An Analysis of Oral Health Disparities and Access to Services in the Appalachian Region

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This report is the result of combined efforts of research teams from the University of Mississippi Medical Center, Mississippi State University, PDA, Inc. and The Cecil G. Sheps Center for Health Services at the University of North Carolina that was edited and compiled by PDA, Inc. with assistance and input from ARC and providers in the Appalachian Region.

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AN ANALYSIS OF ORAL HEALTH DISPARITIES AND ACCESS TO SERVICES IN THE APPALACHIAN REGION

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GLOSSARY OF ACRONYMS

ACS	AMERICAN CANCER SOCIETY
ADA	AMERICAN DENTAL ASSOCIATION
ADHA	AMERICAN DENTAL HYGIENISTS ASSOCIATION
AMA	AMERICAN MEDICAL ASSOCIATION
ANCOVA	ANALYSIS OF COVARIANCE
ANOVA	ANALYSIS OF VARIANCE
ARC	APPALACHIAN REGIONAL COMMISSION
ARF	AREA RESOURCE FILE
ASTDD	ASSOCIATION OF STATE AND TERRITORIAL DENTAL DIRECTORS
BHP	BUREAU OF HEALTH PROFESSIONALS
BLS	BUREAU OF LABOR STATISTICS
BRFSS	BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM
CDC	CENTERS FOR DISEASE CONTROL AND PREVENTION
CHIP	CHILD HEALTH INSURANCE PROGRAM
CHWS	CENTER FOR HEALTH WORKFORCE STUDIES
CMS	CENTERS FOR MEDICARE AND MEDICAID SERVICES
CPS	CURRENT POPULATION SURVEY
CQI	CONTINUOUS QUALITY IMPROVEMENT
CWS	COMMUNITY WATER SYSTEM
DHHS	DEPARTMENT OF HEALTH AND HUMAN SERVICES
DHPPI	DENTAL HYGIENE PROFESSIONAL PRACTICE INDEX
DPH	DEPARTMENT OF PUBLIC HEALTH
EPA	ENVIRONMENTAL PROTECTION AGENCY
EPSDT	EARLY AND PERIODIC SCREENING, DIAGNOSTIC AND TREATMENT SERVICE
FY	FISCAL YEAR
GAO	GOVERNMENT ACCOUNTABILITY OFFICE
HRSA	HEALTH RESOURCE AND SERVICE ADMINISTRATION
JPHC	JAPAN PUBLIC HEALTH CENTER
KCHIP	KENTUCKY CHILDREN'S HEALTH INSURANCE PROGRAM
KFF	HENRY J. KAISER FAMILY FOUNDATION
MCHB	MATERNAL AND CHILD HEALTH BUREAU
MMWP	MORBIDITY AND MORTALITY WEEKLY REPORT

MSA	Metropolitan Statistical Areas
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Surveys
NIDCR	National Institute of Dental and Craniofacial Research
NIH	National Institutes of Health
NIOH	National Institute of Occupational Health
NORC	National Organization for Research at the University of Chicago
OES	Occupational Employment Statistics
RHRC	Rural Health Research Center
SAHIE	Small Area Health Insurance Estimates
SAS	Statistical Analysis System
SCHIP	State's Children's Health Insurance Program
SES	Socioeconomic Status
UNC	University of North Carolina at Chapel Hill
USDA	United States Department of Agriculture
VHA	Veterans Health Administration
WWAMI	Washington, Wyoming, Alaska, Montana and Idaho

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EXECUTIVE SUMMARY

ORAL HEALTH FUNDAMENTALS

Good oral health is the result of positive forces in a complex range of issues –from environmental, socio-cultural and behavioral factors to education and health service access. Though integral to personal well-being, oral health receives less attention and less funding than general physical health. Even measurement of national oral health status is limited to interview questions on the Behavioral Risk Factor Surveillance System (BRFSS), a continuous random sample telephone interview survey conducted annually by the Centers for Disease Control and Prevention (CDC), and other single purpose phone surveys conducted by the National Institutes of Health and the United States Department of Health and Human Services (US DHHS). There is no national database on oral health status. Medicare has limited billing information from hospital visits for dental emergencies. Preventive intervention data is similarly limited. About 60 percent of states voluntarily report to CDC the number of counties that fluoridate public water supplies. Dental care is not covered by most public and private health insurance plans. With the exception of government employee plans and children's Medicaid programs, dental insurance coverage requires a separate policy. Only basic children's dental services are mandatory for Medicaid. Adult care is optional for state Medicaid programs. Dental care, other than hospital emergency care, is not covered by Medicare or TriCare, the basic military insurance. The Veterans Health Administration (VHA) provides dental care only to a select group of qualified veterans. There is no comprehensive national reporting system for dental insurance coverage. Even the vast Kaiser Family Foundation (KFF) state level database has little information on dental care. The National Health Interview Survey (NHIS) is conducted through the CDC surveys for dental health insurance coverage, with sample sizes designed for accuracy at the national and four sub-national levels.

Across the United States, shortages of dental professionals are common. Scope of dental practice is limited by state dental licensure boards, which are only gradually expanding the scope of oral health services permitted for delivery by non-dentists. As this happens, the oral health workforce expands and more services become available to more people, generally at lower costs. Statistics on oral health workforce are maintained by the American Dental Association, the American Dental Hygienists Association, and self-reported professional status is collected by the U.S. Census in the American Community Survey. Wage and employment data for dental hygienists are sampled, reported and forecast by the Bureau of Labor Statistics (BLS) through its National Employment Matrix. Data on state licensure are available only directly from the states, or in a summary report initially developed by the US DHHS, Health Resources and Services Administration (HRSA) through private contractors. Notably, most public data for oral health in states and regions are four to six years behind the current year.

Information in this report is drawn from literature reviews, and public data sources. Anecdotal information on good practices was provided by presenters at the ARC's 2011 Annual Conference, *Healthy Families, Healthy Future*. On contract from ARC (Contract #CO-16034-2008), staff from University of Mississippi Medical Center collected primary information on state oral health initiatives; Appendices A through G of this report include much of the reported information.

This report covers:

- State variation in oral health indicators in 2005 and 2007, using CDC and aggregate BRFSS information over a seven- to eleven-year period.
- County variations in oral health workforce, specifically dentists and hygienists.
- State variations in scope of oral health practice for non-dental providers.
- State variations in Medicaid coverage of dental services and dentist participation in Medicaid.
- Information from state health offices on efforts to increase oral health coverage.
- Recommendations from national reports, specifically the 2011 Institute of Medicine report regarding oral health of disadvantaged populations, and the Pew Charitable Foundation report on children's oral health.

ORAL HEALTH INDICATORS

The report compares counties and states in the Appalachian Region and the United States on three measures of oral health: a preventive measure, fluoridation of water supplies; an access measure, dental visits in the past year; and an outcome measure, tooth loss. Data sets for each measure have gaps. For example, in the sampled year, two Appalachian states did not report public water fluoridation at the county level. Some data gaps were filled with statistical models; others were compensated with data from an adjacent time frame.

Within the sample of states reporting data, Appalachia compares well to the United States on fluoridation of community water supplies. About 60 percent of states voluntarily report to the CDC the counties that fluoridate public water supplies, and these are made public. In the year used for this report, neither Ohio nor Maryland reported. Ohio, one of the missing states, has an active local option fluoridation program and reported 90 percent of communities served by public water, of which 92 percent participated in fluoridation programs in 2011 (Ohio Department of Health 2011). Maryland reported 93 percent of its public water supplies fluoridated (National Institute of Dental and Craniofacial Research 2011). Among 11 Appalachian states reporting to CDC, fluoridation levels ranged from a high 99 percent to a low 20 percent of public water supplies.

The measure of dental service use, a visit in the last year, does not reflect the nature of the service or the severity of the reason for the visit. Aggregated BRFSS survey data showed two-thirds of Appalachians interviewed reported seeing a dentist; half reported disease related tooth loss; and almost one quarter reported losing six or more teeth to disease or decay.

Data on Appalachian tooth loss as a result of decay were synthetically derived by University of Mississippi researchers using seven years of BRFSS surveys, separating metropolitan and non-metropolitan data and regrouping them into Appalachian and non-Appalachian areas (Appendix C). Inferences from these data must be drawn with caution, because the data cover an eight-year time span from 1999 to 2006. In summary, the model showed:

- Appalachian areas generally reported more decay-related tooth loss.
- A few Appalachian metropolitan areas reported better oral health than their non-metropolitan counterparts in Appalachia.
- Nationwide, metropolitan areas reported slightly better oral health than non-metropolitan areas, but differences faded when data were controlled for socioeconomic status.

- On average 26.5 percent of Appalachian seniors (over 65) reported having had all of their teeth removed. (Appendix C). By comparison, the 2006 national average on the BRFSS was 19.3 percent.
- Among Appalachian adults aged 34 to 65, 12.9 percent reported six or more teeth removed as a result of preventable causes, compared to 10.9 percent reported by residents of non-Appalachian areas.

When these synthetic estimates were tested against location and socioeconomic status, the University of Mississippi research team found no difference between the Appalachian Region and the nation. High socioeconomic status and metropolitan location were highly correlated with good oral health status (Appendix C).

State-level analyses of the BRFSS surveys are more reliable than analyses of the synthetic carve-outs for the Appalachian Region. On the state level:

- Fewer teeth were reported lost to disease or decay by people in Northern (Maryland, New York, Ohio and Pennsylvania) than in Southern (Alabama, Georgia, Mississippi, and South Carolina) Appalachian states. Tennessee residents reported less tooth loss than other southern states.
- Maryland, Northern Appalachian states and Virginia reported the best oral health status in 2005.
- Mississippi and Southern Appalachian states reported the worst oral health status (Appendix C).

ORAL HEALTH WORKFORCE

Available workforce data show that, compared to the United States, an Appalachian location is associated with fewer dental providers.

- In 2007, there were 36 percent more persons per dentist in Appalachia than in the United States (2,103 versus 1,546, respectively).
- Dentists are more plentiful in certain metropolitan areas.
- Dental workforce concentrations vary significantly within the Appalachian Region.
- Private dentist participation in Medicaid is a challenge, and not all states report data. In 2005, among the 11 reporting Appalachian states, dentist participation in Medicaid ranged from a low of no dentists in the state participating to a high of 44 percent participating (Association of State and Territorial Dental Directors 2008).

Medicaid dental patients are challenging to serve. In most states, Medicaid payment for dental care is low, and Medicaid beneficiaries are more prone to cancel or be late for appointments.

Properly trained dental hygienists can fill access voids associated with shortages of dentists. However, state licensure boards determine the extent to which these non-dentists may provide oral health services. An economic study, released in July 2011 (Kleiner and Park. 2008), details the status of state licensure in 2008. Prior to that study, the most recently published national study of state licensure status was prepared for the United States DHHS, HRSA by researchers at the University at Albany. According to those studies, Appalachian states have been generally more restrictive with regard to expanded practice for dental hygienists. See Appendix E.

Dentists' fear of potential lost income plays a major role in limiting expansion of non-dentist labor force capabilities. Most dental practices are small and involve substantial personal capital investment on the part of individual proprietors. With few people covered by generous dental insurance, dentists fear loss of paying customers when workforce capacity increases.

Trends in these studies are complemented by promising pilots that were reported by representatives from several Appalachian states.

- West Virginia and Kentucky are notable for recent progress. Kentucky expanded practice in 2006, and West Virginia began in 2010 (McKee. 2011) (Muto. 2011).
- Pilot projects started in Appalachian North Carolina have demonstrated that pediatricians can successfully provide topical dental fluoride and dental sealants to large numbers of children.[1]
- South Carolina is a leader in expanded practice for Dental Hygienists.

The Appalachian Region would benefit from a high level policy initiative involving the insurance industry, dentists, and public health officials in setting goals for minimum dental care for all residents. The American Dental Association (ADA) is working to increase dentist participation in Medicaid (ADA. 2011).

STATE ORAL HEALTH INSURANCE COVERAGE

Little is written about total dental insurance in the United States. Most studies focus on children. Medicaid, state children's health insurance programs (SCHIP), and private dental insurance are the primary sources of insurance coverage for dental care. The Federal Employees Health Benefits Program includes generous dental coverage. However, few non-governmental employers offer dental insurance. Publically available, consistent data for all of these are limited to the NHIS national data and state summaries, which are reported by the KFF. Data are difficult to assemble, because insurance eligibility can change from month to month, depending on a person's income status and employment status.

BRFSS no longer includes questions about dental insurance, so national oral health insurance data will, at best, be restricted to special studies and state level summaries. Coverage increased as income increased. Data from the NHIS, for January to June 2011, indicated that 82.6 percent of persons under 65 had health insurance (Martinez and Cohen. 2011). They note that 40.1 percent of children were covered by public plans, compared to only 15.7 percent of adults.

