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Dental Hygiene Manpower Distribution in Virginia

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DENTAL HYGIENE MANPOWER DISTRIBUTION IN VIRGINIA

by

**Christine Ann Nielsen
B.S. June 1988, Ohio State University**

**A Thesis Submitted
to the Faculty of Old Dominion University
in Partial Fulfillment of the
Requirements for the Degree of**

**MASTER OF SCIENCE
DENTAL HYGIENE**

**OLD DOMINION UNIVERSITY
August 1990**

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ABSTRACT

DENTAL HYGIENE MANPOWER DISTRIBUTION IN VIRGINIA

Christine A. Nielsen
Old Dominion University, 1990
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The purpose of this investigation was to conduct a comprehensive dental hygiene manpower study in the Commonwealth of Virginia. Data were collected to establish the present number of dental hygienists and dentists in Virginia; the estimated number of practicing and non-practicing dental hygienists and dentists in Virginia; and the past, present and forecasted employment opportunities for dental hygienists in Virginia. Primary and secondary data were collected via professional associations, state regulatory boards, health agencies, employment and educational commissions and labor statistics bureaus. Frequency distributions were used to analyze the data. Results suggest that there is an adequate supply of dental hygiene manpower to meet the demand for dental hygienists in the Commonwealth of Virginia. Three areas in Virginia exhibit a surplus of dental hygiene manpower, and eight areas exhibit a deficit of dental hygiene manpower

suggesting a manpower maldistribution rather than a manpower shortage. Recommendations to address the dental hygiene manpower maldistribution include recruitment efforts targeting non-practicing dental hygienists and potential students, attracting dental hygiene manpower from surplus areas to deficient areas, making dental hygiene employment opportunities more attractive and supporting existing educational standards for dental hygienists in Virginia. These aforementioned recommendations could increase the public's access to dental hygiene care in Virginia.

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TABLE OF CONTENTS

	PAGE
LIST OF TABLES.....	iv
LIST OF FIGURES.....	v
 Chapter	
1. INTRODUCTION.....	1
STATEMENT OF PROBLEM.....	3
SIGNIFICANCE OF PROBLEM.....	3
DEFINITION OF TERMS.....	7
ASSUMPTIONS.....	9
LIMITATIONS.....	10
METHODOLOGY.....	11
2. REVIEW OF THE LITERATURE.....	12
INTRODUCTION.....	12
THE MANPOWER SHORTAGE CONCEPT.....	13
DENTAL HYGIENE MANPOWER SUPPLY AND DEMAND.....	17
PROPOSED SOLUTIONS TO MEET DEMAND FOR DENTAL HYGIENISTS.....	23
SUMMARY.....	25
3. METHODS AND MATERIALS.....	27
SAMPLE DESCRIPTION.....	27
METHODOLOGY.....	30

TABLE OF CONTENTS (continued)

	PAGE
4. RESULTS AND DISCUSSION.....	32
RESULTS.....	32
DISCUSSION.....	41
5. SUMMARY AND CONCLUSIONS.....	45
BIBLIOGRAPHY.....	51
APPENDICES	
A. GEOGRAPHICAL LOCATION OF DENTAL HYGIENE PROGRAMS IN VIRGINIA.....	56
B. PROJECTION METHODOLOGY.....	57

LIST OF TABLES

	PAGE
TABLE	
1. Virginia Dental Hygienists' Association Local Components.....	28
2. Dental Hygienists and Dentists Licensed in Virginia.....	33
3. Ratio of Dental Hygienists to Dentists Licensed in Virginia.....	36
4. Number of Surplus or Deficient Dental Hygienists in Local Components of Virginia.....	39
5. Practicing and Non-Practicing Dental Hygienists and Dentists Licensed in Virginia.....	42
6. Dental Hygiene and Dental Employment Opportunities in Virginia.....	42

LIST OF FIGURES

	PAGE
FIGURE	
1. Model of Characteristics that Define Manpower Shortages.....	14
2. Current Dental Hygiene Status.....	18
3. Forecasted Dental Hygiene Status.....	22
4. Geographical Location of Local Components of the Virginia Dental Hygienists' Association.....	29
5. Geographical Distribution of Licensed Dental Hygienists and Dentists in Virginia.....	34
6. Geographical Ratio of Licensed Dental Hygienists to Dentists in Virginia.....	37
7. Geographical Location of Surplus and Deficient Dental Hygienists in Local Components of Virginia.....	40

CHAPTER 1

Introduction

Recent reports of difficulties in hiring dental hygienists have resulted in apprehension about the existence of a dental hygiene manpower shortage.^{1,3,4,11,14,17,18,20,21,23,24,32,36,37,39,41,43,44,49,53,54,59,62,65}

Most of the knowledge concerning this refutable dental hygiene manpower shortage is derived from anecdotal reports of dentists' difficulties in identifying and employing dental hygienists. Reports may be biased simply because during the 1970's dentists became accustomed to an abundance of dental hygienists or may stem from a misconception of what constitutes a manpower shortage.^{21,45}

The term manpower shortage often is used loosely to describe a variety of situations, some of which generally are not considered actual shortages.⁴⁵ Various manpower situations may involve the supply and geographical location of workers, the going wage rate, employer demand for workers and consumer utilization of the product or service.⁴⁵ For this reason it is necessary to identify the type of manpower shortage to employ the proper management approach.

Definitive data to identify and define the current dental hygiene manpower distribution in Virginia is not

available directly. Proposed solutions to remedy this anecdotal dental hygiene manpower shortage include preceptorship training for dental hygienists and the generation of additional dental hygiene programs.^{41,50} History reveals that these solutions are ineffective at increasing the supply of dental hygienists.^{1,34}

Although no empirical evidence exists documenting a true shortage, the Virginia Dental Association (VDA) allocated \$20,000 in 1989 to study the dental hygiene preceptorship program in Alabama.⁵⁰ Dental hygiene preceptorship training would lower standards for dental hygiene education and practice at a time when "quality" could control the rise of malpractice suits filed, minimize risk of infectious disease transmission and attract qualified applicants to the profession.²⁰ Alabama is the only state that utilizes the preceptorship training method to prepare dental hygienists.³² Moreover, a 1990 study reveals that Alabama exhibits a dental hygiene and dental assisting manpower shortage.¹ This finding indicates that preceptorship training has done little to maintain adequate manpower in dental hygiene and dental assisting in Alabama.

As one proposed strategy for solving the perceived dental hygiene manpower shortage, Virginia dentists have been active in pursuing the development of additional dental hygiene programs even though some dental hygiene programs in Virginia remain undersubscribed.^{41,47} However, as enrollment

data from the American Dental Association Council on Dental Education suggests, more dental hygiene programs do not translate into an increase in enrollments and graduates.³⁴

Few would argue that before a problem can be solved it must be identified and defined. Considering the logic of this statement, the first step in dealing with a manpower issue is to assess the manpower distribution. Thus, the purpose of this investigation was to conduct a comprehensive dental hygiene manpower study in Virginia by determining the existing dental hygiene and dental manpower distribution; the number of practicing and non-practicing dental hygienists and dentists; and the past, present and forecasted employment opportunities for dental hygienists.

Statement of the Problem

The general research questions investigated in this study were: What is the existing dental hygiene and dental manpower distribution in Virginia? What is the number of practicing and non-practicing dental hygienists and dentists in Virginia? What are the past, present and forecasted employment opportunities for dental hygienists in Virginia?

Significance of the Problem

Dentists in Virginia have reported difficulties in hiring dental hygienists. Presently, no published data could be found that confirms a dental hygiene manpower shortage. Statements regarding an actual dental hygiene manpower shortage in Virginia have been based on anecdotal

evidence.^{1,3,4,11,17,18,20,21,23,24,32,36,37,39,41,43,44,49,53,54,59,62,65}

However, a 1989 study conducted by the Virginia Dental Association and Virginia Commonwealth University, Survey Research Laboratory reports conditions which contribute to the perceived shortage of dental hygienists.⁵⁹

Some job market conditions are incorrectly called shortages.⁴⁵ Dentists (employers) may no longer hire the desired numbers of dental hygienists (workers) at the wage rate they had once offered. In this situation it may be practical to improve wage rates, fringe benefits and working conditions to attract non-practicing dental hygienists back into the field of dental hygiene. To dental hygiene practitioners and potential students a shortage can be interpreted to mean that positions are readily available and opportunities exist for greater pay and improved fringe benefits. Dental hygiene's marketability to these potential students would be greatly enhanced by increasing the wage rate and offering working conditions which are more attractive.

