 (4.84)</td>
<td>15.38 (7.43)</td>
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<tr>
<td>Maximum</td>
<td>9</td>
<td>3.78 (3.93)</td>
<td>3.11 (2.15)</td>
<td>10.22 (2.73)</td>
<td>17.11 (2.62)</td>
</tr>
<tr>
<td>Ad.Seg.</td>
<td>18</td>
<td>1.44 (1.92)</td>
<td>6.56 (8.73)</td>
<td>7.11 (4.23)</td>
<td>15.11 (8.72)</td>
</tr>
</tbody>
</table>

study (1979), decay peaked in the 18-24 year range but declined afterwards. As inmates are incarcerated longer, they get older; consequently, effects attributable to either of these conditions may be confounded. Analysis of covariance of this relationship, using age as the covariate, showed age to have a significant interaction effect with respect to the number of missing teeth (p<.001) and the composite DMFT Index (p<.0005). Therefore, no hypothesis testing will be done with respect to the number of missing teeth or the DMFT Index, as they are both affected jointly by age and the years of incarceration.

Oneway ANOVA using the Scheffe multiple comparison procedure revealed there was a significantly higher number of decayed teeth among those inmates incarcerated between 0 - 2 years and those incarcerated 10.5 - 30 years (p<.05). ANOVA also found a significant difference between the number of
Table 22

Mean Decayed (D), Missing (M), and Filled (F) Teeth
Their Sum (DMFT) and Standard Deviation by Years of Incarceration

<table>
<thead>
<tr>
<th>Years Incarcerated</th>
<th>n</th>
<th>D(SD)*</th>
<th>M(SD)</th>
<th>F(SD)**</th>
<th>DMFT(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>59</td>
<td>3.58 (4.29)</td>
<td>5.39 (7.46)</td>
<td>4.80 (3.68)</td>
<td>13.76 (7.92)</td>
</tr>
<tr>
<td>2.1-3.8</td>
<td>42</td>
<td>1.71 (2.60)</td>
<td>5.36 (8.20)</td>
<td>5.79 (4.68)</td>
<td>12.86 (8.96)</td>
</tr>
<tr>
<td>4-6</td>
<td>50</td>
<td>2.62 (2.60)</td>
<td>4.58 (5.35)</td>
<td>6.76 (5.69)</td>
<td>13.96 (7.45)</td>
</tr>
<tr>
<td>6.1-10</td>
<td>51</td>
<td>2.74 (3.07)</td>
<td>6.18 (7.54)</td>
<td>7.39 (4.09)</td>
<td>16.31 (7.50)</td>
</tr>
<tr>
<td>10.5-30</td>
<td>49</td>
<td>1.53 (1.73)</td>
<td>10.37 (9.43)</td>
<td>7.13 (4.59)</td>
<td>19.02 (7.69)</td>
</tr>
</tbody>
</table>

* p=.01 for difference between 0-2 years and 10.5-30 years incarceration
** p=.01 for difference between the number of filled teeth and the years of incarceration

filled teeth and the years of incarceration (p=.01), but the Scheffe multiple comparison procedure did not find any of the differences between the given years of incarceration categories to be significant amongst themselves at the p<.05 level.

Periodontal Disease

The number and percentages of sextants demonstrating varying levels of PSR scores, by age and race, are described in Table 23. Chi-square analysis suggests there is a relationship between age and the level of periodontal disease in the sampled inmates (p<.0005). However, care must be taken here to recognize that the identification of a relationship through chi-square analysis does not
Table 23
Periodontal Status: Number and Percentage of PSR Sextants by Age and Race

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Normal (PSR=0)</th>
<th>Bone Loss (PSR=1)</th>
<th>Visible Calculus (PSR=2)</th>
<th>3.5-5.5mm Bone Loss (PSR=3)</th>
<th>&gt;5.5mm Bone Loss (PSR=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>18-34</td>
<td>930</td>
<td>153</td>
<td>292</td>
<td>31.4</td>
<td>232</td>
</tr>
<tr>
<td>35-44</td>
<td>347</td>
<td>32</td>
<td>52</td>
<td>14.9</td>
<td>76</td>
</tr>
<tr>
<td>45+</td>
<td>108</td>
<td>6</td>
<td>8</td>
<td>7.4</td>
<td>28</td>
</tr>
</tbody>
</table>

Race:

<table>
<thead>
<tr>
<th>Race</th>
<th>Normal (PSR=0)</th>
<th>Bone Loss (PSR=1)</th>
<th>Visible Calculus (PSR=2)</th>
<th>3.5-5.5mm Bone Loss (PSR=3)</th>
<th>&gt;5.5mm Bone Loss (PSR=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>White</td>
<td>481</td>
<td>85</td>
<td>128</td>
<td>26.6</td>
<td>121</td>
</tr>
<tr>
<td>Black</td>
<td>838</td>
<td>91</td>
<td>211</td>
<td>25.2</td>
<td>196</td>
</tr>
<tr>
<td>Other</td>
<td>66</td>
<td>15</td>
<td>13</td>
<td>19.7</td>
<td>19</td>
</tr>
<tr>
<td>All</td>
<td>1385</td>
<td>191</td>
<td>352</td>
<td>25.4</td>
<td>336</td>
</tr>
</tbody>
</table>

* Chi-Square = 151.11, df=8, significant at p<.0005 for relationship between age and PSR score
** Chi-Square = 37.49, df=8, significant at p<.0005 for relationship between race and PSR scores

The age group demonstrating the best periodontal health, as measured by the number of sextants with a PSR score equal to zero, was the 18-34 group. Additionally, younger age groups were seen to have less moderate and severe bone loss than older age groups. The most advanced periodontal disease, as measured by the number of sextants with a PSR score equal to four, was observed in the age group 45 years and older.
Chi-square analysis also suggests a relationship between race and the level of periodontal disease \((p<.0005)\). Whites and the "other" category differed from blacks in having a higher percentage of sextants diagnosed as normal, as indicated by a PSR score of zero. Blacks had a higher percentage of sextants than whites diagnosed with moderate periodontal disease, or a PSR score of three.