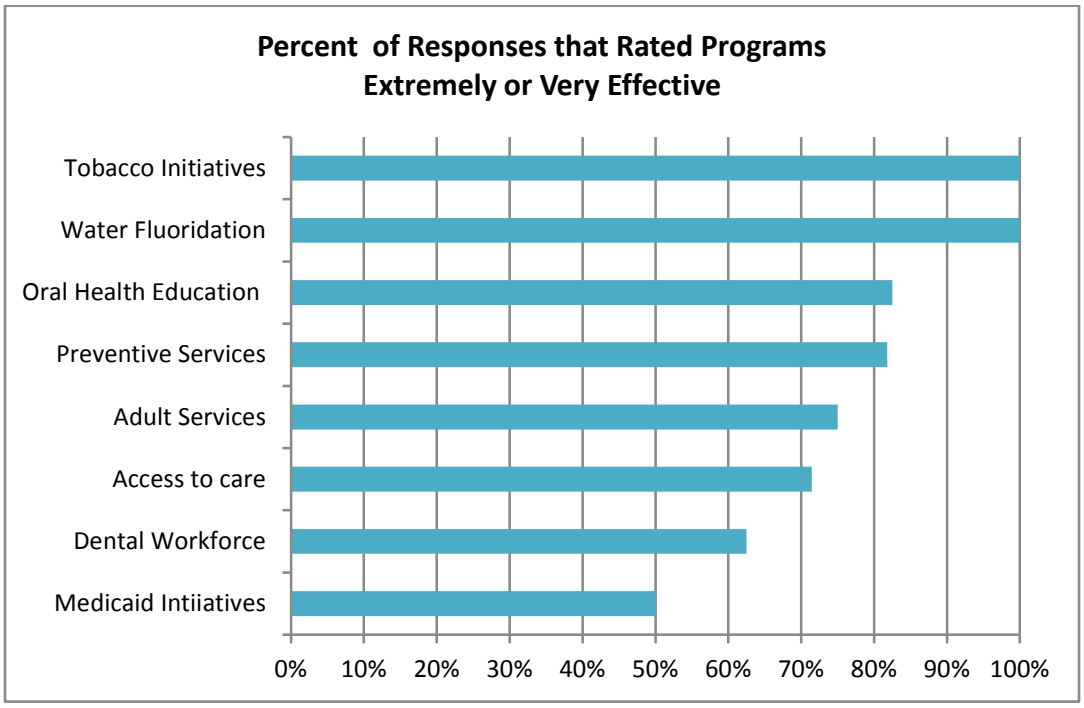
This emphasizes the critical role played by Medicaid in dental insurance of children. Martinez and Cohen also note that the near poor are more likely than the poor to lack any health insurance coverage. A survey of 1,000 people, conducted by Brighter.com in June 2010, showed that a third of those without dental insurance have been to a dentist once or less in the last decade[2].

[1] Communicated to Thomas R. Konrad, UNC.
[2] Linked In news 12 entrepreneurs reinventing health care, online, Jan 5, 2011, 12 reporting from CNN Money

BEST PRACTICES IN STATE ORAL HEALTH POLICIES

Public oral health programs focus primarily on public water supply fluoridation, topical fluoride applications for children, and incentives for providers working in or caring for underserved populations. States struggle to sustain programs that provide dental care for adults. In a telephone interview survey, 31 Appalachian policy makers representing all 13 states reported highest levels of satisfaction with community health interventions: fluoridation, tobacco cessation initiatives and education. At least half reported all of the programs tried were "very effective," though the direct care and workforce subsidies were rated "extremely" or "very effective" less often than the community-wide programs (Figure 1). Costs of sustaining direct intervention programs, compared to the number of people reached, were major reasons for rating programs low on effectiveness.

FIGURE 1 – STATE PUBLIC HEALTH OFFICIAL EVALUATION OF DENTAL HEALTH INITIATIVES



Source: 2009 Survey of Appalachian Oral Health policy makers, University of Mississippi Medical Center, Appendix F.

Though not reported in the surveys, individual states like Kentucky and West Virginia are working in conjunction with state dental schools to improve children's oral health, focusing on schools, family awareness and cooperation with private dentists. These anecdotes were shared at the ARC 2011 *Healthy Families, Healthy Future* Conference

The Pew Charitable Foundation's Oral Health Project is rating states on their attention to children's oral health. Appalachian states, as a whole, are average; however, South Carolina, Maryland and West Virginia have achieved top national scores.

POLICY ISSUES

Appalachian states have launched creative oral health disease prevention initiatives at the community level: fluoridation and education; and at the personal level: expanded practice, school services and sealants for children under six, and incentives to work in underserved areas. Workforce and scope of practice limitations are determined at the state level.

Throughout the Appalachian Region, and elsewhere, poverty is consistently associated with lower oral health indicators. Because the challenges are large, ARC-facilitated sharing forums are very helpful for providing more current information across state lines on both successful and unsuccessful initiatives.

In order to see trends in oral health in the Appalachian Region over time, policy makers need consistent data that can be geographically associated with Appalachia and its sub-regions. The optional nature of dental health questions, the small sample frame and the telephone source of information all inhibit use of BRFSS or NHIS data for this purpose. Making them useful would require oversampling in a sample frame specific to the Appalachian Region. This would produce reliable year to year measures of the impact of state initiatives. Unfortunately, BRFSS is a state-federal initiative that permits each state to select and adjust the questions asked on the survey. States fund the survey efforts in proportion to the size of their sample and scope of questions.

CHAPTER 1 INTRODUCTION

1.1. ORAL HEALTH AND THIS REPORT

Although oral health care is integral to overall health, it is not typically awarded the same priority as basic medical care (Allukian. 2008). Access to care and ability to obtain and keep dental insurance are some of the leading economic causes of oral health disparities in the United States (CDC. 2009). Socioeconomic characteristics and cultural values also contribute to oral health disparities, particularly in regions like Appalachia (Behringer, et al. 2007).

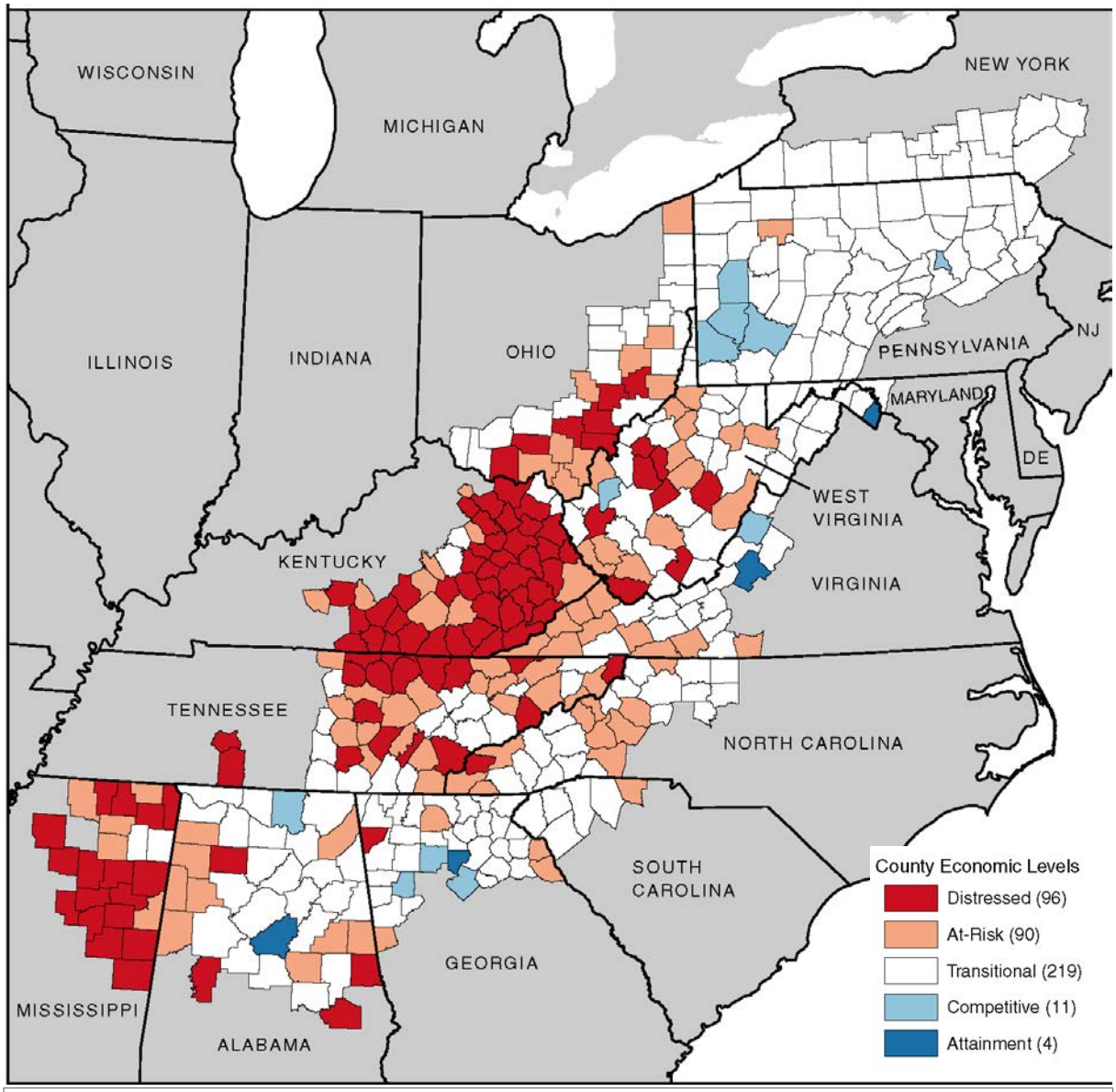
There are many practices in place to help reduce oral health disparities, such as community water fluoridation, application of dental sealants, smoking cessation programs, disease prevention efforts and increased awareness of the importance of proper oral hygiene, like brushing and flossing. Despite the positive impact of preventive methods, oral health disparities still exist (CDC. 2009). Many oral health indicators correlate positively with socioeconomic measures of income and education, as well as measures of race, ethnicity and age (CDC. 2009). Behringer, et al. (2007) compiled a list of general characteristics that set the Appalachian Region apart from the rest of the United States, many of which contribute to oral health disparities in the region. Chief among these characteristics are high levels of poverty, low levels of health insurance coverage and the rural nature of the region, which limit access to health care of any sort (Behringer, et al. 2007).

This study was funded by the Appalachian Regional Commission (ARC) in order to analyze disparities in oral health status and access to oral health care in the Appalachian Region. It also examines relationships between oral health disparities and socioeconomic status indicators. The data and analyses included in this report compare the Appalachian and non-Appalachian metropolitan and non-metropolitan areas, as well as the Appalachian Region, to the rest of the country. Comparisons at the county level within the Appalachian Region are included where data were available. The purpose of this report is to allow for increased understanding of oral health disparities and their contributing factors, and aid efforts to develop targeted interventions to reduce these disparities in Appalachia.

1.2 THE APPALACHIAN REGION AND THE ARC

ARC was instituted by the federal government in 1965, with the objective to promote economic and social growth in the Appalachian Region. As shown in Figure 2, the region extends from southern New York to northeast Mississippi and includes 420 counties in 13 states. Other states in the region include all of West Virginia and portions of Alabama, Georgia, Kentucky, Maryland, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee and Virginia. Of the 420 counties, 82 were designated “economically distressed” in 2011. According to the ARC (2009), approximately 24.8 million people resided in the region.

FIGURE 2 – COUNTY ECONOMIC STATUS IN APPALACHIA, FY 2012



The Appalachian Regional Commission uses an index-based county economic classification system to identify and monitor the economic status of Appalachian counties.

Map Created: March 2011.
Data Sources: U.S. Bureau of Labor Statistics, LAUS, 2007-2009;
U.S. Bureau of Economic Analysis, REIS, 2008;
U.S. Census Bureau, American Community Survey, 2005-2009.

ARC APPALACHIAN REGIONAL COMMISSION
HEALTH CARE COSTS AND ACCESS DISPARITIES IN APPALACHIA
Download at www.arc.gov/research

Source: Appalachian Regional Commission. www.arc.gov.

1.3 Organization of the Report

This report is presented in seven chapters, followed by supporting appendices. Chapters 2 through 4 address three measures of oral health in the Appalachian Region and compare them with the rest of the United States. Chapter 2 examines three major indicators of oral health, and discusses socioeconomic status as it relates to oral health disparities. Chapter 3 assesses characteristics of and trends in the oral health workforce, the effects of changes to the professional responsibilities of dental hygienists, and the challenges the dental community faces to meet the needs of the population. Chapter 4 reviews oral health insurance coverage, both state-sponsored and private-payer. Chapter 5 identifies best practices in state oral health policies. Chapter 6 summarizes the findings and makes recommendations for Appalachian Regional Commission interventions to improve oral health. In Chapter 7, references cited in the report are listed alphabetically, by author. Appendices contain the synthetic statistical analyses and survey materials.

CHAPTER 2 ORAL HEALTH INDICATORS

2.1 FINDINGS

2.1.1 SELECTION OF INDICATORS

Healthy People 2010 identified seventeen objectives related to oral health. These objectives are sometimes referred to as oral health indicators, and include dental caries experience, untreated dental decay, tooth removal from disease-related causes, periodontal diseases, oral cancer, use of dental sealants, public water fluoridation, and use of the oral health care system, among others (DHHS. 2001). In this report, we include analysis of three such indicators in the Appalachian Region and nationally: fluoridation of water supplies, a preventive measure; dental visits, an access measure; and tooth loss, an outcome measure.

2.1.2 FLUORIDATION OF WATER SUPPLIES

HISTORICAL CONTEXT

Water fluoridation was introduced in the twentieth century as a means to prevent dental caries (Bailey, et al. 2008; Kohlway. 2008), and is still considered the most effective method of reducing and preventing the incidence of dental caries (Griffin, Jones and Tomar. 2001; Mouradian, Wehr and Crall. 2000). It is inexpensive and disregards socioeconomic, racial, ethnic or age differences (Allukian. 2008). Some fluoridation occurs naturally. Only areas with low natural fluoride are candidates for supplementation. In 2011, CDC set new standards for water fluoridation at 0.7 ppm (EPA. 2011).

Although professionals continue to debate the proper level of fluoridation to protect teeth without creating challenges to other bone structures, fluoridation remains one of the most cost effective means of maintaining community oral health.

Safe and effective measures exist to prevent the most common dental diseases--dental caries and periodontal diseases. Community water fluoridation is safe and effective in preventing dental caries in both children and adults. Water fluoridation benefits all residents served by community water supplies regardless of their social or economic status (NIDCR. 2000).