A dental hygiene manpower shortage also could mean that dentists may advocate employee-sponsored training, synonymously referred to as dental hygiene preceptorship.^{3,33,40,45,65} Dental hygiene preceptorship, if legalized, would allow dentists to train individuals as limited dental hygienists. This raises the issue of whether dentists are qualified to educate dental hygienists.³¹ Data

from the American Dental Association show that dental students receive 286.5 hours of instruction in periodontics, whereas dental hygiene students receive 718 hours of instruction in preclinical and clinical instruction which includes: periodontology, periodontal assessment, periodontal probing and charting, initial periodontal therapy and oral health education.¹⁰ Data exist which reveal that 2-10 percent of a general dentist's time is spent on periodontics yet 60-90 percent of the population has periodontal diseases.^{2,30} This finding suggests that the American population may not be receiving adequate care in the diagnosis, prevention and treatment of periodontal disease by general dentists. The dental hygienists' primary role is to provide preventive dental and periodontal treatment to dental patients, which has been evident in increasing usage of dental hygienists in initial periodontal therapy.^{5,19,42} This evidence lessens the credibility of dentists to train individuals in dental hygiene and preventive periodontics, and validates the dental hygienists' formal educational qualifications for treating patients with periodontal involvement.

To an individual interested in pursuing a challenging career, the time invested in college is an assumed commitment. Hard-working, motivated individuals choose careers which offer challenge.²⁹ Education usually is needed to prepare individuals with the knowledge necessary

for entering professional careers. Decreasing dental hygiene's educational standards would prevent individuals interested in a college career from entering the dental hygiene field. Dental hygiene preceptorship would decrease dental hygiene career marketability to potential, qualified students, thereby, decreasing the future supply of educated dental hygienists.

Dentists envision a dental hygiene manpower shortage as increasing the cost of doing business, due to the fact that they may be devoting more time to preventive procedures rather than more lucrative restorative procedures and, if preceptorship training is initiated, settling for individuals with less education than is established in national education standards. Obviously, a dentist striving for a quality-oriented practice would idealistically employ dental hygienists capable of providing quality dental care. Dentists should be apprehensive about employing dental hygienists with minimal or no education, such as those trained by the preceptorship method.

To the general public a dental hygiene manpower shortage would decrease the availability and quality of services provided. Although some state dental associations may believe that preceptorship will have no negative effect on public health and safety,^{3,32,33,40} the position taken by the American Dental Association Commission on Dental Accreditation states that: "A two-year formal educational

program is the minimum required to provide adequate public protection."⁷ The American Association of Dental Schools and the American Dental Association Commission on Dental Accreditation hold that preceptorship training does not meet the commission's minimum educational standard of two years of formal education designed to help assure adequate patient protection.³ The American Association of Dental Schools further resolved that: "preceptorship training for dental hygienists endangers the quality of education in that field."⁴ Moreover, the American Dental Association Council on Dental Education maintains the following position:

The growing need to treat an older population with a wide variety of medical complications, together with the imperative that infection control procedures be well established and carefully monitored by the dentist as well as the auxiliary staff, lend credence to efforts to maintain, rather than reduce the educational requirements.⁹

Definition of Terms

The following terms are defined for this investigation:

1. Registered Dental Hygienist -
A licensed, oral health educator and clinician who uses preventive, educational and therapeutic methods for the prevention of oral diseases to aid individuals in attaining and maintaining optimum oral health.⁶³
2. Manpower distribution - the geographical location of individuals who practice a common profession. In this study, the geographical location was limited to the Commonwealth of Virginia.

3. Manpower maldistribution - the overabundance or deficiency of individuals who practice a common profession in one or more geographical locations while other geographical locations exhibit an inadequate supply of individuals who practice that particular profession. In this study, the geographical location was limited to the Commonwealth of Virginia.

4. Manpower shortage - the lack of individuals available to fill the needs of employers.

5. Dental Hygiene preceptorship - an alternative program for preparing dental hygienists for clinical practice; dentists act as "preceptors," providing on-the-job training in limited dental hygiene functions. Preceptorship would allow an individual to be licensed as a dental hygienist without completing a formal dental hygiene program that has been accredited by the American Dental Association, Commission on Dental Accreditation and without successfully completing the National Dental Hygiene Board Examination, prior to licensure.^{17,19}

6. Need - a normative, usually professional judgment as to the amount of health-care manpower required by a population in order to attain or maintain some standard level of health. In this study, need was measured by the number of dentists willing to employ a dental hygienist.

7. Supply - the quantity of health-care manpower available. In this study, supply was measured by the number

of dental hygienists licensed in Virginia.

8. Demand - the volume and type of health-care manpower that a population desires to consume at some level of price. In this study, demand was measured by the forecasted employment opportunities for dental hygienists.

9. Utilization - the volume and type of health-care manpower actually consumed. In this study, utilization was measured by the consumers' demand for and use of dental hygiene services.

Assumptions

For the purpose of this study, the following assumptions were made:

1. The Commonwealth of Virginia attains and maintains accurate economic, educational, occupational and employment statistics and forecasts.

2. Improved salaries and benefits for dental hygienists, the increased regulation of infection control procedures practiced in dental practice settings, availability of reciprocity and the development of a statewide dental hygiene recruitment task force would increase the number of dental hygienists currently practicing in Virginia.

3. An increase in the number of registered dental hygienists employed in a variety of settings would increase the accessibility of dental hygiene services to the public of Virginia.

4. Projections of practicing and non-practicing dental

hygienists were based on a survey conducted in Virginia by the Virginia Dental Association and the Virginia Commonwealth University, Survey Research Laboratory.⁵⁹

5. Calculations of dental hygiene manpower supply deficits and surpluses were based on the 1:2 dental hygienist to dentists employment opportunity ratio which was observed in a study conducted in the Peninsula component of Virginia by Thomas Nelson Community College, Office of Institutional Research and Planning⁵³ and further supported by numerous national studies.^{24-28,52,57}

6. Dentists included in the sample may have been licensed and residing in Virginia; however, may have been practicing across state line, retired, or practicing specialties, not utilizing dental hygienists, thus affecting the sample used in this study.

Limitations

The validity and reliability of the results of this study may be limited by the following factors:

1. Errors may have been made in the data collected on the number of dental hygienists and dentists in Virginia.

2. Errors may have been made in the forecasts drawn for economic growth rates and opportunities in the Commonwealth of Virginia.

3. Forecasts are not always reliable due to unforeseen events.

4. Results of this investigation are only generalizable

to the Commonwealth of Virginia.

5. Dentists residing in States surrounding Virginia may have been licensed and practicing in Virginia, but were not included in the sample, thus affecting the sample used in the study.

Methodology

Existing reports were reviewed regarding the number of registered dental hygienists and dentists, both practicing and non-practicing in Virginia; the number of dentists practicing in Virginia and the past, present and forecasted employment opportunities for dental hygienists in Virginia. Data from surveys conducted by professional associations, regulatory agencies, employment and educational commissions and labor statistics bureaus provided the major sources of data. Data from these reports were divided according to the eleven district components used by the Virginia Dental Hygienists' Association to depict geographic distribution of dental hygienists and dentists throughout the Commonwealth of Virginia.⁶⁰ Frequency distribution of the data determined the existing dental hygiene and dental manpower distribution in Virginia. Estimations concerning the number of practicing and non-practicing dental hygienists were made using percentages from a state study, and employment projections provided insight on the forecasted dental hygiene employment opportunities in Virginia.

CHAPTER 2

Review of the Literature

Manpower has been studied in numerous occupations. A review of the literature from the fields of dental hygiene, dentistry, economics, business, allied health, and nursing revealed findings significant to the study of dental hygiene manpower. This review of literature will focus on manpower shortage concepts, dental hygiene manpower supply and demand and proposed solutions to meet the demand for dental hygienists.

Introduction

In 1987 the American Dental Hygienists' Association established the Special Committee to Study Manpower Issues, which investigated reports of perceived dental hygiene manpower shortages. In 1989, the Special Committee determined the nonexistence of a national dental hygiene manpower shortage, but uncovered issues such as dental hygiene employment opportunities which remain unfilled, a significant number of dental hygienists who are not practicing, and an increased demand for dental hygienists in the work force.¹⁴ Concurring with these findings, a 1989 Virginia dental hygiene manpower study conducted by the Virginia Dental Association and Virginia Commonwealth

University Survey Research Laboratory reported that: "a potential pool of trained hygienists does appear to exist, however 22 percent of dental hygienists are not currently working"⁵⁹ which initiates a perceived shortage of dental hygienists.