Table 24 is a comparison of PSR scores with the level of security. A relationship exists between these variables \((p<.0005)\). Again, causality cannot be assumed. In fact, the lambda statistic, which tells the reduction in error in predicting the dependent variable, when the independent variable is known, is only .07. This means the level of security is of little help in predicting what the PSR

Table 24

<table>
<thead>
<tr>
<th>Security Level*</th>
<th>N</th>
<th>Bleeding &lt;3mm</th>
<th>Visible Bone Loss</th>
<th>3.5-5.5mm</th>
<th>&gt;5.5mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal (PSR=0)</td>
<td>Bone Loss (PSR=1)</td>
<td>Calculus (PSR=2)</td>
<td>Bone Loss (PSR=3)</td>
</tr>
<tr>
<td>Minimum</td>
<td>248</td>
<td>40 16.1</td>
<td>76 30.7</td>
<td>50 20.2</td>
<td>48 19.4</td>
</tr>
<tr>
<td>Medium</td>
<td>665</td>
<td>103 15.5</td>
<td>189 28.4</td>
<td>144 21.7</td>
<td>159 23.9</td>
</tr>
<tr>
<td>Close</td>
<td>321</td>
<td>31 9.7</td>
<td>51 15.9</td>
<td>119 37.1</td>
<td>103 32.1</td>
</tr>
<tr>
<td>Maximum</td>
<td>54</td>
<td>0 0</td>
<td>4 7.4</td>
<td>13 24.1</td>
<td>17 31.5</td>
</tr>
<tr>
<td>Ad.Seg.</td>
<td>97</td>
<td>17 17.5</td>
<td>32 33.0</td>
<td>10 10.3</td>
<td>30 30.9</td>
</tr>
<tr>
<td>All</td>
<td>1385</td>
<td>191 13.8</td>
<td>352 25.4</td>
<td>336 24.3</td>
<td>357 25.8</td>
</tr>
</tbody>
</table>

* Chi-square = 161.45, df=16, significant at the \(p<.0005\) for relationship between level of security and PSR scores

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scores will be.

Comparison of Present Findings to Other Studies

In order to place the present findings in context, they are compared here to the findings of other dental disease studies, both inside and outside of the correctional setting. However, there are inherent drawbacks in making such comparisons. The most severe drawback stems from the degree to which the samples from the other studies are representative of the present study. Inmates come from an institutionalized environment, while adults employed in the civilian labor force, for example, do not. This generates selection bias with respect to various sampling factors such as income, employment and geographic location. Another drawback is the lack of consistency between age categories in different studies. Consequently, findings are difficult to interpret. Nevertheless, the sampled inmates in the present study did come from the larger general population prior to incarceration, and comparison to the general population, therefore, is relevant.

The present findings from the MDOC are compared in Table 25 to findings from the general population through the 1971-74 National Health and Nutrition Examination Survey (NHANES) and the 1985-86 National Survey of Oral Health in US Employed Adults and Seniors at various age categories. The comparison shows that the amount of decayed teeth in the MDOC appears larger than that of the general population (NHANES) and has a higher percentage of unmet restorative need (%D/DFT), as judged against the U.S. Employed Adults
Table 25

Comparison of Mean Decayed (D), Missing (M), Filled (F), DMFT and Percent of Decayed to Decayed and Filled Teeth (%D/DFT) for the Present Study and Other Studies

<table>
<thead>
<tr>
<th></th>
<th>Decayed Teeth</th>
<th>Missing Teeth</th>
<th>Filled Teeth</th>
<th>DMFT</th>
<th>%D/DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men: All ages and races</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NHANES*</td>
<td>1.3</td>
<td>10.4</td>
<td>6.8</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td>US Employed**</td>
<td>2.5</td>
<td>6.4</td>
<td>6.3</td>
<td>15.2</td>
<td>28.3</td>
</tr>
<tr>
<td>MDOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages 35-44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NHANES</td>
<td>1.2</td>
<td>8.4</td>
<td>8.8</td>
<td>18.4</td>
<td></td>
</tr>
<tr>
<td>Mixson et al.</td>
<td>2.3</td>
<td>8.0</td>
<td>6.2</td>
<td>16.4</td>
<td></td>
</tr>
<tr>
<td>MDOC</td>
<td>2.8</td>
<td>8.7</td>
<td>7.8</td>
<td>19.3</td>
<td></td>
</tr>
<tr>
<td>Ages 45+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salive et al.</td>
<td>2.5</td>
<td>16.7</td>
<td>3.3</td>
<td>22.4</td>
<td></td>
</tr>
<tr>
<td>Mixson et al.</td>
<td>1.5</td>
<td>14.0</td>
<td>6.6</td>
<td>22.1</td>
<td></td>
</tr>
<tr>
<td>MDOC</td>
<td>2.1</td>
<td>18.6</td>
<td>4.0</td>
<td>24.7</td>
<td></td>
</tr>
</tbody>
</table>


Survey. The DMFT, however, is larger in the NHANES study, than in the present study, due to a larger difference in the number of missing teeth.

Within correctional settings, comparability of the present study was made
against the Salive et al. (1989) and Mixson et al. (1990) studies because these studies, unlike other correctional studies, utilize randomized sampling designs and multiple age and racial groupings. As compared to these studies, the present study is consistent with respect to increases in the number of missing teeth and the total DMFT index as age increases. The present MDOC study confirms neither white inmates having fewer decayed teeth than black inmates, in the 18-34 age group, nor white inmates having a significantly higher number of filled teeth. All three studies, however, report an inverse relationship between the number of decayed teeth and the years of incarceration (not shown in Table 25).

Periodontally, the present study and the two national studies listed above are comparable only in terms of the percent distribution of the presence or absence of disease. In the NHANES study, 53.7 percent of the males had no periodontal disease, while in the present study, 13.8 percent of inmates were diagnosed as periodontally normal. This comparison is biased, however, because it is inclusive of the age group 6-18, which routinely has low amounts of periodontal disease. A better comparison for this reason is with U.S. employed adults. In this study, the age groups are between 20-64 years, making it closer to the present study. The difference between these studies is striking with respect to the percentage of persons with greater than four millimeters of bone loss. In the employed adults study, 20.5 percent of persons had greater than four millimeters of bone loss, compared to 36.8 percent for MDOC inmates.
Treatment Needs

This section outlines the amount of varying dental treatment needed by the MDOC inmate population. Treatment needs were sorted first by the varying dental services the inmate needed. These services were: silver fillings (amalgams), resin fillings, plastic or steel crowns, simple extractions, impacted wisdom tooth extractions, root canals, partial dentures, full dentures, routine teeth cleaning and advanced teeth cleanings. The filling categories, for amalgams or resins, were subcategorized by the number of surfaces needed to restore the tooth. Lastly, each of these services were arranged into emergency, urgent and routine treatment needs. Emergency treatment needs were defined as those which must be provided immediately. Urgent treatment needs should be performed within six months of diagnosis, while routine treatment needs may take up to a year to be accomplished, without jeopardizing the patient's health or dentition.

Table 26 shows the number and percentages of sampled inmates who need various types of dental services. The procedures are also sub-divided by the priority of the service which is needed, either emergent, urgent or routine. The "Total" column represents the total number of inmates who need a particular level of service. Sometimes the column is not additive of the preceding columns because an inmate may need both emergency and routine services, but in the totals column this individual is only listed once.