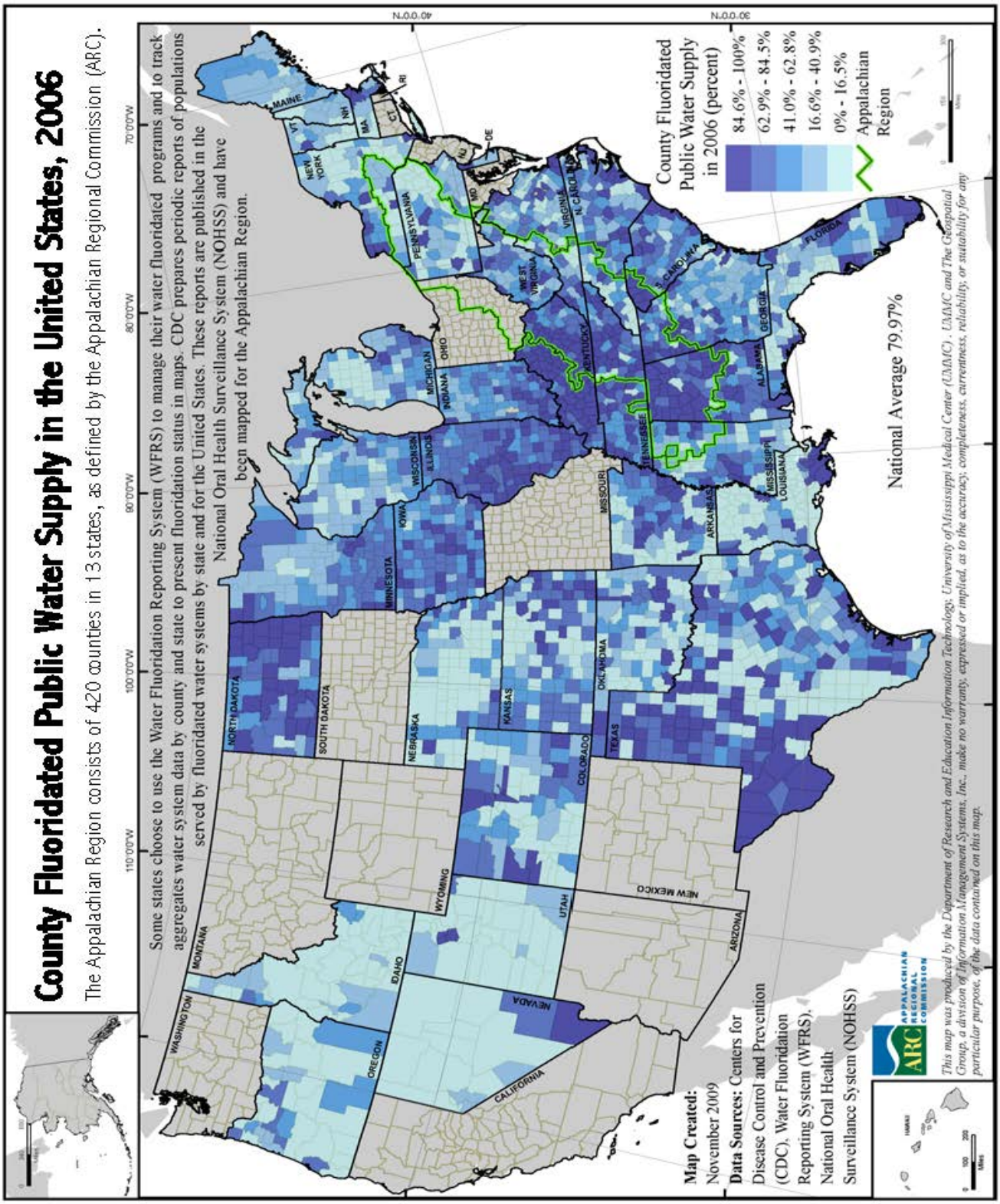
Some water supplies have natural fluoride; sea water, for example, has high fluoride levels. Areas reporting Community Water System (CWS) fluoridation monitor the levels. Others may monitor and not report, or not report and not monitor. In 2006, about 69 percent of the United States population that was served by CWS had access to fluoridated water (CDC. 2007). *Healthy People 2010*, the official public health plan for the United States, stipulated a goal of 75 percent fluoridation of CWS. Overall, public fluoridation efforts among states in Appalachia was very high, with ten of 13 states in the region ranking in the top 20 nationwide, and only one state, Mississippi, ranking in the bottom ten (CDC. 2009). New York was average with 73 percent; Pennsylvania, with 54.2 percent of the population on fluoridated CWS, was close to Mississippi, which reported 50.9 percent.

Population does not distribute evenly across a state's geography. As illustrated in Figure 4, the Appalachian counties in New York and Pennsylvania have very few fluoridated CWS. By contrast, Kentucky, which contains half of Appalachia's distressed counties, ranked highest in the region in 2006 with regard to proportion of persons served by fluoridated CWS (CDC. 2009). However, many people do not have access to or use publicly-supplied water. This "self-supplied" population includes up to 44 percent of residents in some states. This trend is particularly evident in rural areas.

TABLE 1 – APPALACHIAN STATES PERCENT OF POPULATION ON COMMUNITY WATER SUPPLIES WITH FLUORIDATED WATER

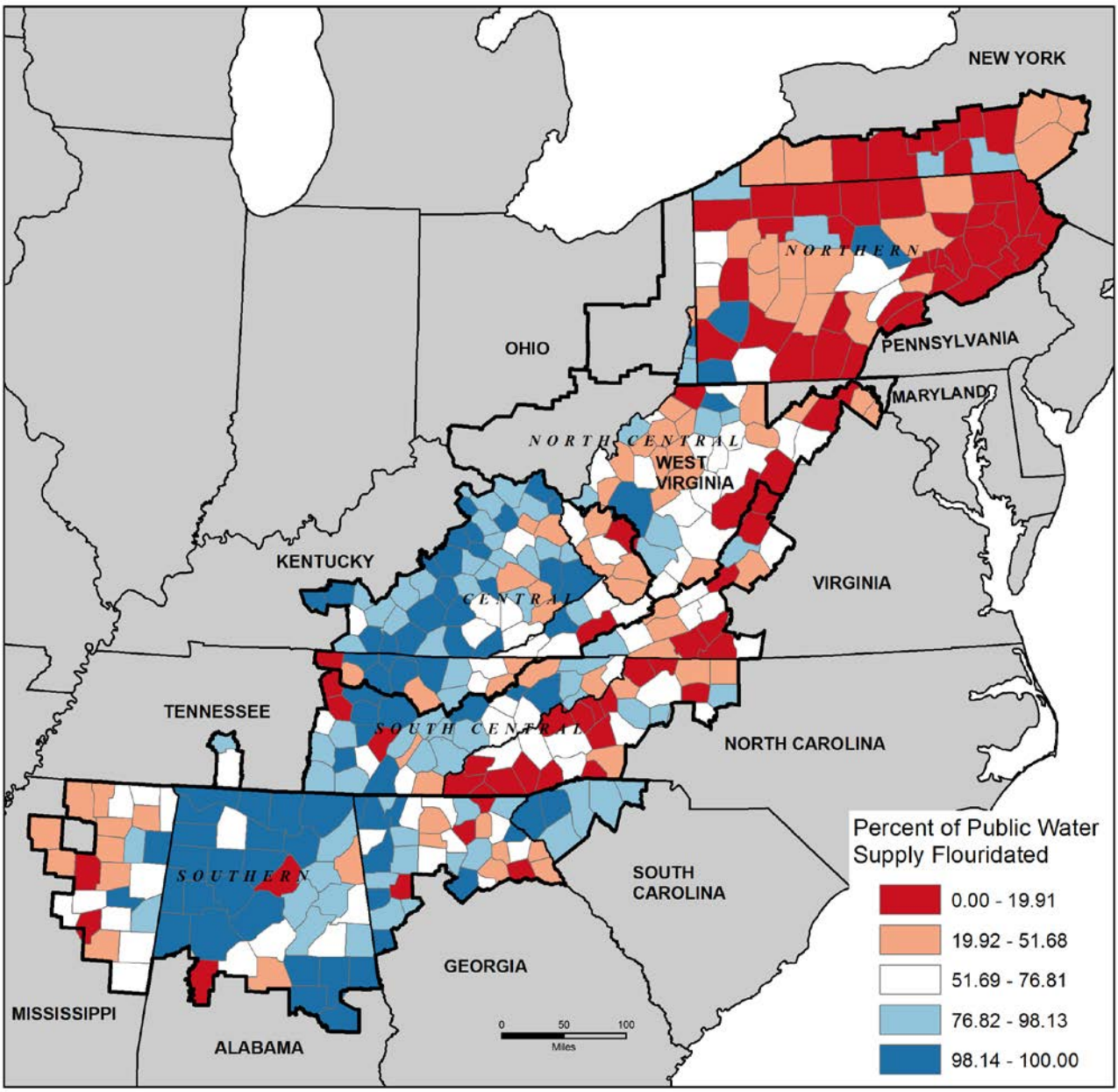
State	2006
Kentucky	99.8
Georgia	95.8
Virginia	95
South Carolina	94.6
Maryland	93.8
Tennessee	93.7
West Virginia	91.7
Ohio	89.3
North Carolina	87.6
Alabama	82.9
New York	72.9
Pennsylvania	54.2
Mississippi	50.9

FIGURE 3 - COUNTY FLUORIDATED PUBLIC WATER SUPPLY IN THE U.S., 2006



Note: Reporting is voluntary. In 2006, Maryland and Ohio did not report county data.

FIGURE 4 – COUNTY FLUORIDATED PUBLIC WATER SUPPLY IN APPALACHIA, 2006



Source: Water Fluoridation Reporting System (WFRS), Centers for Disease Control and Prevention, 2006 and National Oral Health Surveillance System, 2008.

Note: Maryland and Ohio did not report county data in 2006.

Prepared by Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill in cooperation with PDA, Inc, Raleigh, North Carolina, 2011

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States voluntarily report CWS fluoridation at the county level to the Centers for Disease Control and Prevention (CDC)[3]. Because many states do not report data at this level, national comparisons have limited utility. In Ohio, for example, reporting at the county level itself is voluntary. Figure 4 shows wide variation in reported fluoridation of public water supplies among Appalachian counties. Most counties have more than one water supply; hence, percent fluoridated is geographically uneven within a given county. Counties in the top CWS quintile have almost all (98 percent or more) public water supplies fluoridated, whereas counties in the bottom quintile have less than 20 percent of their public water supplies fluoridated. Almost one in five of reporting Appalachian counties was in the top quintile. However, the Southern, South-Central and Central regions show much higher levels of CWS fluoridation than the North-Central and Northern regions of Appalachia. For example, most Appalachian counties in Alabama provide fluoridated water to over 98 percent of residents served by CWS, compared to about half of Appalachian New York, where counties provide fluoridation to less than 20 percent of residents who use CWS. Note that Maryland and Ohio are missing in this sample. A better review of regional fluoride would include both externally supplied and naturally occurring sources. The United States Geological Survey has reported high levels of naturally occurring fluoride in New York and Ohio. However, these data are not annually verified and are subject to change from natural forces.

Table 2 shows persons using self-supplied water as a percent of the total population in Appalachian states. Data are statewide; rural regions are likely to have even higher proportions of people on self-supplied water, thus, less access to fluoridated public water.

TABLE 2 – USE OF SELF-SUPPLIED WATER IN APPALACHIAN STATES, 2005

State	Percent of total population served by self-supplied water
Alabama	11%
Georgia	18%
Kentucky	17%
Maryland	17%
Mississippi	19%
New York	10%
North Carolina	26%
Ohio	17%
Pennsylvania	20%
South Carolina	30%
Tennessee	9%
Virginia	22%
West Virginia	23%

Source: U.S. Geological Survey, 2005. http://ga.water.usgs.gov/edu/wateruse/pdf/wudomestic-2005.pdf

[3] Forty percent of states were not reporting in the most recent data collected; thus, no national analysis on fluoridation was done.

The map in Figure 4 is drawn from CDC data, but the picture is incomplete because it excludes several water systems; self-supplied and school systems are not included. According to the 2005 United States Geological Survey, 10 to 30 percent of residents in 11 of the 13 Appalachian states use self-supplied water (United States Geological Survey. 2005), with disproportionately higher numbers in the rural counties.

Many states also have programs to add fluoride to school water supplies, independent of public water systems, and these are not counted in the CDC statistics. For example, Kentucky's Department of Public Health now provides fluoridated water to all rural schools (Kentucky DPH. 2011) as part of a larger oral health initiative. Kentucky also provides fluoride supplements and oral health education to all households that have small children and no access to a fluoridated water supply.

The research team was unable to find a good comparative source of naturally occurring groundwater fluoride. The United States Geological Survey appears to have a sampling and mapping system that is neither easily accessed, nor consistently updated. The Fluoride Action Network Pesticide Project also tracks naturally occurring fluorides in some state water supplies. However, its website notes that data may not be current[4].

2.1.3 Dental Visits

Historical Context

Defined as "having had a dental visit within the past 12 months," regular dental visits are considered essential to maintaining good oral health and may reduce the incidence of oral health diseases by identifying and treating dental caries early (DHHS. 2000). Dental caries, more commonly known as tooth decay, are the number one childhood disease in the U.S. (Beltran-Aguilar, et al. 2005; Kagihara, Niederhauser, Stark. 2009). Although dental caries are considered preventable (Selwitz, Ismail, Pitts. 2007), the risk of developing dental caries is constant throughout a person's lifespan (Saunders, Meyerowitz. 2005) and the presence of dental caries affects quality of life at all ages (Selwitz, et al. 2007).

Researchers have associated development of dental caries with a variety of factors, including income, education, dental insurance coverage, oral hygiene behaviors, oral health knowledge, cultural beliefs and attitudes, age, race and ethnicity (Selwitz, et al. 2007). Lack of knowledge regarding the importance of maintaining oral health is a major contributing factor to oral health disparities (Selwitz, et al. 2007).

Dental sealants, or plastic coatings applied to the chewing surface of the tooth where decay is most common, have been highly effective in preventing dental caries and preserving good oral health (CDC. 2004). In fact, the 2000 Surgeon General's Report on Oral Health in America found that sealants reduced, by over 70 percent, the risk of developing dental caries; and sealants were cost-effective, especially when used on high-risk children and high-risk teeth. Several community and school-based programs promote use of sealants among dental providers and/or apply them on-site to vulnerable child populations. Reported decreases in caries and increased use of dental sealants occurred at a time when regular children's dental visits remained constant (Dye, et al. 2007).