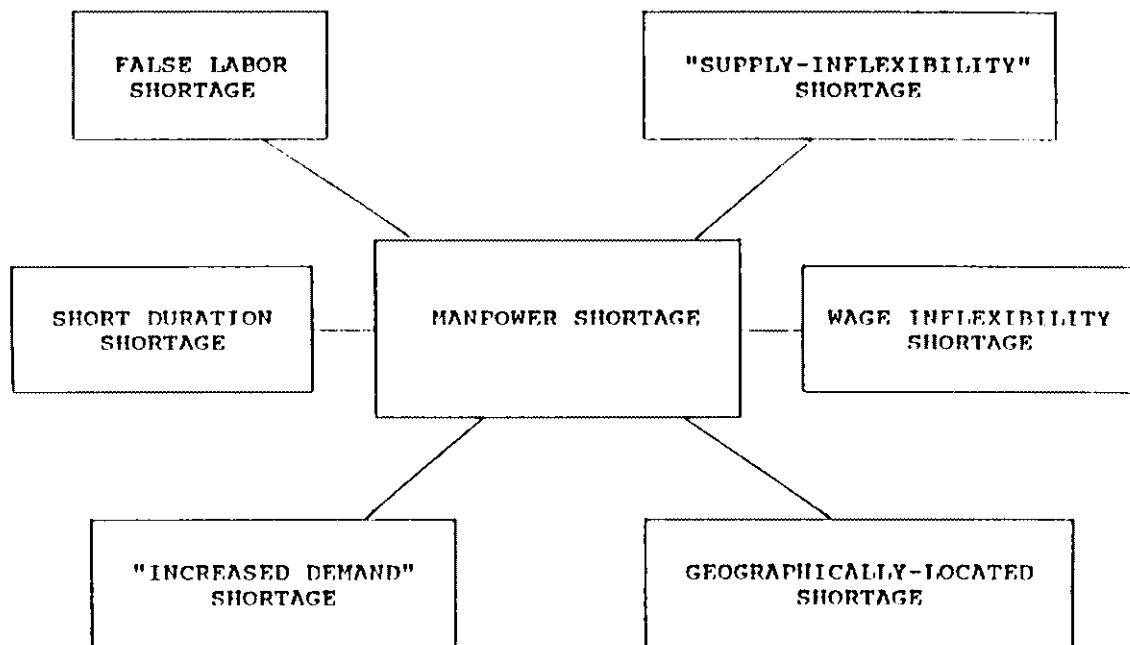
The Manpower Shortage Concept

To understand the dental hygiene manpower issue, it is necessary to be knowledgeable about what constitutes a manpower shortage. A shortage occurs only when adjustment is slow in one of three areas: supply of workers, demand for workers and wage rate.⁴⁵ Moreover, a shortage is eased when higher wages attract more workers as a result of increased labor costs, a slowdown is felt in the economy or a switch in production methods is implemented that requires less labor.⁴⁵ Various manpower shortages are the product of different situations and require unique management approaches.⁴⁵ Types of manpower shortages include the following: false labor shortages, supply inflexibility, short duration, wage inflexibility, increased demand and geographically-located shortage (Figure 1).

According to information published in 1989 by the Institute of Medicine regarding health manpower shortages:

Reported vacancies should be viewed with caution because they do not always represent a shortage. If, through one mechanism or another, wages are kept below the level that would bring demand and supply into equilibrium, employer demand will always exceed the number of allied health personnel who want to work at the going wage. Such excess demand cannot really be characterized as a

FIGURE 1
Model Of Characteristics that
Define Manpower Shortages



shortage but rather as an imperfection in the operation of the market.³⁷

In theory, most labor shortages should disappear as employers increase wages to attract more workers; because of the wage increase, employers must reduce the number of employees. False labor shortages are seen when employers will not raise wage rates or improve working conditions.⁴⁵ Thus, employees will find employment opportunities in other fields until the prevailing wage rate is increased and working conditions improve. This statement suggests that if the employer devalues a career by decreasing compensation or demoting the working conditions, employees will change careers.

The most common type of manpower shortage occurs when increases in the compensation offered by employers fail to attract a sufficient number of potential employees. Such "supply-inflexible shortages" most frequently occur in occupations which require a college education.⁴⁵ When an education is needed to acquire the knowledge necessary before entering an occupation, there may be a lag between the time when employers enhance the attractiveness of the working conditions and when the manpower of that occupation increases. If an increased demand for dental hygienists is projected, employers must enhance the attractiveness of dental hygiene employment opportunities.

Labor shortages in occupations that require a minimal level of training are generally of short duration.⁴⁵ However, the supply of workers can be relatively inflexible or slow to adjust. Many workers are reluctant to accept jobs believed to have low status or associated with undesirable working conditions.⁴⁵ This fact should be kept in mind if lowering the educational standards for dental hygienists is advanced as a solution to the demand for dental hygienists. Many individuals may be unwilling to accept dental hygiene positions because of the low status associated with preceptorship training. This phenomenon already is observed in dental assisting where on-the-job training has done little to attract and retain dental assistants.^{22,51}

Wage inflexibility also may be the cause of a manpower shortage.⁴⁵ An employer may prefer to endure the ill effects of a labor shortage rather than pursue alternatives such as raising the wages of all workers in the occupation, greatly increasing labor costs. A dentist may choose to forego hiring a dental hygienist rather than paying a wage that is perceived to be incongruent with the job requirements.

The increased demand by consumers and employers for a particular service may outpace the market's capacity to supply workers.⁴⁵ Increasing awareness of periodontal disease on the part of consumers may augment the utilization

of dental hygienists in dental practices. Dentists striving for quality also may advocate the use of the dental hygienist in nonsurgical periodontal therapy, solely because of the dental hygienist's expertise and knowledge in this area.^{5,19,42} Ultimately, this would increase the demand for dental hygienists in private dental practices.

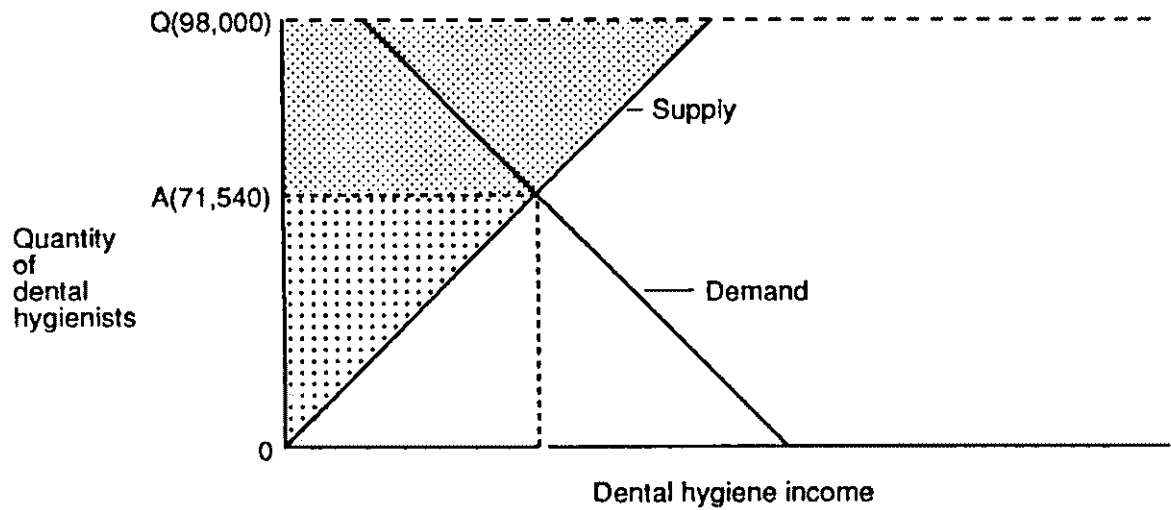
Manpower shortages are observed in different geographical locations.⁴⁵ Underdeveloped, rural areas tend to be the locations in which health professionals are found in shorter supply. To remedy shortages related to geography, employers must understand why a shortage occurs in certain areas and how to remedy this situation.

Dental Hygiene Manpower Supply and Demand



To fully understand the dental hygiene manpower shortage concept it is necessary to consider the current supply. To conceptualize the manpower of an occupation, one must first identify the supply of workers in that occupation.