Table 27 in Appendix C displays the mean for each needed dental
Table 26

Number and Percentages of Sampled Inmates Needing Various Priorities of Basic Treatments (n = 251)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Emergency</th>
<th>Urgency</th>
<th>Routine</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amalgam 1-surface</td>
<td>5 (1.9%)</td>
<td>10 (4.0%)</td>
<td>115 (45.8%)</td>
<td>115 (45.8%)</td>
</tr>
<tr>
<td>Amalgam 2-surface</td>
<td>4 (1.6%)</td>
<td>14 (5.6%)</td>
<td>68 (27.1%)</td>
<td>80 (31.8%)</td>
</tr>
<tr>
<td>Amalgam 3-surface</td>
<td>1 (0.4%)</td>
<td>11 (4.4%)</td>
<td>15 (6.0%)</td>
<td>26 (10.3%)</td>
</tr>
<tr>
<td>Amalgam 4-surface</td>
<td>0</td>
<td>6 (2.4%)</td>
<td>5 (1.9%)</td>
<td>11 (4.4%)</td>
</tr>
<tr>
<td>Amalgam 5-surface</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Resin 1-surface</td>
<td>0</td>
<td>2 (0.8%)</td>
<td>18 (7.2%)</td>
<td>19 (7.6%)</td>
</tr>
<tr>
<td>Resin 2-surface</td>
<td>0</td>
<td>0</td>
<td>18 (7.2%)</td>
<td>18 (7.2%)</td>
</tr>
<tr>
<td>Resin 3-surface</td>
<td>0</td>
<td>4 (1.6%)</td>
<td>7 (2.8%)</td>
<td>11 (4.4%)</td>
</tr>
<tr>
<td>Resin 4-surface</td>
<td>1 (0.4%)</td>
<td>4 (1.6%)</td>
<td>1 (0.4%)</td>
<td>6 (2.4%)</td>
</tr>
<tr>
<td>Resin 5-surface</td>
<td>0</td>
<td>0</td>
<td>1 (0.4%)</td>
<td>1 (0.4%)</td>
</tr>
<tr>
<td>Extractions</td>
<td>7 (2.8%)</td>
<td>13 (5.2%)</td>
<td>16 (6.4%)</td>
<td>32 (12.8%)</td>
</tr>
<tr>
<td>Impacted Extractions</td>
<td>0</td>
<td>3 (1.2%)</td>
<td>10 (4.0%)</td>
<td>13 (5.2%)</td>
</tr>
<tr>
<td>Root canal</td>
<td>2 (0.8%)</td>
<td>1 (0.4%)</td>
<td>1 (0.4%)</td>
<td>4 (1.6%)</td>
</tr>
<tr>
<td>Partial Dentures</td>
<td>0</td>
<td>0</td>
<td>43 (17.1%)</td>
<td>43 (17.1%)</td>
</tr>
<tr>
<td>Full Dentures</td>
<td>0</td>
<td>0</td>
<td>23 (9.2%)</td>
<td>23 (9.2%)</td>
</tr>
<tr>
<td>Plastic Crowns</td>
<td>0</td>
<td>0</td>
<td>1 (0.4%)</td>
<td>1 (0.4%)</td>
</tr>
<tr>
<td>Regular Prophy</td>
<td>0</td>
<td>0</td>
<td>130 (51.8%)</td>
<td>130 (51.8%)</td>
</tr>
<tr>
<td>Perio Prophy</td>
<td>0</td>
<td>0</td>
<td>105 (41.8%)</td>
<td>105 (41.8%)</td>
</tr>
</tbody>
</table>
service according to the age and race of the sampled inmates. One-way ANOVA using the Scheffe multiple comparison procedure indicated there were no significant differences between any of the overall emergency service needs with respect to age and race. The same analysis procedures found a significant difference (p=.05) for overall urgent treatment needs with respect to race. The "others" category, Hispanics, Asian, and American Indian, had a higher need for the urgent priority of extractions than did Whites or Blacks. No differences were found for overall urgent treatment needs with respect to age. For overall routine treatment needs, no significant differences were found for age and race at the .05 level of significance.

The "Sample" column in Table 27 is also useful in demonstrating the services most frequently needed by inmates at each level of service. For example, it is easy to see that the largest service provided to inmates on an emergency and urgent basis is extractions. On the routine level of care, extractions are overshadowed by restorative needs, such as fillings and prosthetic needs. Additionally, hygiene service needs, shown under routine and regular prophies, also have a high level of inmate need.

Table 28 in Appendix C shows the means and overall standard deviations of inmate treatment needs by years of incarceration. One-way ANOVA and the Scheffe multiple comparison method did not reveal significant differences between the need for emergent or urgent services due to the years of incarceration. However, with respect to the need for overall routine services, inmates incarcerated
0-2 years had a higher need for these routine services than those incarcerated 2.1 - 3.8 years ($p=.02$). Table 29 in Appendix C shows the means and overall standard deviations of inmate treatment needs by security levels. One-way ANOVA and the Scheffe multiple comparison method indicated no significant differences between the need for overall emergent, urgent or routine dental services and the level of security.

A description of the inmates treatment needs, by age, race, years of incarceration and security levels is shown in Tables 27, 28 and 29. In order to treat these needs, the time required by dental providers within the MDOC to meet the emergent, urgent and routine service needs of this inmate population is calculated in Table 30 (see Appendix C). This table was constructed using the mean value of each dental service observed to be needed by the inmate population and the time it takes to complete each procedure, as currently defined by the Michigan Department of Corrections (see Table 14). The number of minutes required to service the inmate population is calculated by multiplying the inmate population by the mean of the service required and the number of minutes it took to perform the service. For example, the study determined that the average number of emergency extractions required by the 31,916 inmate population is .14 emergency extractions per inmate. As it takes 22.5 minutes of chairtime to perform this task, the total number of minutes to service the entire inmate population is 100,535.4 minutes or, 1,675.6 hours. Similarly, urgent, routine and hygiene treatment needs are calculated for each dental procedure.
The number of provider hours needed to meet the inmate population's treatment needs is estimated in Table 30. The ability of the current MDOC system to meet this need, with respect to the availability of dental providers, is shown in Table 31. This table provides a comparison of the hours needed to treat the inmate population at each level of service (i.e., emergency, urgency or routine needs) to the availability of dental staff per year.

The availability of dental staff within the MDOC is equal to the number of providers, dentists or dental hygienists multiplied by their hours worked. Table 15 shows the number of dental staff within the MDOC. The hours worked per day by dental staff within this correctional setting is 6.5 hours per day, not 8 hours. This is because 1.5 hours per day are lost to inmate counts and feeding.