With regard to demographics, the prevalence of dental caries in adults aged 20 to 64 is lowest among non-Hispanic whites, those with more than a high school education, and those at or above 200 percent of the federal poverty threshold (Dye, et al. 2007).

[4] Fluoride Action Network Pesticide Project. Index to High Levels of Fluoride in U.S. Drinking Water On line http://www.fluoridealert.org/pesticides/levels/index.html

Geographic Variations in Dental Visits

BRFSS sample frames are too limited to provide meaningful information about the oral health of Appalachian children.

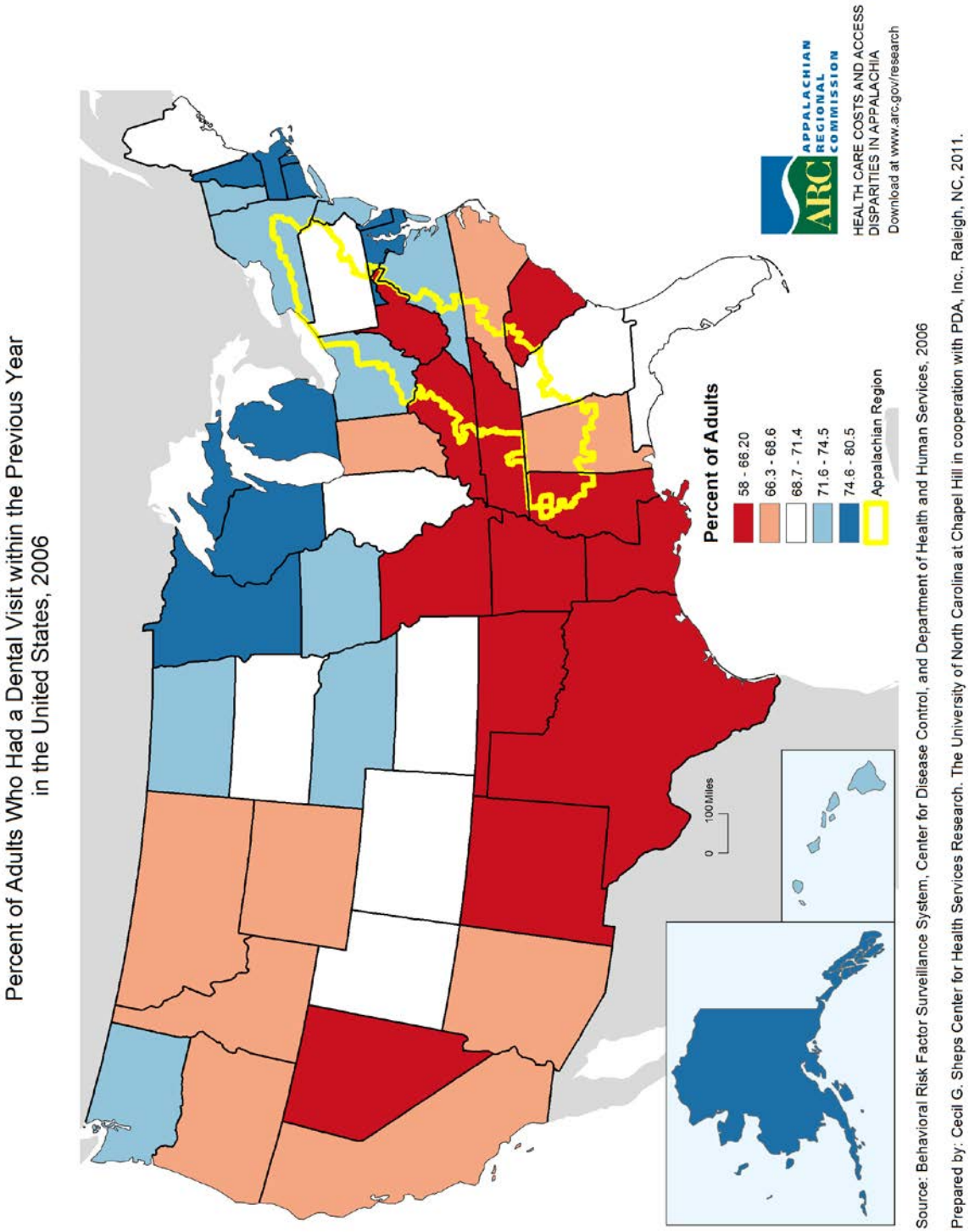
For comparative profiles of dental visits, the CDC Behavioral Risk Factor Surveillance System (BRFSS) and National Health Interview Surveys (NHIS) are the only uniform sources of national data; both studies involve random telephone interview samples and are intended to capture national trends. Most BRFSS dental visit information can be aggregated only for large populations and adults. The amount of BRFSS data on the oral health of Appalachian children between 1999 and 2006 was insufficient for any meaningful mapping or analytical exercise. Similarly, these data sets are too sparse for use in same-year county comparisons; and multi-year comparisons of small area data suffer from variations in sampling frames and question structure.

BRFSS data can be used for state comparisons of adult oral health disparities and the contrasts are stark. Figure 5 shows, at the state level, the percentage of adults responding to BRFSS surveys who reported at least one regular dental visit in 2006. Reports of one visit for individual states ranged from 58 to 80.5 percent of surveyed adults.

The map is scaled in quintiles, with blue areas indicating a high percentage of adults who had a regular annual dental visit and red areas indicating a lower percentage. Nationally, most states in the lowest quintile are in the South and West, while states in the highest quintile are in the Northeast and upper Midwest. On par with the country as a whole, at least half of Appalachia is characterized by red areas, where less than 68 percent of the adult population received a regular dental visit. Five of the ten United States states in the lowest quintile are in Appalachia: Mississippi, Tennessee, South Carolina, Kentucky and West Virginia. Maryland is the only Appalachian state in the highest national quintile for this indicator.

Although this map illustrates unequal use of dental care among state populations, important sub-state variations in availability of dental care, repeated in other limited, small area studies, highlight even deeper disparities in the Appalachian Region. In Appendix C, researchers aggregated BRFSS data over multiple years in order to get enough data to separate Appalachian from non-Appalachian areas. Because the aggregations extend over eight and more years, the information is best interpreted only for trends.

FIGURE 5 – PERCENT OF ADULTS WHO HAD A DENTAL VISIT WITHIN THE PREVIOUS YEAR IN THE U.S., 2006



The NHIS annually samples visits by age group. By 2009, 59.6 percent of the population reported having a dental visit in the past year, with slightly higher percentages of children than adults reporting visits. These data, too, are only reported by state.

TABLE 3 – PERCENT OF PERSONS WHO REPORTED A DENTAL VISIT IN THE PAST YEAR, BY AGE GROUPS, UNITED STATES, SELECTED YEARS 1997–2009

Age	2 years and over			2-17 years			18-64 years			65 years and over[1]		
Year	1997	2008	2009	1997	2008	2009	1997	2008	2009	1997	2008	2009
Total	65.1	63.9	65.4	72.7	77.3	78.4	64.1	60.4	62	54.8	57.6	59.6

Source: CDC/NCHS, NHIS, sample child and sample adult questionnaires. Appendix D.
[1]Based on the 1997 through 2009 NHIS, about 24% to 30% of persons 65 years and over were edentulous (having lost all their natural teeth). In 1997 through2009, about 69% to73% of older persons were edentate and 17%to 21% of older edentate persons had a dental visit in the past year.

A National Survey of Children's Health prepared by the CDC in cooperation with the Health Resources and Services Administration (HRSA) looked at children's preventive dental care in 2007. Data in Table 3 show quintiles by Appalachian state. The average for all states was 79.4 percent. Appalachian states ranked at or above the national average on this metric.

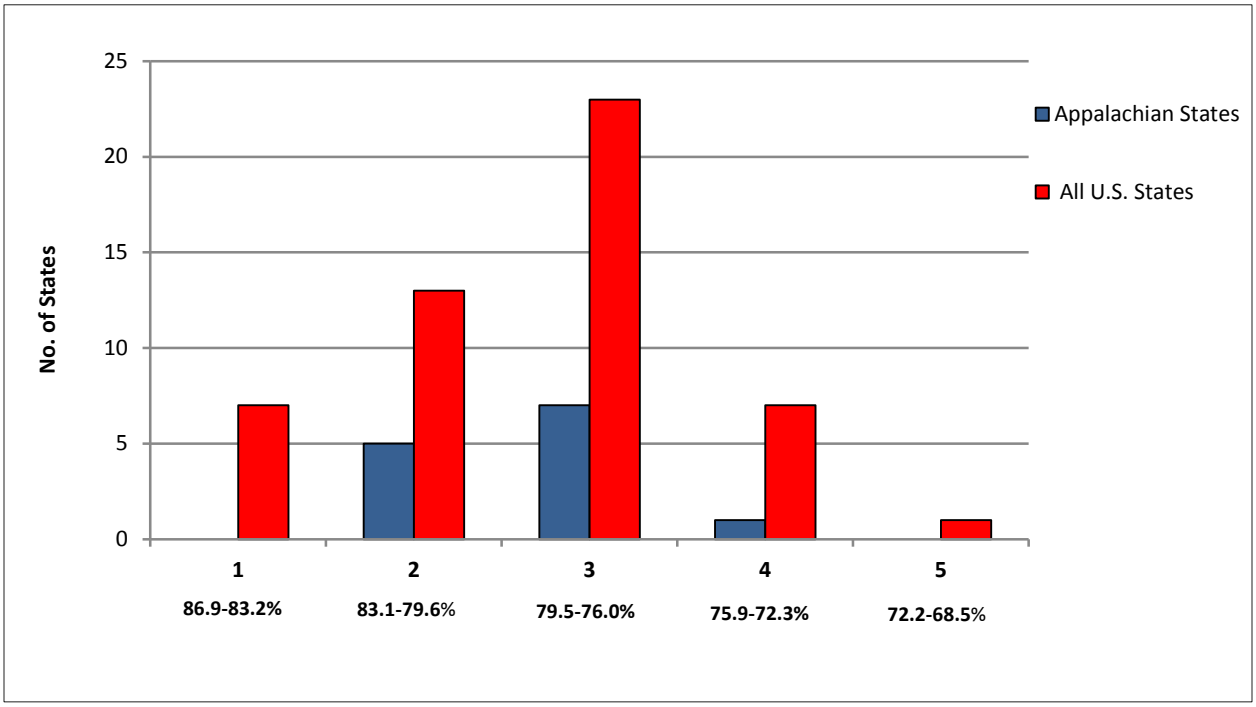
TABLE 4 – PERCENT OF CHILDREN WITH PREVENTIVE DENTAL CARE IN THE LAST 12 MONTHS IN APPALACHIAN STATES, 2007

Appalachian State	Percent of Children Receiving Preventive Dental Care	Quintile
Pennsylvania	82.7%	2
South Carolina	82.0%	2
New York	80.8%	2
Georgia	80.3%	2
West Virginia	80.3%	2
Maryland	79.1%	2
Virginia	79.0%	3
Tennessee	78.8%	3
Ohio	78.7%	3
Alabama	78.4%	3
Kentucky	78.4%	3
North Carolina	78.3%	3
Mississippi	75.5%	4
U. S. Average	79.4%	

Source: National Survey of Children's Health 2007 prepared by HRSA and CDC

Children's use of preventive dental services in Appalachian states was close to the national average. Figure 6 shows no Appalachian state in the highest or the lowest quintiles on the measure of children using preventive dental services in the last 12 months in 2007.

FIGURE 6 – PERCENT OF CHILDREN USING PREVENTIVE DENTAL CARE, 2007



Source: National Survey of Children's Health 2007 prepared by HRSA and CDC
http://childhealthdata.org/learn/NSCH

Year after year, regardless of age, the percentage of NHIS respondents reporting of recent dental visits is smaller for persons inside metropolitan statistical areas (MSA's) than outside MSA's.