Nationally, 98,000 dental hygienists hold current licenses in the United States.¹⁴ Of these 98,000 dental hygienists, approximately 71,540 are actively practicing dental hygiene. Figure 2 depicts the current practicing and non-practicing status of dental hygienists in the United States.¹⁴ The United States Bureau of Labor Statistics estimates that there were 86,700 employment opportunities for dental hygienists in 1986.⁵⁵ According to a 1989 study

FIGURE 2
Current Dental Hygiene Status¹⁴



LEGEND

-  Dental hygienists licensed but not employed in dental hygiene
-  Dental hygienists currently employed in dental hygiene

Q-Number of licensed dental hygienists

A-Existing number of dental hygienists in work force

conducted by the American Dental Hygienists' Association, approximately 27 percent of the nation's dental hygienists were employed in more than one location.¹² Since some dental hygienists are employed in more than one setting, data clearly indicate an adequate supply of dental hygienists.^{13,16} Rather than a dental hygiene manpower shortage these data affirm an adequate dental hygiene manpower supply available to fill existing employment opportunities. Similarly, a 1989 Virginia dental hygiene manpower study conducted by the Virginia Dental Association and Virginia Commonwealth University Survey Research Laboratory report that an adequate supply of dental hygienists exists in the Commonwealth of Virginia.⁵⁹

In the Virginia study conducted by the Virginia Dental Association and Virginia Commonwealth University Survey Research Laboratory, dentists (who employ dental hygienists) reported that the average opportunity for dental hygiene employment was 27.4 hours per week. Dentists indicated that they employed a dental hygienists for 22 hours per week which may suggest an unmet need of 5.4 hours per week. This unmet need then was multiplied by the number of Virginia dentists who practice on at least a part-time basis (79 percent) which revealed a current gap of 14,600 hours of dental hygiene employment opportunities. Dividing this total by 30 hours (the average number of hours worked per week as reported by dental hygienists) resulted in a current

need of 490 dental hygienists. Limitations of this study include the fact that not all dentists employ dental hygienists and although dental hygienists reported an average work week of 30 hours there was no indication if this was their choice or as a result of a lack of employment opportunities.

One issue which merits discussion is the number of dental hygienists and dentists not employed in the dental hygiene or dental work force. The American Dental Hygienists' Association reported that 27 percent of dental hygienists are not actively practicing in the United States, while the Virginia Dental Association and Virginia Commonwealth University Survey Research Laboratory reported that 22 percent of dental hygienists and 21 percent of dentists are licensed, however, not practicing in Virginia.^{14,57}

In 1988, the American Dental Hygienists' Association conducted a study to ascertain the reasons dental hygienists leave the field and which factors would encourage re-entry into dental hygiene. The study revealed that the major reasons for leaving the profession included salary, benefits, family responsibilities, boredom and fear of infectious diseases.

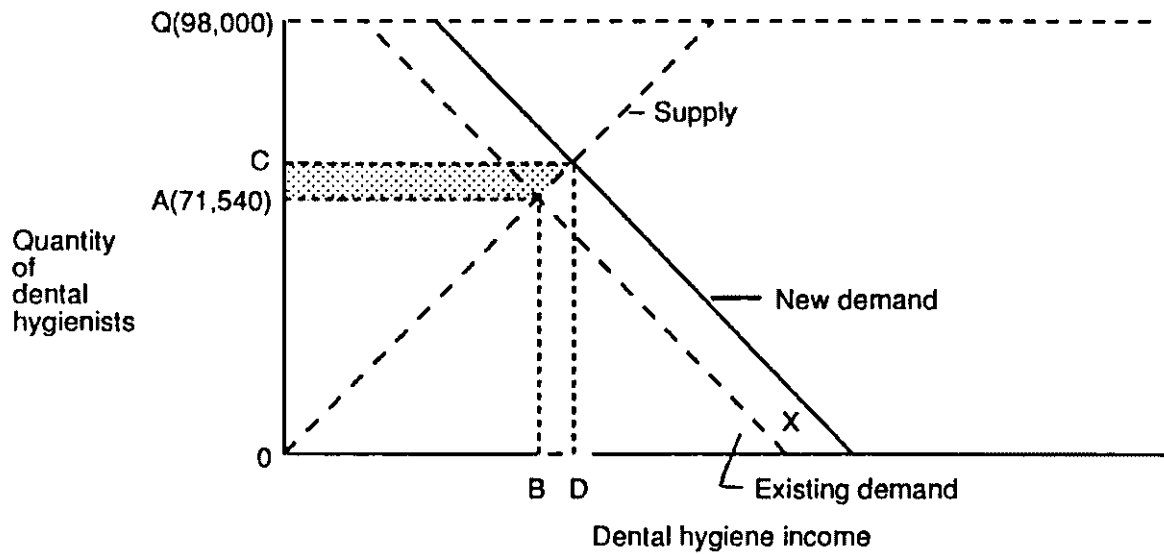
Approximately 65 percent of non-practicing dental hygienists reported that they would consider returning to the dental hygiene work force if circumstances such as

salaries, benefits, infectious disease control and infectious disease control policy setting changed.¹² Virginia dental hygienists indicated a willingness to return to the dental hygiene workforce if factors such as salaries, benefits and personal factors were resolved. Eighty-five percent of Virginia dental hygienists possibly would consider returning to the work force while only 15 percent were not planning to re-enter the dental hygiene work force.⁵⁷

Compensation is the most influential factor in explaining the current dental hygiene supply situation. Between 1978 and 1986, dental hygienists experienced no growth in real wages. During the period from 1978 to 1982, real wages which are adjusted for inflation, decreased annually for dental hygienists. Between 1982 and 1985, wages for dental hygienists began to increase slightly, however, the increase was at a rate lower than that experienced by dentists and did not make up for the loss from the 1978 to 1982 period.^{14,55}

In theory, as increases in real income improve, the dental hygiene supply will increase as shown in Figure 3.¹⁴ Although an adequate supply of dental hygiene manpower exists, an inadequate number of dental hygienists are employed in the dental hygiene workforce. Wage rates must be increased to respond to the increased demand for and utilization of dental hygienists.

FIGURE 3
Forecasted Dental Hygiene Status¹⁴



LEGEND

- A-Existing number of dental hygienists in work force
- B-Existing income
- C-New supply in work force
- D-New higher income
- X-Market adjustment in demand curve
- ▨ Additions to dental hygiene work force

Due to the increase in employee-sponsored dental insurance, the dental economy, dollars per capita spent on dental and dental hygiene care, has witnessed a tremendous growth rate in the past 30 years.^{38,58} Therefore, employee (dental hygienists) compensation should be easily accommodated by employers (dentists) to match the economy. Since compensation was the most influential factor concerning the reason dental hygienists left the work force and increasing compensation was noted as the most influencing factor in enticing dental hygienists back into the work force, it is reasonable to assume that the compensation factor is the most important area to accommodate.

Demand for dental hygienists could be related to consumer trends that emphasize self-care and wellness, lifestyles that support positive health behaviors and dental trends that emphasize oral health promotion and nonsurgical periodontal interventions. These trends reflect the essence of dental hygiene practice. This increased demand for dental hygiene services on the part of consumers could be a factor associated with the increased demand for dental hygienists in the dental community.

Proposed Solutions to Meet the Demand for Dental Hygienists

As a result of this dental hygiene manpower issue, organized dentistry in Virginia has expressed interest in advocating dental hygiene preceptorship and the

development of additional dental hygiene programs.^{41,65,47}

Dental hygiene preceptorship would afford dentists the opportunity to train individuals in limited dental hygiene functions. Preceptees would not graduate from an accredited dental hygiene program; therefore, they would not be eligible for the National Dental Hygiene Board Examination and the Southern Regional Board Examination, currently required for licensure to practice dental hygiene in the Commonwealth of Virginia.^{31,33} In essence, dental hygiene preceptorship would be on-the-job training to become a dental hygienist.

The development of additional dental hygiene programs has been advanced as another solution to the manpower dilemma. Of the five dental hygiene programs in Virginia (Appendix A) some remain undersubscribed.^{41,47}

Since 1980, there has been a decline in the number of individuals enrolling in and graduating from dental hygiene programs.⁴⁸ This evidence suggests a decrease in the applicant pool which would be influenced by the development of more dental hygiene programs. Reasons for a decrease in enrollments in dental hygiene programs may parallel those cited in nursing literature which include: a decrease in the number of high school graduates, a wide range of career choices available to women today, dental hygiene's lack of appeal to minorities, stagnant employment opportunities, lack of employment benefits essential to single women, fear

of infectious diseases and inflexible curricula within programs.^{46,52} Clearly, the increase in the number of dental hygiene programs cannot remedy these conditions.

The establishment of a dental hygiene program requires a significant investment in facilities, manpower and supplies; wealth of health care resources; a large patient population; and a substantial budget to support faculty development, equipment maintenance, staff support and numerous other activities.²¹ Since the opening of new dental hygiene programs would not meet the demand for dental hygienists, it seems to be an impractical approach to increasing dental hygiene manpower.

Summary

Research studies assessing manpower theory and the dental hygiene manpower shortage have been reviewed. The literature supported the following:

1. Dentists in Virginia have reported difficulties in identifying and employing dental hygienists. In many instances, this employment discrepancy has been referred to as a dental hygiene manpower shortage.

2. To deal with the concept of shortage, it is necessary to consider the current supply of manpower. If an inadequate supply of workers exists, a shortage will be evidenced; however, if the supply of workers is adequate, a false labor shortage is reflected due to an imperfection in the operation of market.