### Table 31

**Comparison of Dental Need to Dental Staffing by Level of Treatment Needed**

<table>
<thead>
<tr>
<th>Level</th>
<th>Dentist</th>
<th></th>
<th>Dental Hygienist</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hours Needed (hours)</td>
<td>Difference (hours)</td>
<td>Hours Needed (hours)</td>
</tr>
<tr>
<td>-Emergency Only</td>
<td>2,672.9</td>
<td>56,387.5</td>
<td>53,714.6</td>
<td></td>
</tr>
<tr>
<td>-Urgent Only</td>
<td>8,231.7</td>
<td>56,387.5</td>
<td>48,155.8</td>
<td></td>
</tr>
<tr>
<td>-Routine Only</td>
<td>62,395.8</td>
<td>56,387.5</td>
<td>-6,008.3</td>
<td>59,416.9</td>
</tr>
<tr>
<td>-Total (emergent+urgent+routine)</td>
<td>73,300.4</td>
<td>56,387.5</td>
<td>-16,912.9</td>
<td></td>
</tr>
</tbody>
</table>
During these times, inmates are not available to be treated in the dental clinic. The availability of dental staff, therefore, is calculated by multiplying the number of dentists and dental hygienists given in Table 15 by 6.5 hours per day, times 5 days per week, times 50 weeks per year. This calculation would give close to the upper limit of staff availability, as additional sick time, vacation time and holidays are not considered in the assumption of 50 work weeks per year. The actual number of work weeks could very likely be less.

Table 31 segregates the responsibilities of dentists and hygienists, particularly with respect to the prioritizing of dental care into emergency, urgent and routine care needs. Dental hygienists are predominantly routine care providers. For example, it is infrequent that an inmate requires an emergency cleaning. Dentists may clean teeth, but rarely do so in the MDOC because of other treatment priorities. Their availability to impact the inmate’s hygiene needs is thus minimal. Therefore, for the purpose of analyzing the capacity of the MDOC system to meet existing dental needs, particularly with respect to prioritization, dentists and dental hygienists are separated in this evaluation.

It is clear from the Total row in Table 31 that there are not enough dentist staff hours to care for the combined emergency, urgency and routine care needs of inmates. The "Difference" columns in Table 31 demonstrates that there is more than adequate dentist staff to treat separate or combined emergency and urgent dental conditions of inmates, as these rows have high positive numbers. However, the negative difference in the routine treatment row indicates there is
not enough staff time to provide all of the routine dentist or hygienist care that is needed by inmates in this population.

Summary of Findings

The 251 inmates in the study sample were comparable with respect to age, race and distribution of security levels to the State’s male inmate population. The mean age of the study sample was 33.14 years and the mean length of incarceration was 6.37 years. Medium security inmates comprised the largest percentage of the MDOC population and the sample, while maximum security inmates made up the smallest percentages. Maximum security inmates in the sample, not surprisingly, were found to have been incarcerated longer than minimum and medium security inmates. No relationship was found between security level and age or race.

The mean number of decayed, missing and filled teeth, for all ages and races in the sample, was 2.51, 6.35, and 6.34 teeth, respectively. The composite DMFT score for all ages and races in the sample was 15.20. The sample was partitioned into three age groups for analysis, 18-34 years, 35-44 years and 45 years and older, in an attempt to supply continuity with the age breakdowns of the most recent study on this topic by Mixson et al. (1990). However, this study is also inclusive of some age groupings in other studies, such as in the NHANES study (1979) where the 35-44 age grouping is included, and the study by Salive et al. (1989), where the 45 years and above category was included. Lastly, the three age
partitions were stratified by race into whites, blacks and others. The "others" category included Hispanics, Asians and American Indians.

The study found no difference in the number of decayed teeth with respect to age and race. There were significant increases in the number of missing teeth with advancing age, but no such findings were evident between races in the same age group. The number of filled teeth decreased between the two age groups of 18 - 34 years and 35 - 44 years, and the age group of 45 years and older. The composite DMFT score increased with age; however, no significant differences were found in the DMFT score with race. Whites had a higher DMFT score than blacks in the 18 - 34 age group. Maximum security inmates had fewer missing teeth than minimum security inmates and medium security inmates had a lower composite DMFT score than maximum security inmates. Inmates incarcerated between 0 - 2 years had more decayed teeth than those incarcerated 10.5 - 30 years. Inmates incarcerated between 6.1 - 10 years had a higher number of filled teeth, than those incarcerated 0 - 2 years. As the number of decayed teeth trended downward with years of incarceration, there was a corresponding increase in the number of filled and missing teeth.

Periodontally, younger age groups had less moderate and severe periodontal disease than older age groups. Correspondingly, the age group 18 - 34 was diagnosed as having the best periodontal health, while the 45 years and older age group had the highest amount of advanced periodontal disease. Blacks had a higher prevalence than whites of moderate periodontal disease. Lastly, a relationship was found to exist between the level of security and PSR scores; however, the
strength and nature of the relationship is weak, as measured by the lambda statistic.

Table 32 provides a summary of the significant findings, with respect to the DMFT and PSR Indices and the demographic variables of age, race, security level and length of incarceration. Finally, the treatment needs section of the Findings demonstrates that the present Michigan Department of Corrections dental staffing is adequate to take care of the emergency and urgency needs of the inmate population. However, it is neither adequate to handle all of the inmate population's routine dental needs, nor, is it adequate to handle the population's hygiene needs.

Table 32
Summary of Significant Findings

<table>
<thead>
<tr>
<th>Number Decayed Teeth</th>
<th>Number Missing Teeth</th>
<th>Number Filled Teeth</th>
<th>Periodontal DMFT Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>increase with age</td>
<td>decrease with age</td>
<td>increase with age</td>
</tr>
<tr>
<td></td>
<td>18-34&gt;45+</td>
<td>35-44&gt;45+</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td>whites&gt;</td>
<td>blacks&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>blacks</td>
<td>whites</td>
</tr>
<tr>
<td>Security Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of Incarceration (years)</td>
<td>0-2&gt;</td>
<td>6.1-10&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.5-30</td>
<td>0-2</td>
<td></td>
</tr>
</tbody>
</table>

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CHAPTER VI

ACTIONABLE FINDINGS

The purpose of this research is to document the amount of dental disease of male inmates in the Michigan Department of Corrections (MDOC) and to use this information to formulate policy for the delivery of dental services in Michigan and possibly other state prison systems. This research is grounded on the assumption that the present dental service delivery system in the MDOC cannot address the dental needs of the inmate population, if it does not know what they are. However, most studies that measured dental disease in a correctional setting are anecdotal or use only convenience samples to obtain information. The absence of sound information with which to plan necessarily results in broad-banded administrative methods.

The primary purpose of this chapter is to identify findings from the data reported in Chapter V that could improve the design and operation of dental services in the Michigan Department of Corrections. These "actionable" findings could then be used to recommend strategies that would allow administrative systems to parallel clinical necessities.