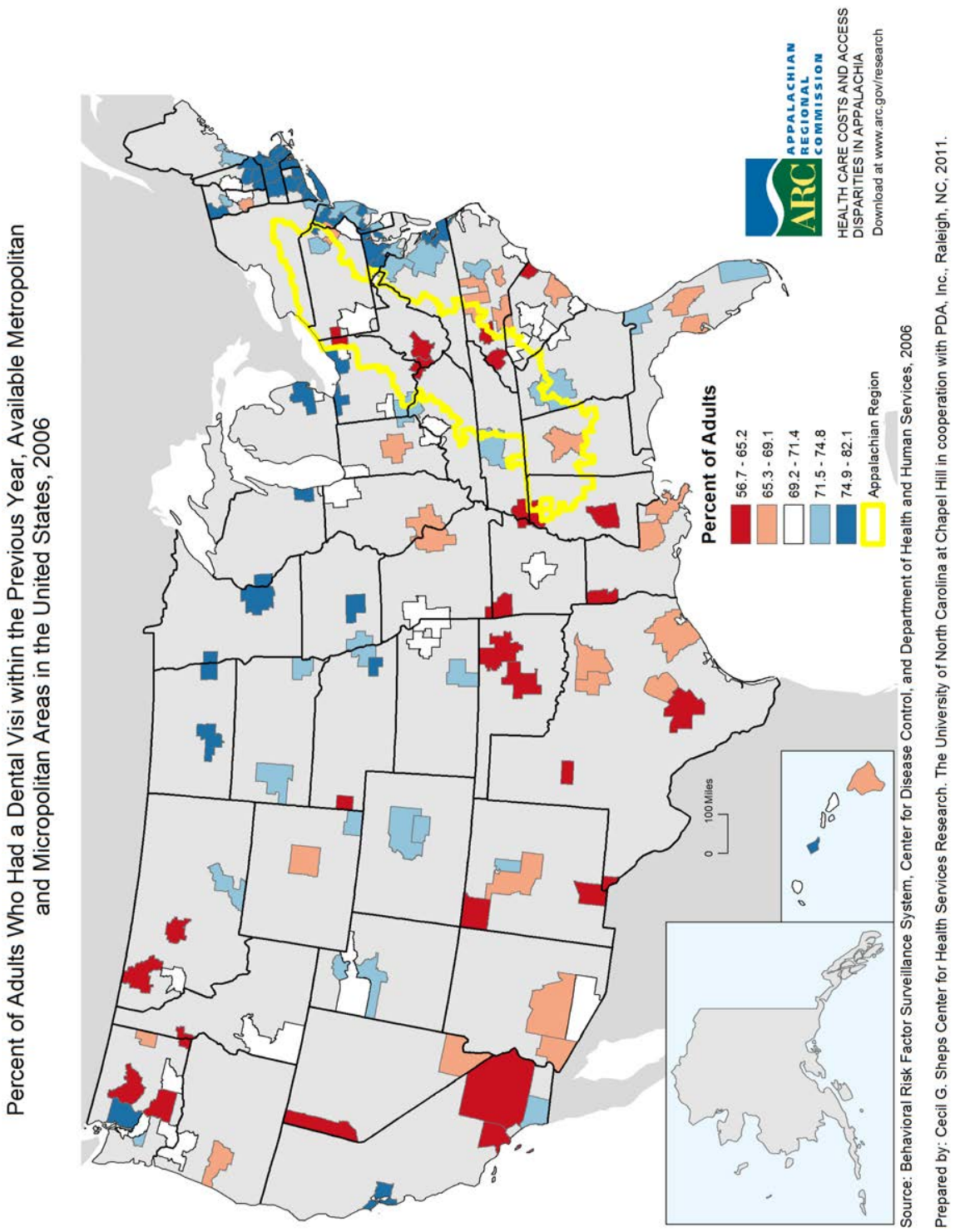
TABLE 5 – PERCENT OF PERSONS WHO REPORTED A DENTAL VISIT IN THE PAST YEAR, BY AGE GROUP, METRO AND NON-METRO AREAS IN THE UNITED STATES, 1997-2009

Age	2 years and over			2-17 years			18-64 years			65 years and over[1]		
Year	**1997**	**2008**	**2009**	**1997**	**2008**	**2009**	**1997**	**2008**	**2009**	**1997**	**2008**	**2009**
Within MSA	66.7	65.1	66.5	73.6	77.7	79.0	65.7	61.5	63.1	57.6	60.3	61.8
Outside MSA	59.1	57.9	59.5	69.3	75.1	75.5	58.0	54.5	55.9	46.1	48.3	51.3

Source: CDC/NCHS, NHIS, http://www.cdc.gov/nchs/data/hus/2010/093.pdf See Appendix D.

Figure 7 maps the very limited BRFSS geographic data sample. It shows the geographic limitation of the metropolitan/ micropolitan sample frame. However it illustrates large national geographic variations in adult dental visits even in urban areas. The mapped data are for 2006 for reporting metropolitan (large urban) and micropolitan (small urban) areas throughout the United States. In the surveyed areas, visit patterns were similar to state visit patterns, with about 56 to 82 percent of adults reporting regular dental visits. Southern and Western urban areas favor the lower two quintiles and the Midwestern and Northeastern urban areas fall in the higher two quintiles.

FIGURE 7 –DENTAL VISITS WITHIN THE PREVIOUS YEAR, METROPOLITAN AND MICROPOLITAN AREAS IN THE U.S., 2006



*This map offers a snapshot of the limited data available on dental visits in reporting metropolitan and micropolitan areas, or any area with at least 10,000 people in its "urban care" (U.S. Census Bureau 2011). There are no data for many of the metropolitan areas within Appalachia. Please see Appendix A.

APPALACHIAN STATES

The University of Mississippi Medical Center conducted a statistical analysis of multiple years of BRFSS survey results, which are detailed in Appendix C. The analysis shows that on average, adult residents of Appalachian and non-Appalachian areas reported similar patterns of regular dental care. Table 6 shows the percent of Appalachian adults who reported regular dental visits from 1997 to2007. However, study results indicate that from state to state, adults 18 or older who reported a regular dental visit varied as much as 45 percent. In metropolitan Appalachian Mississippi, only 39.2 percent of adults reported visits within the year, compared to metropolitan Virginia *outside* of Appalachia where 74.2 percent reported visits (BRFSS. 1997-2007). Please see Figure 7 for state results.

TABLE 6 - ADULT ANNUAL DENTAL VISITS 1997-2007, BY LOCATION

ADULTS WHO HAD A DENTAL VISIT WITHIN THE PAST 12 MONTHS

Location	Appalachian Region	Non-Appalachian Region
Metropolitan	**65%**	**68%**
Non-metropolitan	**65%**	**66%**

Source: Observed unadjusted values, from survey responses 1997-2007; BRFSS; CDC.

As noted earlier, the BRFSS data samples do not permit a systematic review at the sub-state level. The map in Figure 7 shows the BRFSS sampling areas for Metropolitan and Micropolitan areas. All other data are sampled in "rest of state categories." The University of Mississippi research team used algorithms to assign values to Appalachian portions of metropolitan and non-metropolitan areas.

Table 23 in Appendix C compares individual Appalachian states on the oral health indicator 'Dental Visit in Last Year', and shows the range of prevalence at a high of 74.2 percent having visited the dentist within the past year for metropolitan Virginia, *outside* Appalachia, to a low of 39.2 percent having visited a dentist in metropolitan Mississippi *inside* Appalachia. That lowest prevalence (rank 49) in Appalachian Mississippi is substantially lower than 48th ranked non-Appalachia, non-metropolitan Mississippi (at 54 percent). For the most part, the metropolitan regions have a higher prevalence of annual dental visits than the non-metropolitan areas. In other words, there is little difference in the prevalence of visits to the dentist in the past year between Appalachia and non-Appalachia metropolitan areas. Thus, the maps in Figures 7 and 9, though limited, do provide insight to oral health status in the region.

2.1.4 TOOTH REMOVAL

FIGURE 8 – SENIORS AGE 65 OR OLDER WITH ALL TEETH REMOVED IN THE U.S., 2006

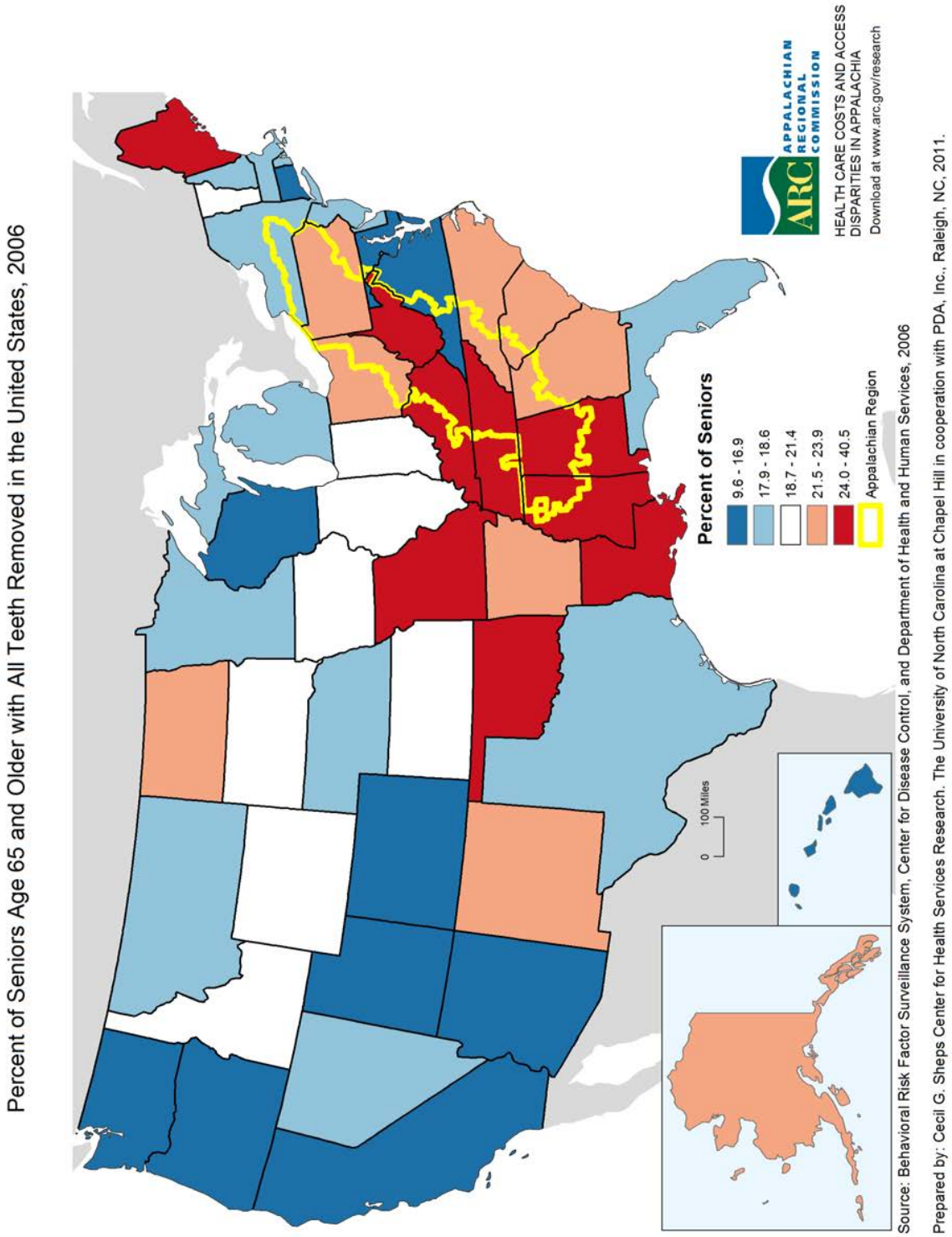
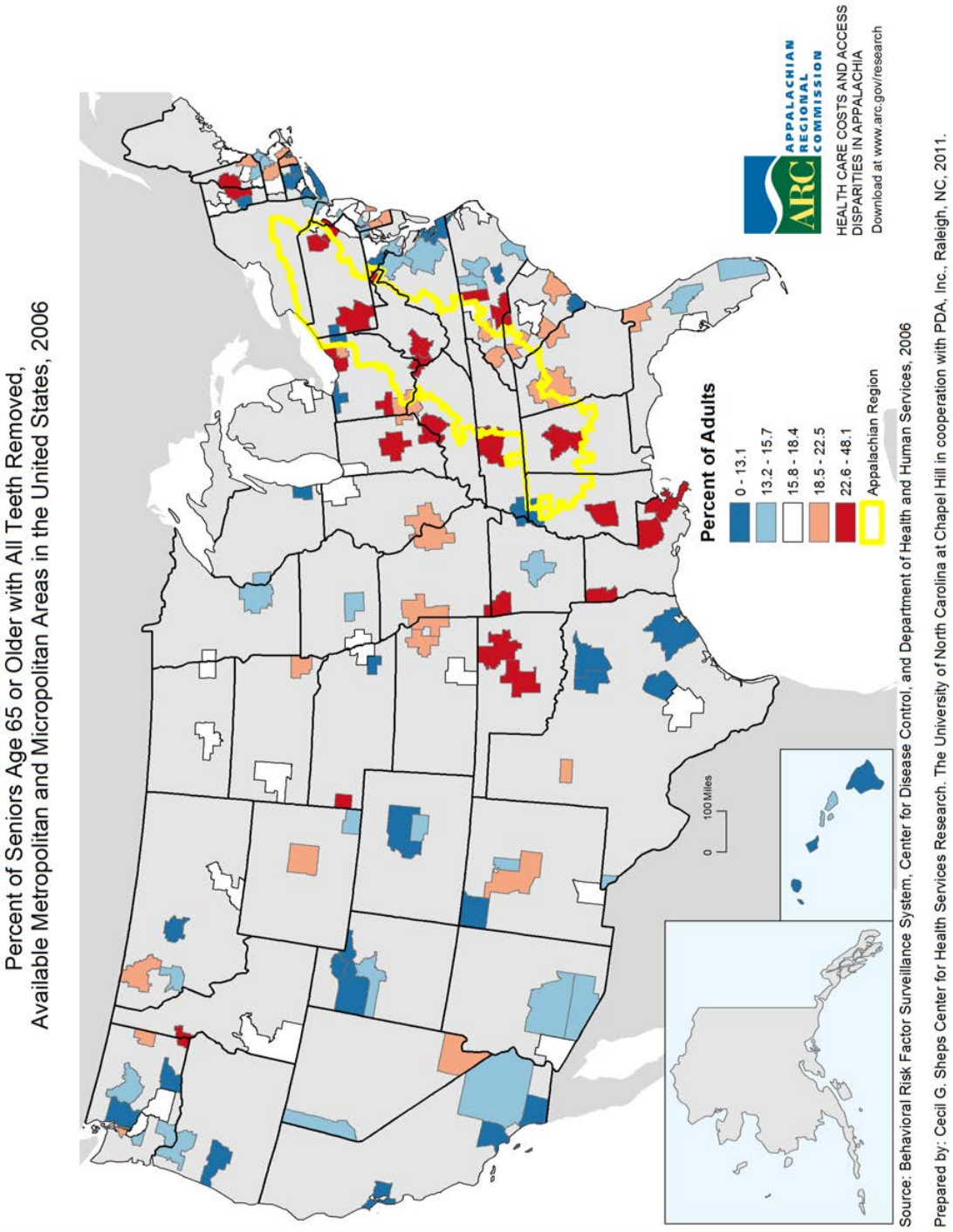