3. Factors which contribute to a dental hygiene supply and demand imbalance are correctable. A collaborative effort by dentists and dental hygienists needs to be made to correct this imbalance.

4. Improving compensation and working conditions are both rectifiable areas. Compensation must improve to match the dental economic growth rate experienced over the past 30 years. Working conditions must be improved by dental hygienists and dentists.

5. Proposed solutions to remedy this anecdotal dental hygiene manpower shortage include preceptorship training for dental hygienists and the generation of additional dental hygiene programs. History reveals that these solutions are ineffective at increasing the supply of dental hygienists.

Ultimately, dental hygienists and dentists must collaborate to provide access to quality oral health care to the public. The health of the public must come first when considering alternative routes of dental care. To meet this need, adequate dental hygiene manpower must be attained and maintained. The present study investigated the dental hygiene manpower distribution in Virginia.

CHAPTER 3

Methods and Materials

The purpose of this investigation was to determine the existing dental hygiene and dental manpower distribution, number of practicing and non-practicing dental hygienists and dentists and the employment opportunities for dental hygienists in Virginia. Primary and secondary data collection and literature reviews were used to obtain accurate data for describing Virginia dental hygiene manpower.

Sample Description

The sample utilized in this investigation consisted of all licensed dental hygienists and dentists residing in the Commonwealth of Virginia. The population was geographically divided into eleven components including Northern Virginia, Greater Richmond, Virginia Tidewater, Piedmont, Shenandoah Valley, Peninsula, Virginia Southern, Southwest Virginia, Northwest, Blue Ridge and Southside. These subdivisions are designated by the Virginia Dental Hygienists' Association as components of the association (Table 1 and Figure 4).⁶⁰ Differentiating geographic location of the number of dental hygienists and dentists assisted in determining the manpower distribution or maldistribution within regions of Virginia.

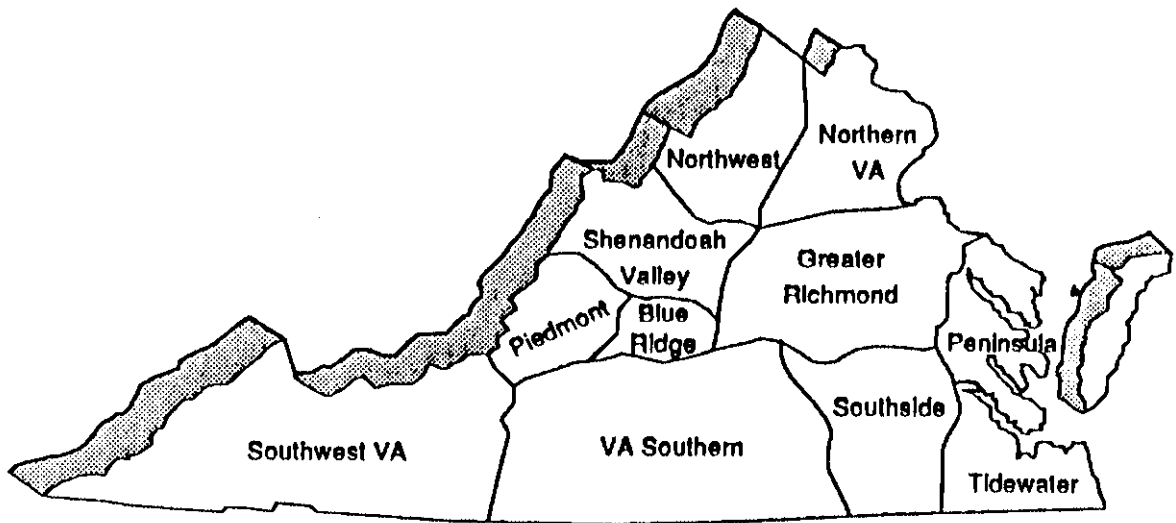
TABLE 1
VIRGINIA DENTAL HYGIENISTS' ASSOCIATION
LOCAL COMPONENTS

<u>CODE</u>	<u>LOCAL COMPONENT</u>
01	Northern Virginia
02	Greater Richmond*
03	Virginia Tidewater
05	Piedmont
06	Shenandoah Valley*
07	Peninsula
08	Virginia Southern
09	Southwest Virginia
10	Northwest
11	Blue Ridge
12	Southside

* Three areas of Virginia are referred to as "member-at-large" components because of geographical location. To effectively place these members in the geographically correct location, the members have been included in the designated components.

FIGURE 4

**GEOGRAPHICAL LOCATION
OF LOCAL COMPONENTS OF THE VIRGINIA
DENTAL HYGIENISTS' ASSOCIATION**



Methodology

A list in zipcode permutations of licensed dental hygienists and dentists residing in Virginia was obtained from the Virginia State Board of Dentistry on January 26, 1990. Data were then segregated by zip codes and placed into one of the eleven respective components resulting in a frequency distribution of dental hygienists and dentists in Virginia. For a more definitive analysis, the frequency distributions were depicted in ratio scales. To understand whether the present supply of dental hygienists met the demand for dental hygienists in Virginia, secondary data were obtained via Thomas Nelson Community College, Office of Institutional Research and Planning.⁵³ The study conducted by Thomas Nelson Community College, surveyed dentists from the Peninsula Component of Virginia to identify the present employment opportunities available for dental hygienists. Findings were supported further by national studies.^{24-28,57,64}

To calculate the number of dental hygienists and dentists currently not practicing, secondary data were obtained from a study conducted by the Virginia Dental Association and Virginia Commonwealth University Survey Research Laboratory.⁵⁹ These results were supported by a 1989 national study conducted by the American Dental Hygienists' Association concerning the practicing and non-practicing status of dental hygienists.¹⁴ Investigation results were used to estimate the number of nonpracticing

dental hygienists dentists in Virginia.

The Virginia Employment Commission provided secondary data that revealed past and projected dental hygiene employment opportunities in Virginia.^{56,61} Projection methodology used by the Virginia Employment Commission was developed by the U.S. Department of Labor, Bureau of Labor Statistics (Appendix B). A time series provided a historical framework of estimated employment opportunities. This time series served as an input for the initial industry employment projections, which were made using the following projection techniques available through the Data Analysis System for Industry Employment (DASIE): multiple and simple linear regressions, various employment share projection models and several shift and share projection models. The independent variables used for state industry projections were national employment in the industry group and times.⁵⁶

CHAPTER 4

Results and Discussion

Existing data were reviewed concerning the number of dental hygienists and dentists; the practicing and non-practicing status of dental hygienists and past, present and projected employment opportunities for dental hygienists. Primary and secondary data were obtained via professional associations, regulatory agencies and employment commissions.

Results

Primary data were obtained from the Virginia State Board of Dentistry regarding the number of dental hygienists and dentists licensed in the Commonwealth of Virginia. A list permutated according to zipcodes was used to geographically distribute the dental hygienists and dentists into eleven individual components comprehensive to Virginia. These eleven components represent the local dental hygiene localities which comprise the Virginia Dental Hygienists' Association.⁶⁰

Findings concerning the supply of dental hygienists and dentists in Virginia are presented in Table 2 and Figure 5. The findings indicate that 1,774 dental hygienists and 3,476 dentists hold Virginia licenses and currently are residing

TABLE 2

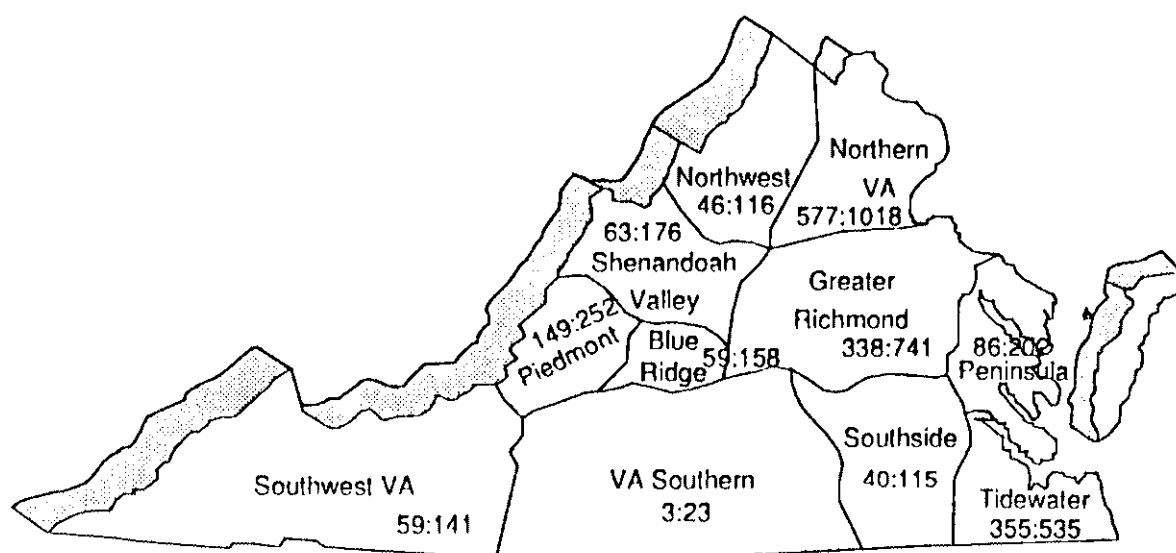
Dental Hygienists and Dentists
Licensed in Virginia