Actionable Findings

Actionable findings are findings that may be used to alter the design and
operation of administrative systems. For example, in the present study, the fact that the number of filled teeth decreased between the age groups of 18 - 34 and 45 years and over is of epidemiological significance, but it is not of actionable significance. Changes in policy or procedure are not going to be generated from this descriptive finding. In contrast, the discrepancy between the inmate population’s dental needs and the availability of dental staff (Table 31) may be used to suggest changes in policy and procedure, and therefore becomes actionable. The present study suggests six actionable findings:

1. Routine dental service needs is the level of service most required by the inmate population. This is true when the population is compared by age, race, security level and years of incarceration (Tables 27, 28 and 29).

2. While there is enough dental staff to treat all of the inmate population’s emergency and urgent dental needs, there is not enough dental staff to accommodate all of the inmate’s routine dental care needs (Table 31).

3. There is a high percentage of unmet restorative need (%D/DFT), particularly with respect to routine one and two surface amalgams (Table 25).

4. Prosthetic services account for 32 percent of the hours needed to treat the inmate population’s routine dental care needs (Table 30).

5. Inmates incarcerated 0 - 2 years had a higher mean amount of decay than inmates incarcerated either 2.1 - 3.8 years or 10.5 - 30 years (Table 22). This contributes to the difference observed in the overall routine treatment needs between inmates incarcerated 0 -2 years and 2.1 -3.8 years (Table 28).
6. Periodontal disease increases with age in this population and the available number of hours to provide hygiene services to inmates is inadequate (Tables 23 and 31).

Analysis of Actionable Findings

The six actionable findings cannot be viewed as being mutually exclusive or discrete. Instead, they are interwoven. As none of these findings are currently acted upon within the MDOC, analyses or recommendations involving one finding will necessarily affect others to a high degree. There are several structural givens, however, that must be mentioned prior to the development of recommendations affecting the design and operation of the MDOC dental clinics. Namely, the organizational structure, the number of staff and the physical layout (i.e., clinic space and equipment) of the dental clinics cannot be used to address these findings. Budgetary constraints will not allow alteration of staffing levels, the addition of clinic space, or significant equipment purchases in any practical sense. Further, as the MDOC recently completed a reorganization of its administrative functions to a regionalized structure, the suggestion of new changes to this structure was likely to be seen as untimely. Therefore, recommendations involving the actionable findings must be predominantly programmatic, if they are to be implemented.

The key finding of the present research is that although present dental staffing levels can meet the emergency and urgent dental care needs of the inmate population, the staff cannot also meet all of their routine dental care needs. This
finding is complemented by a corresponding finding of a large percentage of unmet restorative need (%D/DFT). Both of these findings underscore potential access deficiencies for routine dental care throughout the MDOC dental care system.

For inmates, unlike the general public, health care is a right, not a privilege. This is based on the Eighth Amendment to the United States Constitution, which guards against "cruel and unusual punishment". However, this amendment neither implies, nor do the Courts stipulate, the methods by which compliance must be attained. Therefore, correctional departments have the leeway to create their own operating systems, as long as they can demonstrate that the inmate's rights have not been violated.

Within the Dental Services Division of the Michigan Department of Corrections, as with all of health care, there is no difference in eligibility for services based on any of the demographic variables of the present study. All inmates are entitled to all services simply by asking. The only current restrictions to dental care in the MDOC pertains to types of dental care and services. Dental treatment is prioritized according to emergent and urgent needs, i.e., emergent and urgent services are treated before routine services. Further, crowns, fixed bridges, orthodontic treatment, implants and periodontal surgery are not provided for residents. As a result of these few restrictions, demand for routine services is relentless and controlled on the basis of a first-come, first-served rationale. Unfortunately, this rationale creates perpetual difficulties for dental clinics which must
serve an inmate population that not only is inherently impatient, but demonstrates higher amounts of dental disease than the general public.

The current dental policy and procedures do not take into account any differences in the need for dental treatment. Instead, all inmates, regardless of custody level or length of incarceration, are assumed to have the same dental needs. The fact is, however, they do not. The result of these broad-banded policies create situations where, for example, prosthetic services account for 32 percent of the hours needed to treat the inmate population's routine care needs. This translates conservatively into 19,761 hours or 9.5 full time equivalent dentist positions. This estimate is conservative, though, since it does not take into account denture repairs, relines and bite splints. The current restrictions on the fabrication of partial and full dentures are simply that: (a) inmates having less than six back teeth may be in occlusion to fabricate partial dentures; (b) the inmate is totally edentulous for full dentures; and (c) the prosthesis will be constructed only once in every five year period at the State's expense, unless extenuating circumstances can be shown. There is no cost to the inmate for the construction of dentures or partial dentures unless they are willfully destroyed by the inmate.

From Table 20, it is apparent that the number of missing teeth in the inmate population increases markedly with age. Further, the median age of the inmate population is getting progressively higher (French, 1996). This means the number of inmates needing prosthetic services will increase. Given these data, even if the present dental resources could meet a large portion of this need in a
timely fashion, in the future, it will become increasingly difficult to sustain this level of service.

As stated earlier, the key finding from the present study is the lack of enough dental staff hours to provide routine dental services to inmates, despite expectations of inmates to the contrary. However, the timely delivery of routine services in the present system depends on the levels of emergent or urgent dental care needs, as these must be addressed before routine services.

Figure 2 provides a flow chart of the process of accessing routine versus emergency dental services within the Michigan Department of Corrections. This flowchart was formulated from MDOC Policy OP-DWA 64.02. From this diagram, it is apparent that dental work may be attained faster through the emergent route.

Inmates entering the correctional system have high amounts of dental decay. Tables 22 indicate inmates incarcerated 0-2 years had a high mean number of decayed teeth. Correspondingly, Table 28 demonstrates a high need for routine services for inmates incarcerated 0-2 years, as opposed to those incarcerated 2.1 - 3.8 years. Correctional system may provide inmates with their first real opportunity to attain professional dental care. Consequently, when given the chance, these inmates want to obtain as much dental care as they can, as quickly as possible. As inmates receive routine services in the order they request care, per the MDOC Dental Services Policy 4.05.150, chronological waiting lists are created. To circumvent these waiting lists, one tactic is to claim a succession of
ACCESSING DENTAL CARE

Inmate fills out Health Care Request Form CHR-549 (kite)

All kites forwarded to Health Care Services

All kites sorted by Nursing to respective disciplines

Dental Clinic receives kite

Kite receipt - Recorded into Logbook

Inmates health care record pulled

Kite recorded onto Dental Treatment Sheet

Determine if Dental Emergency

Yes

Advises inmate of action taken on kite

Schedules inmate into Dental Clinic ASAP

Return answered kite to inmate

No

Places on appropriate Dental waiting list as of date of kite

Advises inmate of action taken on kite

Schedules inmate to Dental Clinic in order name appears on waiting list

Return answered kite to inmate

Inmate arrives in Dental Clinic

Dentist performs Emergency

Figure 2. Flow Chart for Accessing Routine Versus Emergency Dental Services.
dental emergencies. By doing this, dental care is obtained in a more timely fashion, but at the expense of inmates who have been incarcerated longer.