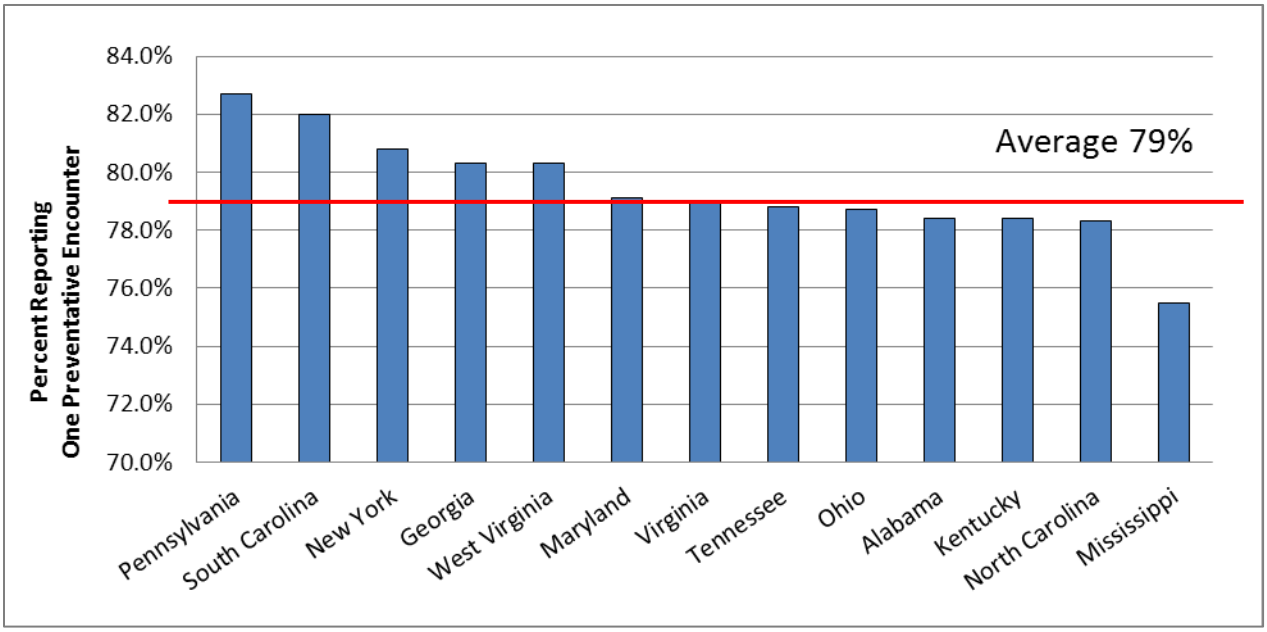
FIGURE 9 – SENIORS AGE 65 OR OLDER WITH ALL TEETH REMOVED, METROPOLITAN AND MICROPOLITAN AREAS IN THE U.S., 2006



*This map offers a snapshot of the limited data available on tooth removal among seniors in the reporting metropolitan and micropolitan areas, or any area with at least 10,000 people in its "urban core" (U.S. Census Bureau, 2011). There are no data for many of the metropolitan areas within Appalachia. Please see Appendix A.

The results of a 2007 survey of children's preventive dental care in Appalachian states are similar to reports for the entire United States. On average, 79 percent of children in Appalachian states reported having preventive dental care in the past year, but Appalachian states represented both the highest and the lowest in the United States. However, even in the lowest state, Mississippi, 75.5 percent of children reported receiving preventive dental care. In Pennsylvania, 82.7 percent reported receiving preventive dental care (CDC. 2007).

FIGURE 10 – STATUS OF CHILDREN'S PREVENTIVE DENTAL CARE IN APPALACHIA, 2007



Source: National Survey of Children's Health 2007, Department of Health and Human Services, Maternal and Child Health Bureau of the HRSA.

These reports merely scratch the surface; none tested completeness of care or distinguished between screening and treatment. The National Survey of Children's Health (2007) also noted that family income and presence of dental insurance accounted for major differences in use of services. "While 82.4 percent of children with private health insurance and 76.2 percent of those with public insurance received preventive dental care, only 58.5 percent of uninsured children did so."

Historical Context

Though Tu and Gilthorpe (2005) carefully observed the lack of definitive research to determine whether the relationships between tooth loss and good health is truly causative or an outcome of other bad health practices, primarily smoking, researchers agree that a relationship does exist.

Sanders, Spencer and Slade (2006) found that adults residing in disadvantaged areas had more teeth removed, on average, than adults residing in more affluent areas. Over time, tooth retention has generally improved among adults (Dye, et al. 2007). While this generally indicates improved oral health, having more teeth also puts a person at an increased risk of dental caries (Selwitz, et al. 2007). Tooth removal in adults is also significantly associated with certain behaviors, such as smoking (Tomar and Asma, 2000; Yanagisawa, et al., 2009). However, details on lifestyle factors are not examined in this report.

State and Metro and Micropolitan Areas

Figure 8 shows state level estimates of the percent of older adults that reported having all of their teeth removed as a result of preventable causes. This is generally considered an indicator of a life history of poor oral health and/or inadequate access to high quality oral health care. States ranged from a low of 9.6 percent (dark blue states) to a high of 40.5 percent (dark red states). Nationally, most states in the lowest quintile were in the Southeast and Lower Midwest, while states in the highest quintile were on the Pacific Coast and Southwest. In general, Appalachian states reflect this pattern: seniors in Southern Appalachian states are more likely to report being edentulous (toothless) than those in Northern Appalachian states. Five of the ten United States states in the lowest quintile are in Appalachia (Alabama, Mississippi, Tennessee, Kentucky and West Virginia), and five more Appalachian states fall within the next lowest quintile (Georgia, South Carolina, North Carolina, Ohio and Pennsylvania). Only two Appalachian states, Virginia and Maryland, both states with relatively few Appalachian counties, are in the highest national quintile that reported the fewest teeth removed.

Similarly, Figure 9 shows the percentage of seniors reporting all teeth removed in the same reporting metropolitan and micropolitan areas described earlier (BRFSS. 2006). The scale ranges from zero to 48.1 percent of seniors. Resembling the state profiles in Figure 8, the Southeast and lower Midwest reporting urban areas favor the lower two quintiles, while the Western part of the country favors the higher two quintiles. Again, Appalachian urban areas appear to be far behind the rest of the country on this metric. Nationally, 27 states contain reporting urban areas that fall within the lower three quintiles (15.8 to 48.1 percent of adults had all teeth removed). In Appalachia, nine of 13 states contain urban areas that fall in this lower range. Only very small parts of Appalachian Pennsylvania, Ohio and Alabama report fewer than 15.8 percent of seniors with all teeth removed among reporting urban areas.

These samples are too incomplete to provide conclusive assessments. At best, they suggest areas for more detailed investigation.

APPALACHIA

The wide variation in patterns of oral health indicators among Appalachian states and between metropolitan and non-metropolitan areas is less noticeable when the Appalachian Region is considered as a whole. Table 7 shows degrees of tooth removal reported by residents of Appalachian states over an eight-year period (from 1999-2006). Because BRFSS surveys contained too few samples from the Appalachian Region to provide significant information in a single year, raw survey data were extracted and summarized over the eight year span.

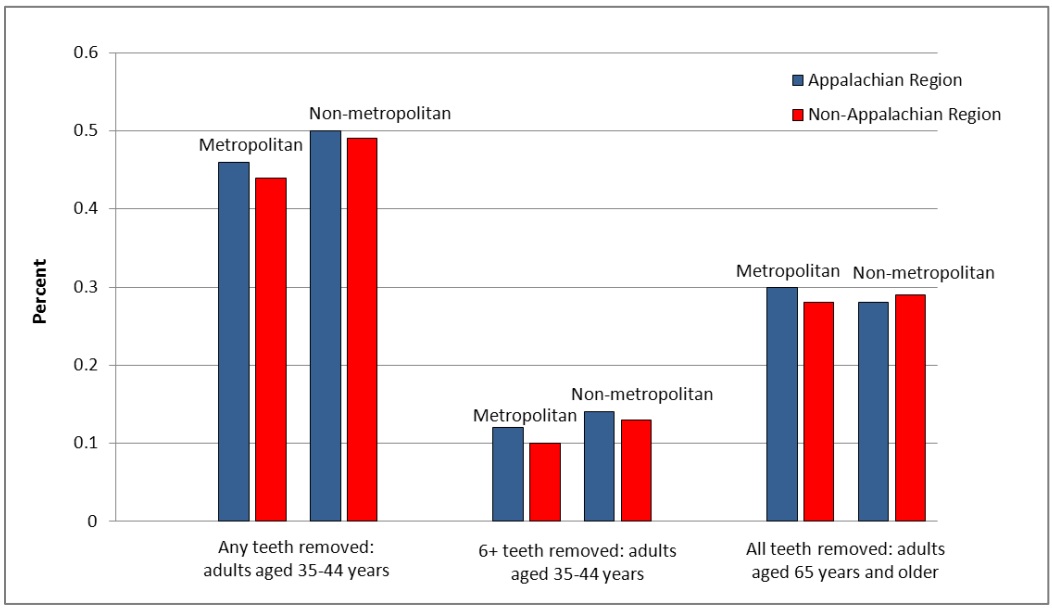
Appendix C contains the statistics by state for each of the years. At the aggregate level, geographic patterns are similar inside and outside Appalachia. At the small area level, adults with any teeth removed varied from only 31.1 percent in metropolitan Virginia, *outside* of Appalachia, to 65.2 percent in Appalachian areas of non-metropolitan Kentucky. Similarly, adults in this age range, with six or more teeth removed, varied in Appalachian regions from only 4.5 percent in metropolitan Georgia to 25 percent in non-metropolitan Kentucky. Geographically, seniors, adults aged 65 or older, reporting all teeth removed varied almost 40 percent. Reporting metropolitan areas differed substantially. Only 14.4 percent of seniors in metropolitan Virginia, *outside* of Appalachia reported all teeth removed; this compares to 54.3 percent in non-metropolitan areas of Appalachian Kentucky. Because of the time lapse in the data, results should be considered indicators rather than exact measures. Any teeth removed, refers to removal only as a result of disease or decay.

TABLE 7 - ORAL HEALTH STATUS IN APPALACHIAN STATES 1999 -2006

Location	Appalachian Region	Non-Appalachian Region
Any teeth removed: adults aged 35-44 years		
Metropolitan	46%	44%
Non-metropolitan	50%	49%
6+ teeth removed: adults aged 35-44 years		
Metropolitan	12%	10%
Non-metropolitan	14%	13%
All teeth removed: adults aged 65 or older		
Metropolitan	30%	28%
Non-metropolitan	28%	29%

Source: BRFSS and CDC, 1999-2006. Data assembled by University of Mississippi Medical Center, 2010.

FIGURE 11 – REPORTED TOOTH LOSS BY AGE AND METRO VERSUS NON-METRO GEOGRAPHY 1999-2006



Source: BRFSS Raw Survey Data 1999-2006. Statistics. See Appendix C.

For all three oral health indicators, the variable that explains any apparent small differences between Appalachian and non-Appalachian counties or between metropolitan and non-metropolitan counties is the level of poverty in the county in which these individuals lived. People, who live in counties where a larger percentage of the population is poor, tend to be less likely to report a dentist visit and report poorer oral health status as measured by tooth removal. When data were statistically controlled for the level of poverty of the community, any distinctive Appalachian or non-metropolitan effect was less apparent. The statistical analysis supporting this conclusion is developed in Appendix C.

2.2 METHODOLOGY

2.2.1 NOTE ON DATA

There is a dearth of meaningful, up-to-date data available for the study of Appalachia's oral health status. The majority of available data are from survey results that are five to 13 years old. Small sample sizes in those databases have required that multi-year (and often multi-state) data be aggregated in order to produce meaningful analysis. Even then, for the oral health indicators studied, there was insufficient data to draw any meaningful conclusions about the current oral health status of children. The data used in this study do not include measures of lifestyle behaviors, such as oral hygiene, nutrition and tobacco use, which also influence oral health status.

2.2.2 Fluoridation of Water Supplies

Data Sources

About 60 percent of states voluntarily report the counties that fluoridate public water supplies to the CDC, and these are made public. The most recent available data on this indicator is for 2006. With 40 percent of states not reporting, national analysis was unreasonable. Fortunately, all but two Appalachian states, Maryland and Ohio, reported on this indicator in 2006. Thus, a map of Appalachian counties presents a reasonable comparison. Please see Figure 4.

The water fluoridation measure used in this study is the percent of the county population receiving fluoridated water from public water supplies. Data for all United States counties were obtained from the CDC (CDC. 2009). A spreadsheet of these data was created for analytical and mapping purposes. Not only are data voluntary and may not be reported by all states, they are continuously sampled. Data are updated every 24 hours. Spreadsheet data mapped in Figures 3 and 4 are scaled differently. In Figure 3, the scale is distributed in a normal bell curve. Figure 4 data are distributed evenly in five percentile groups. Percentages listed in the legend are those associated with the percentile group.

The National Survey of Children's Health (2007) was sponsored by DHHS, Maternal and Child Health Bureau of the HRSA and conducted under contract to University of Chicago National Organization for Research at the University of Chicago. These were telephone interviews conducted from April 2007 through June 2008 producing a sample of 91,642 completed interviews for children ages 0 through 17.

Data Analysis

A spreadsheet of data from all counties in the 11 reporting Appalachian states was created for analytical and mapping purposes, and can be found in Appendix C. Figure 4 was produced to depict fluoridation efforts in Appalachia; blue areas represent those counties in the upper two quintiles, and with the most fluoridation; red areas represent those counties in the lower two quintiles, and with the least fluoridation.

Mapping

Water fluoridation at the national level, Figure 3, was prepared by researchers from the University of Mississippi Medical Center. Figure 4 was produced from raw data assembled by the University of Mississippi researchers, and regrouped to display five equal categories on a color scheme that represents low performance, in red, to high performance, in blue; white represents average percentages. Both maps represent percentage of community water supplies that were fluoridated.