VDHA* COMPONENTS	DENTAL HYGIENISTS	DENTISTS
Northern Virginia	577	1018
Greater Richmond	338	741
Virginia Tidewater	355	535
Piedmont	149	252
Shenandoah Valley	63	176
Peninsula	86	202
Virginia Southern	3	23
Southwest Virginia	59	141
Northwest	46	116
Blue Ridge	59	158
Southside	40	115
TOTAL	1,774	3,476

*Virginia Dental Hygienists' Association (VDHA)

FIGURE 5

Geographical Distribution of Licensed Dental Hygienists
and Dentists in Virginia



in Virginia. The manpower distribution of dental hygienists and dentists, respectively, is as follows: 355 and 535 Virginia Tidewater, 149 and 252 Piedmont, 577 and 1018 Northern Virginia, 59 and 141 Southwest Virginia, 338 and 741 Greater Richmond, 86 and 202 Peninsula, 46 and 116 Northwest, 59 and 158 Blue Ridge, 63 and 176 Shenandoah Valley, 40 and 115 Southside and 3 and 23 Virginia Southern.

Ratio scales of the dental hygiene and dental manpower distribution in Virginia are shown in Table 3 and Figure 6. The mean number of dental hygienists to dentists in Virginia is 1 to 1.96. The range of dental hygienist to dentists ratios in Virginia includes: 1 to 1.5 Virginia Tidewater, 1 to 1.69 Piedmont, 1 to 1.76 Northern Virginia, 1 to 2.20 Greater Richmond, 1 to 2.34 Peninsula, 1 to 2.38 Southwest Virginia, 1 to 2.52 Northwest, 1 to 2.67 Blue Ridge, 1 to 2.79 Shenandoah Valley, 1 to 2.87 Southside and 1 to 7.60 Virginia Southern.

According to a 1989 Thomas Nelson Community College, Office of Institutional Research and Planning study on dental hygiene employment opportunities conducted in the Peninsula Component of Virginia, one half of the dentists surveyed employed a dental hygienist or would like to employ a dental hygienist.⁵³ The survey suggests that approximately 50 percent of the dentists employ or would like to employ a dental hygienist in their practices, resulting in a dental hygienist to dentist employment

TABLE 3

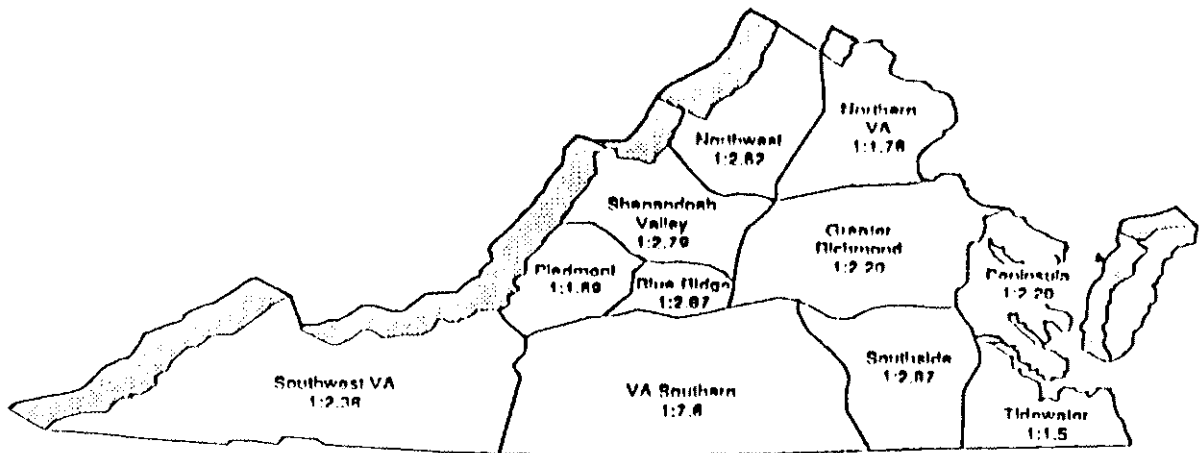
Ratio of Dental Hygienists and Dentists
Licensed in Virginia

VDHA COMPONENTS	DENTAL HYGIENISTS	to	DENTISTS
Northern Virginia	1		1.76
Greater Richmond	1		2.20
Virginia Tidewater	1		1.50
Piedmont	1		1.69
Shenandoah Valley	1		2.79
Peninsula	1		2.34
Virginia Southern	1		7.60
Southwest Virginia	1		2.38
Northwest	1		2.52
Blue Ridge	1		2.67
Southside	1		2.87
TOTAL	1		1.96

*Virginia Dental Hygienists' Association (VDHA)

FIGURE 6

Geographical Ratio of Licensed Dental Hygienists
to Dentists in Virginia



opportunity ratio of 1 to 2. This study is further validated by the number of national studies which reflect the same finding.^{24-28,57,64} Based on licensure data from the Board of Dentistry, Virginia currently has a dental hygienist to dentist employment opportunity ratio of 1 to 1.96.

Utilizing this information the number of dental hygienists in each component that were exhibiting a surplus or deficiency were calculated: Northern Virginia surplus of 68, Greater Richmond deficiency of 32.5, Virginia Tidewater surplus of 87.5, Piedmont surplus of 23, Shenandoah Valley deficiency of 25, Peninsula deficiency of 15, Virginia Southern deficiency of 8.5, Southwest Virginia deficiency of 11.5, Northwest deficiency of 12, Blue Ridge deficiency of 20 and Southside deficiency of 17.5 (Table 4 and Figure 7). Overall, Virginia exhibits a surplus 36.5 dental hygienists.

Secondary data and primary data were used to estimate the number of dental hygienists and dentists actually practicing in Virginia. Data gained from a 1989 Virginia study reported that 22 percent of dental hygienists and 21 percent of dentists licensed in Virginia were not practicing.⁵⁹ An estimation was made comparing that percentage with the number of dental hygienists and dentists licensed in Virginia.

Of the 1,774 dental hygienists licensed in Virginia 22 percent or 390 currently are not practicing dental hygiene,

TABLE 4

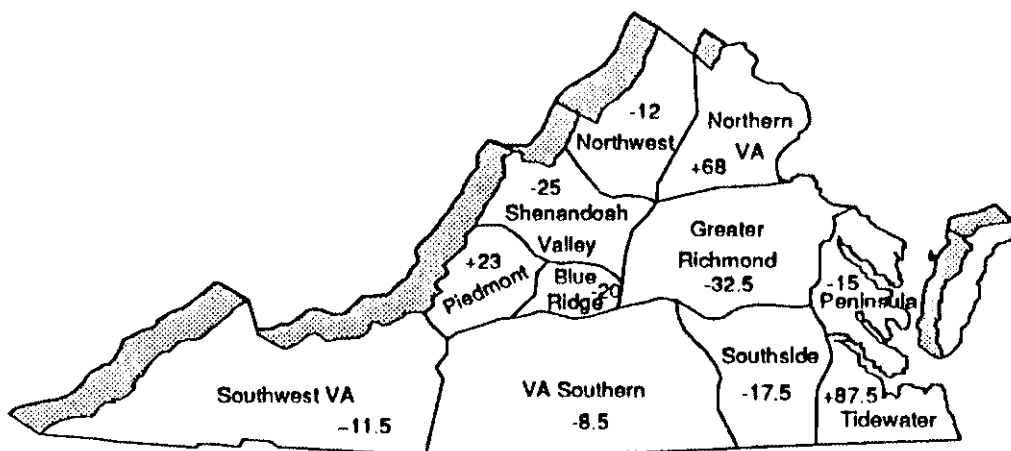
Number of Surplus or Deficient Dental Hygienists
in Local Components of Virginia

VDHA COMPONENTS	SURPLUS	DEFICIENCY
Northern Virginia	68	*
Greater Richmond	*	32.5
Virginia Tidewater	87.5	*
Piedmont	23	*
Shenandoah Valley	*	25
Peninsula	*	15
Virginia Southern	*	8.5
Southwest Virginia	*	11.5
Northwest	*	12
Blue Ridge	*	20
Southside	*	17.5
TOTAL	178.5	142

*Virginia Dental Hygienists' Association (VDHA)

FIGURE 7

Geographical Location of Surplus and Deficient Dental Hygienists in Local Components of Virginia



while 1,384 dental hygienists (78 percent) are practicing dental hygiene. Of the 3,476 dentists licensed in Virginia 21 percent or 730 currently are not practicing dentistry, while 2,746 dentists (79 percent) are practicing dentistry. This estimated percentage of practicing and non-practicing dental hygienists and dentists is shown in Table 5.