A possible solution to addressing their needs would be to prioritize the treatment of emergent and urgent dental conditions upon entry into the correctional system at the Reception Centers. This would reduce emergency visits at dental clinics throughout the State and enhance the provision of routine dental services at these clinics. However, to do this, dental clinics and staff would have to be added to the Reception Centers and this is not likely. Therefore, since emergent and urgent dental care needs cannot be prioritized at the Reception Centers, they should become exclusive priorities at the correctional institutions for inmates just entering the system. Restricting dental services to inmates incarcerated 0 - 2 years to emergent services only would allow more staff availability to address the routine treatment needs of inmates in the State’s care for longer periods of time.

Lastly, the present study shows that periodontal disease increases with age (Table 24). This is consistent with other correctional and non-correctional studies. Unfortunately, the Michigan Department of Correction’s clientele is also getting older as a group. Even worse, the critical number of dental staff needed to provide hygiene services to the inmate population is missing. Further, as the inmate population ages, the need for more aggressive periodontal therapy will increase. This is a source for problems in the future. Not only can the present system not meet the current inmate needs, but the need is going to get worse as the population ages.
CHAPTER VII

RECOMMENDATIONS AND CONCLUSIONS

It is clear that any suggestion for improving the delivery of correctional dental care which is based purely on the expansion of scarce resources is optimistic. Recommendations for improvement must be formulated which target the structural elements of the program, rather than its fluctuations in funding. Certainly, funding is a structural element of any program; however, it is neither to the administrator’s advantage, nor to that of the program’s beneficiaries, to rely primarily on funding improvements, without also examining commensurate changes in structure. To that end, recommendations based on the aforementioned actionable findings are grouped into two large potential areas of control: (1) Utilization Controls, and (2) Benefit Limitations.

Utilization Controls

In order to modify an inmate’s access to health care, treatment protocols must be established that not only limit the unnecessary use of the health care system, but also begin to develop some sense of accountability of the patient for his or her own well-being. Dental care in the Michigan Department of Corrections is price inelastic, i.e., demand by the inmate is not affected by the cost of the service. The lack of fees associated with a visit makes overuse even more
appealing. Dental care is a benefit of incarceration for inmates. Additionally, this study has shown that inmates incarcerated for lesser periods of time have higher routine dental care needs.

A recommendation that would diminish utilization is to restrict eligibility for routine dental care. Since the present dental delivery system cannot provide all of the inmate population’s routine dental care needs, the system should prioritize the dental care of inmates who have longer periods of incarceration to serve. Emergent and urgent treatment would still be prioritized over routine care in all instances. Beyond those considerations, however, the proposed prioritization would allow the current dental program to focus its resources on inmates who would be with the Department longer, which would give the Department a bigger bang for the buck in the long run. Shorter term inmates would then become financially accountable for their own dental care on release, which in effect removes total dentistry service as a benefit of short-term incarceration. Additionally, eligibility for routine dental services should be restricted based on the inmate’s compliance to oral hygiene instruction, i.e., if inmates desire routine dental care, they should demonstrate the initiative to take proper care of their mouths.

The specific proposals to address eligibility are:

1. Inmates should receive only emergency-based dental care during their first year of incarceration.

2. Inmates should receive only emergency-based dental care during their
last six months of incarceration.

3. Inmates who continually demonstrate poor oral hygiene should be eligible for only emergency dental services.

Benefit Limitations

Creating stricter protocols for dental procedures which take more time to perform increases the availability of staff to treat other patients. Dental procedures, such as root canals and partial denture construction, are arduous, often take more than one appointment and sometimes, depending on the provider, are not successful. Implementing limitations, with respect to case selection, is important in enhancing available clinic time and offsetting a portion of the costs of providing such services. As prosthetics accounts for 32 percent of the hours needed by the population for routine care, it is an ideal candidate for restriction. The specific proposals to address benefit limitations are:

1. **Tighten Prosthetic Guidelines.** Partial dentures should be made strictly for function, not aesthetics. Prosthetic criteria should be adopted, which state that one or two teeth anterior partial dentures should not be made. The construction of prosthetics should not begin if the inmate has less than six months to serve on his or her sentence. Inmates should bear some portion of the cost of denture construction

2. **Prior Approval through a Peer Review Committee.** A final step toward stricter protocols for dental procedures would be to require that prior approval
be obtained through a statewide correctional service review committee, before more sophisticated dental procedures are rendered.

Limitations of the Study

The limitations of this study begin with the difficulty in making comparisons between the state's inmate population and the general public. This comes from selection biases, as the two populations have differing socioeconomic levels and health histories (Raba & Orbis, 1983). This study also did not include camp inmates. Consequently, the measurement of dental disease might change with their inclusion.

In addition, the present study cannot discount treatment effects which result from the present Dental Services Department doing its job. This could be particularly evident for inmates incarcerated over a period of years. Incarceration might have an effect on the amount of measured dental disease. Also, diagnosis of emergency dental treatment need in the study is based solely on the judgement of the dentist, not the perception of the inmate. Often, however, inmates will send a health care request complaining of an emergency dental situation. This situation may or may not be a true dental emergency in the eyes of the dentist, but it is to the inmate. However, such patient-initiated emergency complaints are not measured in this study.

Another limitation to the present study is that the sample mean is used as though it were the population mean in the treatment needs section. The listed
means in the treatment needs section are actually sample means within a predetermined confidence interval. Even though the sample was designed with a 95% confidence limit and a 5% tolerable error, the distribution of this data is positively skewed as a result of the large number of inmates not needing any of the individual dental services (Table 27). Therefore, only the mean was used in the projections made in Table 30 because calculating confidence intervals for each individual service would have been too confusing to the reader. Limitations also exist due to the time period of the study's results. As noted above, the median age of the State's institutionalized population is rising (State of Michigan, 1994). Many of the findings, particularly those relating to periodontal disease and missing teeth, will change as the inmate population gets older.

Suggestions for Future Research

The present study cannot discount treatment effects. A longitudinal intake study that identified inmates on admission and followed their dental health and treatment over a period of years would solve this problem. This study design could define the evolution of present and future dental needs within the Department. Other studies of potential interest could appraise the utilization of dental services by security level, length of incarceration and time until release. However, it is studies concerning the impact of preventive programs on dental disease in correctional settings that represent the next generation of research on this topic—specifically, the effects of topical fluoride application on inmate dental disease.
A Final Word

The problem with dentistry, in a public or private setting, is that a prescription does not cure a dental problem. Dental providers must physically intervene in the disease process to promote resolution. Because of the physical nature of this intervention, and the fact that interventions come singularly, one tooth at a time, more time is required to treat dental disease.