2.2.3 Dental Visits and Tooth Removal

Data Sources

Data on regular dental visits and tooth removal are publicly available from a CDC-sponsored, state-administered annual survey, BRFSS. The BRFSS is an extensive, continuous telephone health survey used for monitoring health conditions and health-risk behaviors across the entire United States, the District of Columbia, Puerto Rico, U.S. Virgin Islands and Guam. The survey is designed to estimate state-level information on health behaviors and disease prevalence through the use of a probability sample accomplished through a random selection of telephone numbers. Most data are available only at the state level and are current only to 2006.

For the state and metro/micropolitan analyses, only 2006 (single-year) BRFSS data were used. For the Appalachian area analysis, no single year of BRFSS data set is sufficient for generalized analysis. Thus, the analyses here involves aggregate BRFSS data over eight to eleven years, 1999 through 2006 and 1997 through 2007, to estimate oral health status and service use in smaller sub-state areas within the Appalachian Region.

The complete BRFSS dataset for 1999 through 2006 contains 2,085,241 individual records based on yearly probability samples aimed at estimating prevalence of health indicators and health behaviors for all 50 states. Of these, only 543,204 respondents, to three different questions, came from the Appalachian Region. Four oral health indicators were obtained from the BRFSS datasets: adults who reported a dental visit within the past 12 months, those aged 35 to 44 reporting any tooth removal, those aged 35 to 44 reporting six or more teeth removed, and those aged 65 or older reporting all teeth missing. Table 8, which lists the small and varying annual sample sizes for the indicators, demonstrates why researchers aggregated so many years of data. However, data aggregated over so many years should be considered carefully and with limitations.

Table 8 - Sample Sizes for Oral Health Indicators: Number of Appalachian Respondents by Year (n=543,204)

Year	Adults who had a dental visit within the past 12 months	Respondents for six tooth removal indicators, aged 35 to 44	Seniors aged 65 or older with all teeth removed
1999	40,898	8,919	7,864
2000	9,766	2,268	1,578
2001	15,599	3,306	2,901
2002	67,931	13,747	14,273
2003	23,965	4,840	4,660
2004	79,227	14,771	18,082
2005	9,511	1,638	2,293
2006	95,441	16,614	25,230
Total	**342,338**	**65,103**	**76,881**
Number surveyed for this question	**342,338**	**65,614**	**76,881**

Source: CDC/BRFSS, 1999-2006. See Appendix C. Note annual totals do not match reported surveys for the Ages 35-44 group.

Using this dataset to draw generalizations about the Appalachian Region as a whole has important limitations:

- BRFSS responses are not reported each year in every state. Thus, if only one or two states reported much of the data on a single indicator, estimates at the regional level might disproportionately reflect the situation in the reporting states and not accurately reflect the overall region.
- Not every question is asked in every state, so some indicators may be heavily skewed toward certain states and less representative of the entire region.
- Numbers of responses differ substantially from year to year; for example, nearly ten times as many people responded about dental visits in 2006 (95,411 people) as in 2005 (9,511 people).
- The total sample sizes of aggregated data are still small, relative to the 24.8 million people in the region.
- Some data appear to be missing for the 35 to 44 age group.
- All data were collected by random telephone survey. Samplers in most states tried to incorporate cell phones.

The University of Mississippi Medical Center analysis did summarize information at the state level, and is included in Appendix C. Though the data indicate wide variation in oral health status measures among the Appalachian states, the limitations urge the reader to avoid drawing conclusions about individual states. The more important message is in the absence of a reliable baseline estimate of annual change in Appalachian oral health status.

The CDC, National Center for Health Statistics (NCHS) maintain several databases from interview surveys. However, with regard to dental care, none is robust enough to provide information at the Appalachian Region-level over time.

DATA ANALYSIS

The BRFSS survey was designed to estimate health behaviors at the state-level, and the yearly estimates are reasonably good approximations of the state-level population prevalence. Estimates for areas smaller than the state level require attention to sample size issues. The data may be sparse when isolated to small local areas, particularly when further separated for three age-specific oral health/behavior indicators. The CDC suggests that estimates be based on at least 50 individual observations for a specific small area. As a first attempt at analysis, University of Mississippi research team estimated the prevalence proportions for each of the three indicators at the county level. In the Appalachian states, there are a total of 1,070 counties. Of these, only 531 counties had at least one respondent to at least one of the oral health/behavior indicator questions. The strict requirement of at least 50 observations retains estimates for a reduced number of counties as listed in the following table:

TABLE 9 - ASSESSMENT OF COUNTIES IN APPALACHIAN STATES REPRESENTED IN BRFSS DATA

Indicator	Number of counties with 1+ observations	Number of counties with 50+ observations
Visit Within 1 Year	504	496
Any/Major Removal (35-44)	503	260
Major Removal (65+)	503	311

Source: BRFSS Surveys aggregated 199-2006, See Appendix C.

Therefore, difficulties with sample size requirements for the BRFSS county-level estimates warranted other approaches for identifying differences between Appalachian and non-Appalachian Regions within the Appalachian states. Initially, the University of Mississippi research team considered using the county-level prevalence estimates of the oral health/behavior indicators from the aggregated 1999-2006 BRFSS data.

MSA and non-MSA conclusions were developed by aggregating BRFSS data from Appalachian states to metropolitan versus non-metropolitan and Appalachian versus non-Appalachian Regions within each state. Area estimates were made for 39 separate regions, with varying levels of precision (see Appendix A for map of regions used, and detailed statistical analyses). Note that the number of children in the survey was still too small to use for separate analyses.

The major limitations of this method include: better estimates in metropolitan areas than in rural areas; better estimates for adults than for children; and a lack of adequate data points for meaningful county-level estimates. Moreover, the large deficiency of county-level and rural data leave a largely incomplete picture of the current state of oral health in Appalachia. Increased data collection, or over-sampling, in the Appalachian Region is highly advised as a part of future policy and best practice recommendations.

As noted in Appendix C, the University of Mississippi research team submitted a proposal to the NCHS Research Data Center requesting oral health indicator data from the NHANES survey aggregated to the county-level for the Appalachian states. After several revisions and conversations with NCHS staff, they received the following from an NCHS reviewer:

"As I understand the analyses of interest, the researchers are interested in presenting oral health measures stratified by individual counties. **The proposed analysis cannot be done without presenting disclosure risk. We do not allow presentation of data at the county level**. Secondly, there are practical issues that raise questions about the feasibility of the analysis as planned. NHANES goes to 30 sites (which are individual counties) per year. Respondents are not selected to be representative of the population of individual counties."

MAPPING

Reported Dental Visits, and Teeth Removed, were mapped using data prepared by researchers from the University of Mississippi Medical Center (Krause. 2010) or directly from data extracted from HRSA Area Resource Files by the Cecil G. Sheps Center for Health Service Research, University of North Carolina at Chapel Hill. Unless otherwise noted, the UNC Sheps staff opened the Mississippi map compositions, found locations of source data and made new maps in a consistent style, using categories determined by national quintiles. Data sources and attribution were inferred from information in a first draft of this report (Krause. 2010) and data archives labeled as being source data for maps.

2.3 Summary and Discussion

2.3.1 Oral Health Indicators and Appalachia

Spatial analyses of water fluoridation, dental visits, and tooth extractions generally reflect poorer oral health in parts of the Appalachian Region than in the nation as a whole. Nationally, metropolitan areas reported better oral health than non-metropolitan areas, and this trend largely holds true for Appalachia. Southern and Central Appalachian states tend to have poorer overall measures of oral health than Northern Appalachian states. Maryland and Virginia reported the best oral health status, while Southern Appalachian States reported the worst.

While there is substantial variability in the extent of water fluoridation and access to public water supply within Appalachia, most areas in Southern and Central Appalachia fluoridate 75 percent or more of the public water supply. Northern Appalachia is less active with water fluoridation efforts, with much of the area fluoridating less than 20 percent of the public water supply. Some states, such as Ohio, have high concentrations of naturally occurring fluoride. Importantly, ten to 30 percent of people in Appalachian states, and likely more in rural Appalachian counties, draw from self-supplied water sources without added fluoride.

Two-thirds of Appalachians reported seeing a dentist in the aggregated BRFSS data from 1997-2007, but half reported disease-related tooth loss, and almost one quarter reported losing six or more teeth to disease or decay in 1999-2006. Appalachian areas generally reported more decay-related tooth loss than the rest of the United States, with Northern Appalachian states reporting fewer teeth lost than Southern states. Almost ten percent of Appalachian seniors reported having lost all of their teeth over the eight-year span.

An important take-away from this study is that state-level analyses oversimplify the variations occurring at sub-state levels. To accurately evaluate the status of oral health in the Appalachian Region and recommend the best targeted approaches, ARC will require collection of more and better sub-state data. BRFSS sampling is too small for county-level analyses. However, future BRFSS sample designs that intentionally separate Appalachian and/or rural versus metropolitan subareas of a state would provide better year to year comparisons.

From **Surgeon General's Report on Oral Health in America**

- Tobacco-related oral lesions are prevalent in adolescents who currently use smokeless tobacco.
- Professional care is necessary for maintaining oral health, yet 25 percent of poor children have not seen a dentist before entering kindergarten.
- Medical insurance is a strong predictor of access to dental care. Uninsured children are 2.5 times less likely than insured children to receive dental care. Children from families without dental insurance are 3 times more likely to have dental needs than children with either public or private insurance. For each child without medical insurance, there are at least 2.6 children without dental insurance.
- Medicaid has not been able to fill the gap in providing dental care to poor children. Fewer than one in five Medicaid-covered children received a single dental visit in a recent year-long study period. Although new programs such as the State Children's Health Insurance Program (SCHIP) may increase the number of insured children, many will still be left without effective dental coverage.
- The social impact of oral diseases in children is substantial. More than 51 million school hours are lost each year to dental-related illness. Poor children suffer nearly 12 times more restricted-activity days than children from higher-income families. Pain and suffering due to untreated diseases can lead to problems in eating, speaking, and attending to learning.

Source: Oral Health in America-a Report of the Surgeon General. U.S. DHHS / NIDCR / NIH. 2000.

2.3.2 Oral Health Indicators and Socioeconomic Status

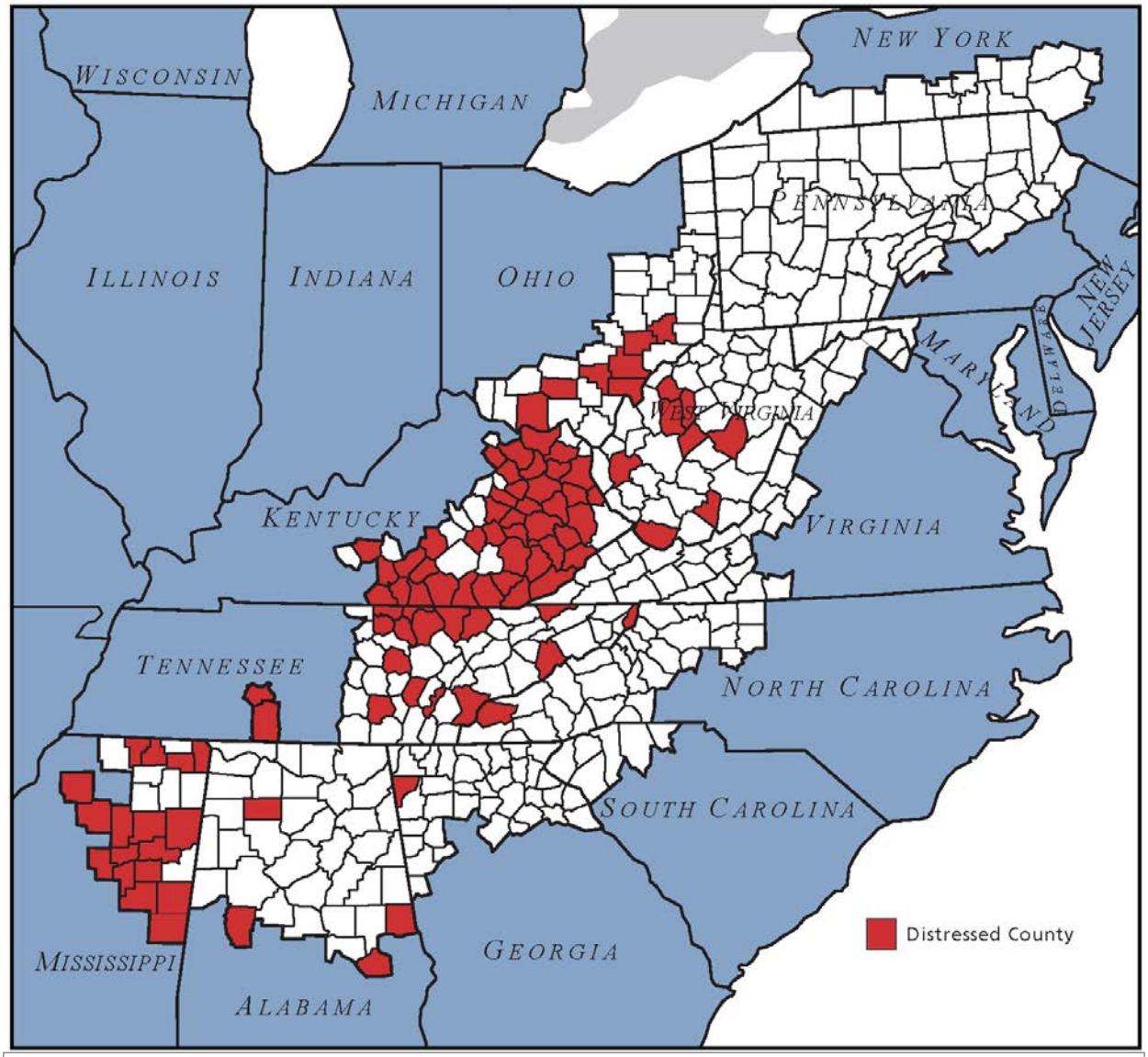
Socioeconomic status (SES) is statistically related to oral health status, as measured in several different ways. This report examines those SES indicators that set Appalachia apart and for which good data were available, including metropolitan versus non-metropolitan status, poverty levels, and—to the extent possible—dental insurance coverage. Other SES indicators, such as percent of school children that receive free or reduced lunch or level of education are not included in this report for lack of data. In general, the Appalachian Region is characterized by high rates of poverty and unemployment, low incomes and a large rural population (Behringer, et al. 2007).