The past and projected employment opportunities for dental hygienists and dentists in Virginia is reflected in Table 6.^{56,61} The employment opportunities available to Virginia dental hygienists in 1984 was 1,347 and is projected to grow 41.87 percent to 1,911 in 1995.

Discussion

The results of this study indicate that Virginia is not experiencing a dental hygiene manpower shortage. Numerous national and one Virginia study confirm that the dental hygienist to dentist employment opportunity ratio is 1 dental hygienist to 2 dentists.^{24-28,53,57,64} Virginia exhibits 1 dental hygienist to every 1.96 dentists. This finding suggests that there is an adequate supply of dental hygienists in Virginia.

Various dental hygiene and dental manpower distribution discrepancies were noted in this study. For example, as a result of the maldistribution of dental hygienists in Virginia, seven components were experiencing a dental hygiene manpower shortage as evident by ratios of higher than 1:2: Virginia Southern, Southside, Shenandoah Valley,

TABLE 5
Practicing and Non-practicing
Dental Hygienists and Dentists Licensed in Virginia

Licensed Dental Hygienists in Virginia	Dental Hygienists Currently Practicing	Dental Hygienists Currently Non-practicing
1,774	1,384	390
100%	78%	22%
Licensed Dentists in Virginia	Dentists Currently Practicing	Dentists Currently Non-practicing
3,476	2,746	730
100%	79%	21%

TABLE 6
Dental Hygiene and Dental
Employment Opportunities in Virginia

Profession	Estimated 1984 Employment	Projected 1995 Employment	Percent Growth
Dental Hygienists	1,347	1,911	41.87%
Dentists	1,396	1,977	41.62%

Blue Ridge, Greater Richmond, Southwest Virginia and Peninsula. One component, namely Virginia Southern, exhibits 1 dental hygienist to every 7.60 dentists which represents a geographic maldistribution. However, this area is bordered by two areas which have a surplus of dental hygienists, (more than 1 dental hygienist to every 2 dentists) making the maldistribution problem resolvable. By using two obvious strategies, increasing salaries and improving working conditions, dentists in Virginia Southern could make dental hygiene positions attractive enough to entice dental hygienists from surplus areas to work in this undersubscribed area. This strategy, aimed at already licensed dental hygienists, would bring the maldistribution of dental hygienists into balance.

Three areas in Virginia have a surplus of dental hygiene manpower. These include: Northern Virginia, Virginia Tidewater and Piedmont. A surplus of dental hygienists has a negative affect on dental hygiene student recruitment because potential students may perceive an abundance of dental hygienists indicative of fewer employment opportunities upon graduation and a decrease in wage rates.

Additionally, 1,384 practicing dental hygienists are adequate in filling employment positions when considering the fact that only 2,746 licensed dentists are practicing. This 1:2 dental hygienist to dentist ratio is, therefore,

applicable to currently practicing dental professionals.

A 1989 national study revealed that 65 percent of non-practicing dental hygienists indicated a willingness to seek employment in dental hygiene if the following employment conditions improved: salaries, benefits, procedures for infection control and increased control in setting infection control procedures.¹ The Virginia Dental Association and Virginia Commonwealth University study determined 36 percent of non-practicing dental hygienists definitely planned to return to the workforce. Additionally, 49 percent were unsure of their plans to re-enter the workforce. Re-entry recruitment efforts could be targeted to this potential pool of 332 dental hygienists. Employment conditions need to improve in order to attract non-practicing dental hygienists back to the workforce. These strategies could be used by Virginia dentists interested in attracting non-practicing dental hygienists to their practices.

Dental hygiene employment opportunities have been forecasted by the Virginia Employment Commission as 1,911 in 1995 which illustrates 41.87 percent growth from 1,347 in 1984.⁶¹ Presently, in 1990, there are 1,774 dental hygienists licensed in Virginia. The supply of dental hygienists, therefore, is adequate to meet the demand for dental hygienists in the private dental sector in Virginia.

Chapter 5

Summary and Conclusions

There is a widely held assumption among practicing dentists in Virginia that a shortage of dental hygiene manpower exists.^{1,18,21,41,43,50,53,54,62,65} Due to this assumption, dental hygiene preceptorship training and the generation of new dental hygiene programs when existing dental hygiene programs remain undersubscribed have been advanced as solutions to this manpower discrepancy.^{41,50}

During the past 20 years, the health care sector has experienced a tremendous growth in malpractice suits filed, the risk of infectious disease transmission, and the demand for quality health care by consumers.²⁰ Dental hygiene preceptorship training would lower the educational standards for dental hygiene professionals during a critical time in health care.^{2-4,5,17,18,30-33,37,43,49,54,65} This on-the-job training would do little to advocate effective risk management procedures and qualify an individual to provide direct patient care. Furthermore, Alabama, the only state that prepares dental hygienists by the preceptorship method, currently is experiencing a dental hygiene manpower shortage.¹ This clearly reveals that preceptorship training is an ineffective method to maintaining an adequate supply

of dental hygienists.

History reveals that the opening of additional dental hygiene programs does not translate into an increase in enrollments and graduates.³⁴ Since 1980 there has been a decline the number of individuals enrolling in and graduating from dental hygiene programs nationwide and in Virginia.^{47,48} Evidence suggests that a deficit in the applicant pool cannot be remedied by the opening of new dental hygiene programs.³⁴ Moreover, this deficit might have intensified the perceived demand for dental hygienists in Virginia.

The purpose of this investigation was to conduct a comprehensive dental hygiene manpower study by determining the existing dental hygiene and dental manpower distribution; the number of practicing and non-practicing dental hygienists and the past, present and forecasted employment opportunities for dental hygienists.

To understand the dental hygiene manpower issue it is necessary to be knowledgeable about what constitutes a manpower shortage. A manpower shortage occurs only when adjustment is slow in one of the three variables: the supply of workers, the demand for workers and the wage rate.⁴⁵ Moreover, a manpower shortage is eased when higher wages attract more workers as a result of increased labor costs, a slowdown is felt in the economy or switch in production methods is implemented that requires less

labor.⁴⁵

Primary and secondary data were collected via regulatory agencies, professional associations, educational institutions, employment commissions and labor statistics bureaus. Investigation results were presented in frequency distributions, ratios and employment forecast projections.

The findings from this study lead to the following conclusions:

1. Overall, Virginia exhibits 1 dental hygienist to every 1.96 dentists. Given that only 50 percent of all dentists employ one dental hygienist, there appears to be no overall shortage in Virginia.

2. Eight areas in Virginia do not have an adequate dental hygienist to dentists ratio, thus exhibiting a geographic maldistribution. Virginia Southern, one of these areas, has a ratio of 1 dental hygienist to every 7 dentists. This area of Virginia is the only area which has a definitive geographic maldistribution.

3. In Virginia, the supply of dental hygienists adequately meets the demand (number of employment opportunities available) for dental hygienists.

4. In three areas of Virginia, there is a surplus of dental hygiene manpower. One way to rectify geographical maldistribution is to initiate strategies that will attract dental hygienists from surplus areas to deficient areas.

5. Since 22 percent and 21 percent of all licensed dental

hygienists and dentists are not practicing, respectively, the number of practicing dental hygienists is adequate to fill employment opportunities.

Based upon the outcome of this study, further research is needed to compare the dental hygiene and dental manpower data with population data in Virginia. Such a study would delineate the public's need for dental hygiene and dental services.

Although the data fail to support a dental hygiene manpower shortage in Virginia, there seems to be an increased demand for dental hygienists among the dental community. The demand could be related to trends that emphasize self-care and wellness lifestyles that support positive health behaviors and dental trends that emphasize oral health promotion and nonsurgical periodontal interventions. These trends reflect the essence of dental hygiene practice. For these reasons the following strategies for augmenting the attractiveness of dental hygiene as a career are offered:

1. Dental practices need to enhance the attractiveness of employment opportunities attractive by increasing salaries, offering benefits and improving dental infection control procedures. Attention to these issues should be focused particularly in the regions of Virginia Southern, Southside, Shenandoah Valley, Blue Ridge, Greater Richmond, Southwest Virginia and Peninsula areas of Virginia.