It is clear from this study and others that inmates have higher amounts of dental decay and periodontal disease than the general population. When this level of disease is superimposed on finite dental resources, the probability of meeting all emergent and urgent dental needs seems good. However, the probability of meeting all routine dental needs is slim. Yet, there is an expectation by a demanding inmate population and judiciary to approach this need. To do this, most states adopt a prioritization system where emergent and urgent dental needs are given preference over routine care needs. Emergent and urgent needs are treated first and routine care needs are usually scheduled subsequently, according to the time frame of the inmate’s request for care. However, even after emergent and urgent dental care needs are met, the realization of completely satisfying all of the inmate population’s routine dental care needs is illusory.

Therefore, states, including Michigan, must adopt restrictions on the provision of routine dental care. These restrictions usually entail alterations in eligibility or in the scope and menu of available services, or some system of inmate
co-payment. Larger programs must inherently be more restrictive, as economies of scale do not apply to these labor-intensive services. More resources within a correctional Department should be spent on the longer-term inmate, rather than on those inmates who are quickly passing through the system and want to use the correctional dental clinics as an alternative to paying for their own dental work on release. Naturally, an inmate cannot be denied emergent or urgent care, but these levels of service comprise the minority of all the dental care rendered in a correctional setting. It is the routine care needs that account for the majority of inmate dental need, and it is here that spending may be prioritized for the longer-term offender. Preventive services, such as topical fluoridation, which affect decay rates and periodontal disease (Grembowski et al., 1992, 1993), and oral hygiene instruction must be considered as tools which might ameliorate these high levels of dental disease.

It is a correctional system’s responsibility to provide dental care to its inmate populations. However, the provision of these services must vary among inmates because disease rates are so high. A non-strategic approach to treating this amount of disease will be ineffective and frequently result in judicial intervention. This study demonstrates that correctional departments must identify the amount and distribution of dental disease within their populations and adapt dental policies to meet their particular requirements.
Appendix A

Three Letter Acronyms for MDOC Facilities
Three Letter Acronyms for MDOC Facilities

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Facility Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>JCF</td>
<td>J. C. Cotton Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>SMI</td>
<td>State Prison of Southern Michigan - Central</td>
<td></td>
</tr>
<tr>
<td>SMN</td>
<td>State Prison of Southern Michigan - Northside</td>
<td></td>
</tr>
<tr>
<td>SMT</td>
<td>State Prison of Southern Michigan - Trustee</td>
<td></td>
</tr>
<tr>
<td>AMF</td>
<td>Baraga Regional Facility</td>
<td></td>
</tr>
<tr>
<td>HTF</td>
<td>Hiawatha Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>LMF</td>
<td>Munising Maximum Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>URF</td>
<td>Chippewa Regional Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>MBP</td>
<td>Marquette Branch Prison - Brooks &amp; Trustee</td>
<td></td>
</tr>
<tr>
<td>KTF</td>
<td>Chippewa Temporary Facility</td>
<td></td>
</tr>
<tr>
<td>KCF</td>
<td>Kinross Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>ARF</td>
<td>Adrian Regional Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>ATF</td>
<td>Adrian Temporary Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>HVM</td>
<td>Huron Valley Men's Facility</td>
<td></td>
</tr>
<tr>
<td>MRF</td>
<td>Macomb Regional Facility</td>
<td></td>
</tr>
<tr>
<td>SRF</td>
<td>Saginaw Regional Facility</td>
<td></td>
</tr>
<tr>
<td>TCF</td>
<td>Thumb Regional Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>WCF</td>
<td>Western Wayne Correctional Facility</td>
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</tr>
<tr>
<td>LCF</td>
<td>Lakeland Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>RRF</td>
<td>Ryan Regional Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>OTF</td>
<td>Carson City Temporary Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>ICF</td>
<td>Ionia Maximum Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>MCF</td>
<td>Muskegon Correctional Facility</td>
<td></td>
</tr>
<tr>
<td>RCF</td>
<td>Riverside Correctional Facility</td>
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<td>LRF</td>
<td>Brooks Regional Correctional Facility</td>
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<tr>
<td>MTU</td>
<td>Michigan Training Facility</td>
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<td>SMF</td>
<td>Standish Maximum Correctional Facility</td>
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<td>ITF</td>
<td>Ionia Temporary Facility</td>
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<td>RMI</td>
<td>Michigan Reformatory</td>
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<td>ECF</td>
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<td>DRF</td>
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<td>STF</td>
<td>Mid-Michigan Correctional Facility</td>
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<tr>
<td>MTF</td>
<td>Muskegon Temporary Correctional Facility</td>
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Appendix B

Disease Measurement Survey
**Disease Measurement Survey**

**Demographics**
- Facility
- Age (years)
- Security Level
- Race
- Length of Incarceration (years)

**Dental Disease Information**
- No. Decayed Teeth
- PSR Score:
- No. Missing Teeth
- No. Filled Teeth

**Dental Treatment Needs**

<table>
<thead>
<tr>
<th>Amalgams Needed</th>
<th>Resins Needed</th>
<th>Extractions Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>U</td>
<td>R</td>
</tr>
<tr>
<td>No. 1-surface</td>
<td>No. 1-surface</td>
<td>No. Routine</td>
</tr>
<tr>
<td>No. 2-surface</td>
<td>No. 2-surface</td>
<td>No. Impactions</td>
</tr>
<tr>
<td>No. 3-surface</td>
<td>No. 3-surface</td>
<td></td>
</tr>
<tr>
<td>No. 4-surface</td>
<td>No. 4-surface</td>
<td></td>
</tr>
<tr>
<td>No. 5-surface</td>
<td>No. 5-surface</td>
<td></td>
</tr>
</tbody>
</table>

- No. Plastic Crowns needed

**Endodontics**
- (E) (U) (R)
- No. Root Canals Needed (per filled canal)

**Prosthetics**
- No. Partials Needed
- No. Full Dentures Needed

**CHECK ONE**

**Hygiene Services Needed**
- Regular Prophy Needed
- Perio. Prophy Needed

**KEY:**
- E = Emergency Care Needed
- U = Urgent Care Needed
- R = Routine Care Needed
- (immediately) (< 6 months) (> 6 months)
Appendix C

Tables
Table 27
Means and Overall Standard Deviations of Inmate Dental Service Needs by Age and Race