2. Encourage non-practicing dental hygienists to re-enter the workforce demonstrating support, enrichment and growth of the profession.

3. Encourage prospective students to pursue dental hygiene careers and enter dental hygiene programs through media events, consumer product endorsements, personal contacts and increased community visibility.

4. Repress efforts supporting preceptorship training for dental hygienists and increase awareness of the level of education attained and required to provide direct care to the public.

The mission of the American Dental Hygienists' Association is to improve the public's total health by increasing the awareness of and access to quality oral health care.¹⁵ The mission of the American Dental Association is to encourage the improvement of the health of the public, to promote the art and science of dentistry and to represent the interests of the dental profession and public which it serves.⁶ To accomplish these missions it is necessary to meet the increasing demand for dental hygiene care by increasing the number of practicing dental hygienists and decreasing the barriers to the public's access to dental hygiene care. With a collaborative effort between the dental hygiene and dental communities working toward a common goal of increasing the access to dental hygiene care, the public will benefit ultimately by

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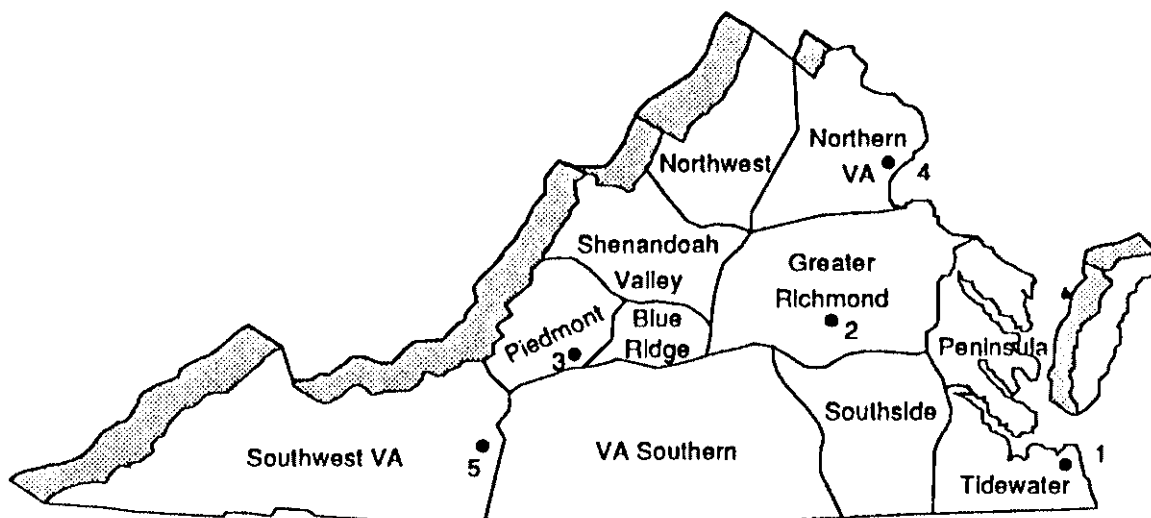
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APPENDIX A
GEOGRAPHICAL LOCATION
OF DENTAL HYGIENE PROGRAMS
IN VIRGINIA

**GEOGRAPHICAL LOCATION OF DENTAL HYGIENE PROGRAMS
IN VIRGINIA**

1. Old Dominion University School of Dental Hygiene
Norfolk, Virginia
2. Virginia Commonwealth University Division of Dental Hygiene
Richmond, Virginia
3. Virginia Western Community College Department of Dental Hygiene
Roanoke, Virginia
4. Northern Virginia Community College Department of Dental Hygiene
Annandale, Virginia
5. Wytheville Community College Department of Dental Hygiene
Wytheville, Virginia



APPENDIX B
PROJECTION METHODOLOGY

PROJECTION METHODOLOGY⁵⁵

DEVELOPED BY U.S. DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS

Introduction

The 1984 employment estimates, the 1995 employment projections, and the estimated of average annual job openings were prepared according to procedures outlined in various memoranda of the United States Department of Labor's Bureau of Labor Statistics (BLS). The Maine Department of Labor's Eastern Service Center for Employment Projections provided the computer systems necessary to process the data. Three major steps were followed:

1. Development of wage and salary industry employment projections.
2. Development of a 1984 base year Industry-Occupation (I/O) Matrix.
3. Development of 1995 occupational projections and job openings data.

Development of Wage and Salary Industry Employment Projections

The future employment in individual industries is a primary determinant of projected occupational requirements because each industry has a unique occupational structure. To begin the process of developing industry employment projections, a time series of historical estimates of wage and salary jobs in nonagricultural industries was constructed. This series was assembled at the three-digit Standard Industrial Classification (SIC) level, based on data collected from business establishments throughout the Current Employment Statistics (CES) and the Quarterly Employment and Wages (ES-202) Programs. The time series served as the input for the initial industry employment projections, which were made using the following projections techniques available through the Data Analysis System for Industry Employment (DASIE): multiple and simple linear regressions, various employment share projection models, and several shift and share projection models. The independent variables used for State industry projections were national employment in the industry group and time. For area projections, State employment in the industry group was substituted for the national industry employment variable.

The projections produced by the DASIE system were evaluated by labor market analysts for reasonableness and for consistency among industries and areas. The projections were also reviewed and adjusted in light of analysts' knowledge of the industry. In making adjustments, particular attention was given to recent and expected openings and permanent closings of plants having sizable employment. A summary table of these industry projections, by major group, has been published for the state and each metropolitan area. Information on more detailed industries is available upon request; however, not all industries are included. Employment estimates for certain industries have been eliminated in order to avoid revealing employment information about specific, identifiable employers.

Development of a 1984 Base Year I/O Matrix

The industry-occupation (I/O) matrix is a table arraying the occupational staffing patterns for each industry: i.e., the ratio of employment in each occupation in an industry to the total employment in the industry. The OES survey-based I/O matrix covers approximately 1,500 detailed occupations cross-classified by nearly 400 three-digit SIC industries.

The major component in construction of the I/O matrix is the data collected through the Occupational Employment Statistics (OES) survey. The OES survey, conducted by the Virginia Employment Commission's Research and Analysis Division in cooperation with the Bureau of Labor Statistics, is a periodic mail survey of a sample of establishments in the nonagricultural wage and salary sectors of the economy. Designed to provide current estimates of occupational employment for each industry, the OES surveys are conducted on a three-year cycle--approximately one-third of the industries are surveyed each year. The staffing pattern data collected from the most recent complete OES survey cycle (1980, 1981, 1982, and 1984 surveys) comprised most of the nonfarm wage and salary I/O matrix for the base year. Supplemental data for some industrial sectors including Agriculture, Railroad Transportation, Private Households, and the Federal Government were obtained from sources such as the Census and the Civil Service Commission since those sectors are not covered under the OES survey. Occupational employment information for areas other than the Northern Virginia Metropolitan Area, for which an area-specific matrix was produced, were developed by applying statewide occupational patterns to the specific industry employment structure of the labor area. It is important to point out that the occupational employment information that is generated from this method is dependent upon the reliability of the base data that employers have provided. The

projections, therefore, could be affected by such factors as employers reporting workers in the wrong occupation or too few employers participating in the survey in a particular industry.

Development of 1995 Occupational Projections and Job Openings Data

Once the total wage and salary employment I/O matrix was complete, the industry projections and I/O matrix were merged. The industry employment projections for each three-digit industry were applied to the appropriate I/O matrix ratio to derive occupational projections by industry. Resulting occupational projections were then summed across all industries to yield employment projections for all the occupations in the matrices. Occupations that were estimated to have fewer than 25 employees in the entire State and fewer than 10 in each metropolitan area for both 1984 and 1995 were deleted from the tables. Relatively small numbers are considered to unreliable and should always be evaluated with care. The data have been presented in unrounded form. This sometimes implies a degree of accuracy that does not exist; for example, the fact that 147 civil engineers are projected for a certain area does not mean that there will be exactly 147 civil engineers and not 146 or 148. It is more valid to note the trend and not just the numerical value of the projected employment.

In addition to a projection of employment, an estimate of the total number of job openings expected to occur in each occupation was developed. Average annual job openings due to growth are calculated by simply dividing the difference between the projected year and base year employment by ten. Average annual openings due to separations are projected by multiplying occupational employment estimates by State specific separation rates supplied by the Bureau of Labor Statistics.* Separation rates estimate job openings resulting from death, retirement, and other reasons for leaving the labor force. The rates do not reflect job openings due to labor turnover and/or occupational mobility.

*See Tomorrow's Manpower Needs: Estimating Occupational Separations From The Labor Force For States: Supplement IV, 976. Output Tables.