<table>
<thead>
<tr>
<th></th>
<th>Age:18-34</th>
<th>Age:35-44</th>
<th>Age:45+</th>
<th>Sample</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
<td>Other</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>n=47</td>
<td>n=102</td>
<td>n=6</td>
<td>n=32</td>
</tr>
<tr>
<td>LEVELS OF SERVICES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emerg. amalgam 1-Surface</td>
<td>21</td>
<td>02</td>
<td>0.03</td>
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</tr>
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<td>Emerg. amalgam 2-Surface</td>
<td>02</td>
<td>02</td>
<td>0.06</td>
<td>0.02</td>
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<tr>
<td>Emerg. amalgam 3-Surface</td>
<td></td>
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<tr>
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<td>2.09 (1.49)</td>
<td>1.85 (3.12)</td>
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<td>0.24 (1.26)</td>
<td>0.16 (0.69)</td>
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</tr>
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<td>0.02</td>
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</tr>
<tr>
<td>Urgent resin 2-Surface</td>
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<tr>
<td>Urgent resin 3-Surface</td>
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<td>0.02</td>
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<td>Urgent resin 4-Surface</td>
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<td>Urgent extraction</td>
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<td>0.61</td>
<td>0.02</td>
<td>0.10</td>
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<td>0.02</td>
<td>0.02</td>
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</tr>
<tr>
<td>Urgent root canal</td>
<td>0.02</td>
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<td>Overall</td>
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<td>0.92 (3.82)</td>
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<td>0.14</td>
<td>0.10</td>
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<tr>
<td>Routine resin 1-Surface</td>
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<td>0.02</td>
<td>0.14</td>
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<td>Routine resin 3-Surface</td>
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<td>0.04</td>
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<td>0.61</td>
<td>0.10</td>
<td>0.14</td>
<td>0.55</td>
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<td>0.02</td>
<td>0.12</td>
<td>0.04</td>
<td>0.10</td>
</tr>
<tr>
<td>Routine root canal</td>
<td></td>
<td></td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Partial dentures</td>
<td>0.17</td>
<td>0.05</td>
<td>0.20</td>
<td>0.20</td>
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<td>0.15</td>
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<td>0.04</td>
<td>0.16</td>
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<td>Plastic crowns</td>
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<td>0.02</td>
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<td>0.56</td>
<td>0.58</td>
<td>0.55</td>
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<td>Perio prophylactic</td>
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<td>0.37</td>
<td>0.40</td>
<td>0.37</td>
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<td>Overall</td>
<td>4.54 (4.41)</td>
<td>2.37 (1.90)</td>
<td>3.58 (2.42)</td>
<td>4.02 (4.16)</td>
</tr>
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</table>
Table 29

Means and Overall Standard Deviations of Inmate Dental Treatment Needs by Security Levels

<table>
<thead>
<tr>
<th>LEVELS OF SERVICES</th>
<th>Minimum</th>
<th>Medium</th>
<th>Close</th>
<th>Maximum</th>
<th>Administrative Segregation</th>
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<tr>
<td></td>
<td>n=49</td>
<td>n=120</td>
<td>n=55</td>
<td>n=9</td>
<td>n=18</td>
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</table>

**EMERGENCY**
- emerg. amalgam 1-Surface: 
  - Minimum: .02
  - Medium: .08
  - Close: .11
  - Maximum: .06

- emerg. amalgam 2-Surface: 
  - Minimum: .02
  - Medium: .02
  - Close: .11

- emerg. amalgam 3-Surface: 
  - Minimum: .02

- emerg. amalgam 4-Surface: 
  - Minimum: .02

- emerg. amalgam 5-Surface: 
  - Minimum: .02

- emerg. resin 1-Surface: 
  - Minimum: .01

- emerg. resin 2-Surface: 
  - Minimum: .01

- emerg. resin 3-Surface: 
  - Minimum: .02

- emerg. resin 4-Surface: 
  - Minimum: .02

- emerg. resin 5-Surface: 
  - Minimum: .02

- emerg. extraction: 
  - Minimum: .20

- emerg. impacted extraction: 
  - Minimum: .01

- emerg. root canal: 
  - Minimum: .06

- Overall: .06 (.32)

**URGENCY**
- urgent amalgam 1-Surface: 
  - Minimum: .12

- urgent amalgam 2-Surface: 
  - Minimum: .04

- urgent amalgam 3-Surface: 
  - Minimum: .06

- urgent amalgam 4-Surface: 
  - Minimum: .04

- urgent amalgam 5-Surface: 
  - Minimum: .02

- urgent resin 1-Surface: 
  - Minimum: .01

- urgent resin 2-Surface: 
  - Minimum: .01

- urgent resin 3-Surface: 
  - Minimum: .02

- urgent resin 4-Surface: 
  - Minimum: .04

- urgent resin 5-Surface: 
  - Minimum: .01

- Urgent extraction: 
  - Minimum: .20

- urgent impacted extraction: 
  - Minimum: .01

- urgent root canal: 
  - Minimum: .06

- Overall: .35 (1.52)

**ROUTINE**
- routine amalgam 1-Surface: 
  - Minimum: .88

- routine amalgam 2-Surface: 
  - Minimum: .47

- routine amalgam 3-Surface: 
  - Minimum: .10

- routine amalgam 4-Surface: 
  - Minimum: .05

- routine amalgam 5-Surface: 
  - Minimum: .02

- routine resin 1-Surface: 
  - Minimum: .02

- routine resin 2-Surface: 
  - Minimum: .02

- routine resin 3-Surface: 
  - Minimum: .02

- routine resin 4-Surface: 
  - Minimum: .02

- routine resin 5-Surface: 
  - Minimum: .01

- routine extractions: 
  - Minimum: 1.24

- routine impacted extraction: 
  - Minimum: .01

- routine root canal: 
  - Minimum: .01

- partial dentures: 
  - Minimum: .14

- full dentures: 
  - Minimum: .20

- plastic crowns: 
  - Minimum: .01

- regular prophy: 
  - Minimum: .55

- perio prophy: 
  - Minimum: .47

- Overall: 3.98 (5.17)
Table 30

Emergency, Urgent and Routine Treatment Needs of MDOC Inmate Population

<table>
<thead>
<tr>
<th>LEVELS OF SERVICES</th>
<th>MINUTES REQUIRED TO PERFORM SERVICE</th>
<th>SAMPLE MEAN</th>
<th>INMATE POPULATION</th>
<th>MINUTES REQUIRED HOURS NEEDED TO TREAT POPULATION</th>
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<td>35905.5</td>
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<td>31916</td>
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<td>0.01</td>
<td>31916</td>
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<td>31916</td>
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Appendix D

Approval Letter From Human Subjects
Institutional Review Board
To: Walter Ormes
From: Richard Wright, Chair
Re: HSIRB Project Number 95-08-12

Date: October 20, 1995

This letter will serve as confirmation that your research project entitled "The measurement of dental disease in a correctional setting: the importance to functional service delivery" has been approved, as modified, under the expedited category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you must seek specific approval for any changes in this design. You must also seek reapproval if the project extends beyond the termination date. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: October 20, 1996

xc: Peter Kobrak, SPAA
BIBLIOGRAPHY