Twice as many people in Appalachia live in rural areas compared to the rest of the U.S. (42 and 20 percent, respectively) (ARC. 2011). The region lags in many health care technological advances, in part because of its more rural nature and high number of uninsured persons (Behringer, Friedell. 2006). Rural areas face more challenges accessing dental care than urban areas. Both workforce size and number of facilities are more limited in rural areas. (Huttinger, Schaller-Ayers, Lawson. 2004: 103). The result is dentists who practice in these areas can be overburdened with patients (Krause, Mosca, and Livingston. 2003). For lower income families, transportation to the few available facilities may not always be feasible (Krause, et al. 2003).

Many non-metropolitan areas have high levels of poverty; and this holds true in Appalachia. The poverty rate in Appalachia exceeded the national average by nearly five percent in 2008 (18 and 13.2 percent, respectively) (U.S. Census Bureau and ARC. 2011). Poverty has long been considered an indicator of poor health in general; however, a study (Hudson, Stockard, Ramberg. 2007) concluded that "[i]n spite of the pervasive cultural images associating poor dental care with poverty, very little of this research has focused on dental and oral health." However, Dye and colleagues (2007) noted that areas with high poverty levels have a higher incidence of decayed, missing, and filled teeth. Low income is also correlated with other SES indicators such as unemployment and lack of dental insurance, which may also affect oral health status.

Within the Appalachian Region, Central Appalachia has the highest concentration of poverty, with about 21 percent of the population in poverty (Lichter, Campbell. 2005). ARC has designated 82 of the 420 Appalachian counties "distressed" based on high poverty rates, high unemployment rates and low per capita income (ARC. 2011). More than half of these counties are in Kentucky. Unfortunately, there are too few data in this report to make current assessments of relationships between poverty areas and oral health at the sub-state level.

FIGURE 12 – ARC DESIGNATED DISTRESSED COUNTIES, FY 2012



Prepared by the Appalachian Regional Commission.

Data Sources:
Unemployment data: U.S. Department of Labor, Bureau of Labor Statistics, LAUS, 2007-2009
Income data: U.S. Department of Commerce, Bureau of Economic Analysis, REIS, 2008
Poverty data: U.S. Department of Commerce, Bureau of the Census, American Community Survey, 2005-2009

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Source: Appalachian Regional Commission. www.arc.gov/research.

We can only note that at the Appalachian Region-level, when data in this study were controlled for socioeconomic indicators (SES), geographic differences disappeared. Details on that analysis are contained in Appendix C. Poverty, low income in the community and low levels of insurance in the community correlated with low rates of dental visits. Poverty and rural location correlated with high rates of tooth removal. See Table 27.

Dental care does not receive the same priority as basic medical care for residents in the region and this is attributed to household budget constraints (Huttinger, et al. 2004). Accordingly, children (Flores, Tomany-Korman. 2008) and adults are less likely to have dental insurance than medical insurance (NIH and CDC, 2002). There is also evidence of low utilization of dental services among rural populations covered by Medicaid (Fisher, Mascarenhas. 2007); contributing factors could include scarcity of nearby facilities and practitioners that participate in Medicaid. Please see Chapter 4, Oral Health Insurance Coverage, for further discussion on dental insurance.

The Surgeon General's reports in both 2000 and 2011 draw attention to relationships between diabetes and oral health in Appalachia and the Ozarks, indicating the importance of involving both pediatricians and geriatricians in helping their patients recognize this link to total health maintenance.

2.3.3 Oral Health of Children in Appalachia

For children, poverty is one of the most influential variables on health status (de la Fuente-Hernandez and Acosta-Gio, 2007; Dietrich, et al., 2008; Krol, 2003; Krol and Nedley, 2007; Sabbah, et al., 2007; Selwitz, Ismail and Pitts, 2007; Sgan-Cohen and Mann, 2007). Low-income children are also the least likely group to receive any preventive oral care (Kenney, et al. 2005). In a recent study conducted with 2,183 school children in North Carolina, children with poor oral health status were nearly four times more likely than others to miss school due to dental pain (Jackson, et al. 2011). Absences caused by pain were associated with poorer school performance, but absences for routine care were not (Jackson, et al. 2011). Overall, oral health status was associated with poorer academic performance independent of school absence for pain (Jackson, et al. 2011).

Presenters at the 2011 ARC Conference on Healthy Families, Healthy Future shared experiences indicating that children in Appalachia still face significant dental care and oral health hurdles.

Reporting for **North Central Pennsylvania** Area Health Education Center, Tioga County Partnership for Community Health, Laurel Health System Mansfield University, Tioga County Dental Society and Temple School of Dentistry, Executive Director, **Deborah L. Sawyer**, noted that 90 percent of students at the clinic fail the dental care comprehension exam in seventh grade. The exam tests awareness of good oral health practices. She also observed that having all teeth extracted and dentures made is a rite of passage for many 16-year olds in the clinic's service area. Her program serves 41,981 rural residents in a Dental Health Professional Shortage Area.

Reporting for **Eastern Kentucky**, **Julie Watts McKee**, DMD, State Dental Director, described continued high incidence of dental caries in five- and six-year olds. She described Governor Steve Beshear's campaign to address it by extending Medicaid to Oral Health Coalitions in 12 Eastern Kentucky counties and 13 Eastern Kentucky school systems. She, too, noted that awareness of good dental hygiene practices is as significant as problems with access to providers.

> 42 percent of children ages 2 to 4 had untreated decay.
>
> Kentucky's Department of Public Health Oral Health Program
> *Julie Watts McKee 2011*

Bobbi Jo Muto noted that in 2005, **West Virginia** ranked lowest in the nation in oral health and highest in tobacco use. At that time, West Virginia's Dental Director worked part time and had limited staff. Working with Marshall University, West Virginia policy makers began to tackle the problem with a program aimed at establishing dental homes for children. The program works with local dentists, focuses on sealants and community education and builds a scorecard on the status of children's oral health.

Shelley Goodall, Mountain Laurel Clinic, Garrett Co., **Maryland** reported a substantial unmet need for dental care among residents of her clinic's service area. Her story illustrates how good statistics from the rest of the state mask problems in Appalachian communities.

2.3.4 IMPLICATIONS

Oral health is tightly tied with population health and productivity. In general, poor oral health is considered a precursor to more serious health conditions, such as cardiovascular disease (Kenney, McFeeters, Yee. 2005). To this point, the CDC has actually identified two of the indicators studied in this report, dental visits and tooth removal, as chronic disease indicators (CDC. 2007).

Safe, effective measures like fluoridation, dental sealants, fluoride rinses, dietary supplements and good personal oral hygiene practices are relatively low cost investments that can reach large numbers of people. Yet, large parts of Appalachian states have lower oral health status than the rest of the country.

Socioeconomic conditions are directly associated with oral health status. Because direct care for purposes of either repair or prevention is costly and poorly covered by public or private health insurance, the best opportunities for improvement in oral health status are community initiatives. Fluoridation, fluoride rinses and public information about good oral health hygiene practices reach more people with smaller investments. Programs for children, even those involving direct care, are aimed at building a foundation of good oral health practices.

CHAPTER 3 ORAL HEALTH WORKFORCE

3.1 FINDINGS

3.1.1 WORKFORCE CHARACTERISTICS AND SUPPLY TRENDS

According to the United States Department of Health and Human Services (DHHS. 2000), the ability of the oral health workforce to adequately meet the preventive and care needs of the population is a national concern. Professional workforce capacity is unevenly distributed, and the Appalachian Region has far fewer dental providers than the United States average. Even within the Appalachian Region, workforce concentrations vary significantly. Opportunities to improve Appalachian oral health care access, thus, involve the number and distribution of dentists, as well as expanded roles of dental hygienists and other auxiliary dental providers and staff.

In addition to the uneven distribution of dental care providers, national policy makers are also concerned about workforce trends that show a shift toward part-time work, and scarcity of specialists. Available geographic data on the oral health workforce do not distinguish between full- and part-time providers; however, the number of dentists practicing part-time has been increasing, from fewer than ten percent in 1975 to 20 percent in 2004 to as many as 25 percent projected in 2020 (Solomon. 2004). Historically, a high debt load at completion of dental school has been part of the distribution problem, making dentists less likely to practice in poor areas (DHHS. 2000). While medical school graduates in 2010, on average, accumulated $157,944 in debt (AMA. 2011), dental school graduates averaged $177,144 (ADA. 2011). Rural areas typically lack the financial resources to attract dentists (Guay. 2004).

Though general dentistry is critical for good oral health care, specialists play a critical role in total oral health care. Eighty five percent of all dentists practiced general dentistry in 2008 (BLS. 2008), limiting access to specialists, such as orthodontists, pediatric dentists, or periodontitis. Anecdotal reports indicate this is especially true in underserved areas. Specialization and length of work week factors are largely absent from national databases, but are critical to the dialogue on the reach and productivity of the oral health workforce.

3.1.2 DENTISTS

Figure 13 shows county dentists per 100,000 persons in the United States in 2007. Counties range from zero to 377 dentists per 100,000 persons. The map is scaled in quintiles: areas in blue have a higher ratio of dentists (from 39 to 377 per 100,000 persons); areas in red have a lower ratio of dentists (from zero to 27 per 100,000 persons); white counties are average. The 2007 average for the United States was 65 dentists per 100,000 people, or 1,546 people per dentist. The western third of the country and northeastern states have the most dentists per population, while the middle third and southeastern states have the fewest.

With regard to the distribution of high and low supply counties, Appalachia appears to be a microcosm of the United States. Distribution patterns in Figure 14 mimic those in Figure 13. However, the Appalachian Region averaged only 48 dentists per 100,000 persons in 2007, or about 2,100 people per dentist (Area Resource File (ARF) raw data files. 2007). This is 36 percent more people per dentist than the national average. Northern Appalachian states had more dentists per population than Southern and Central Appalachian states. Every Appalachian state, except Maryland, had low supply counties.

FIGURE 13 – COUNTY DENTISTS PER 100,000 PERSONS IN THE U.S., 2007

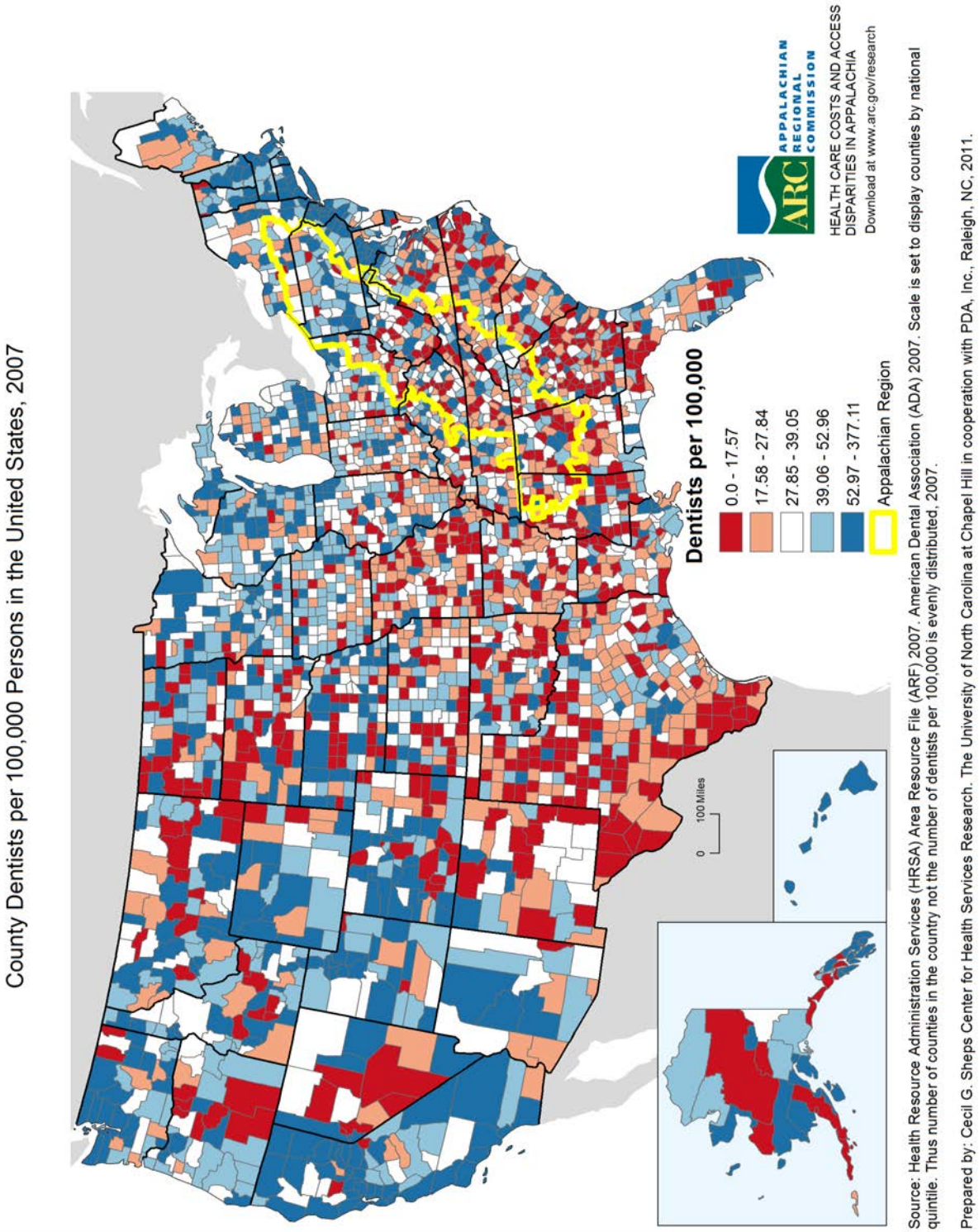
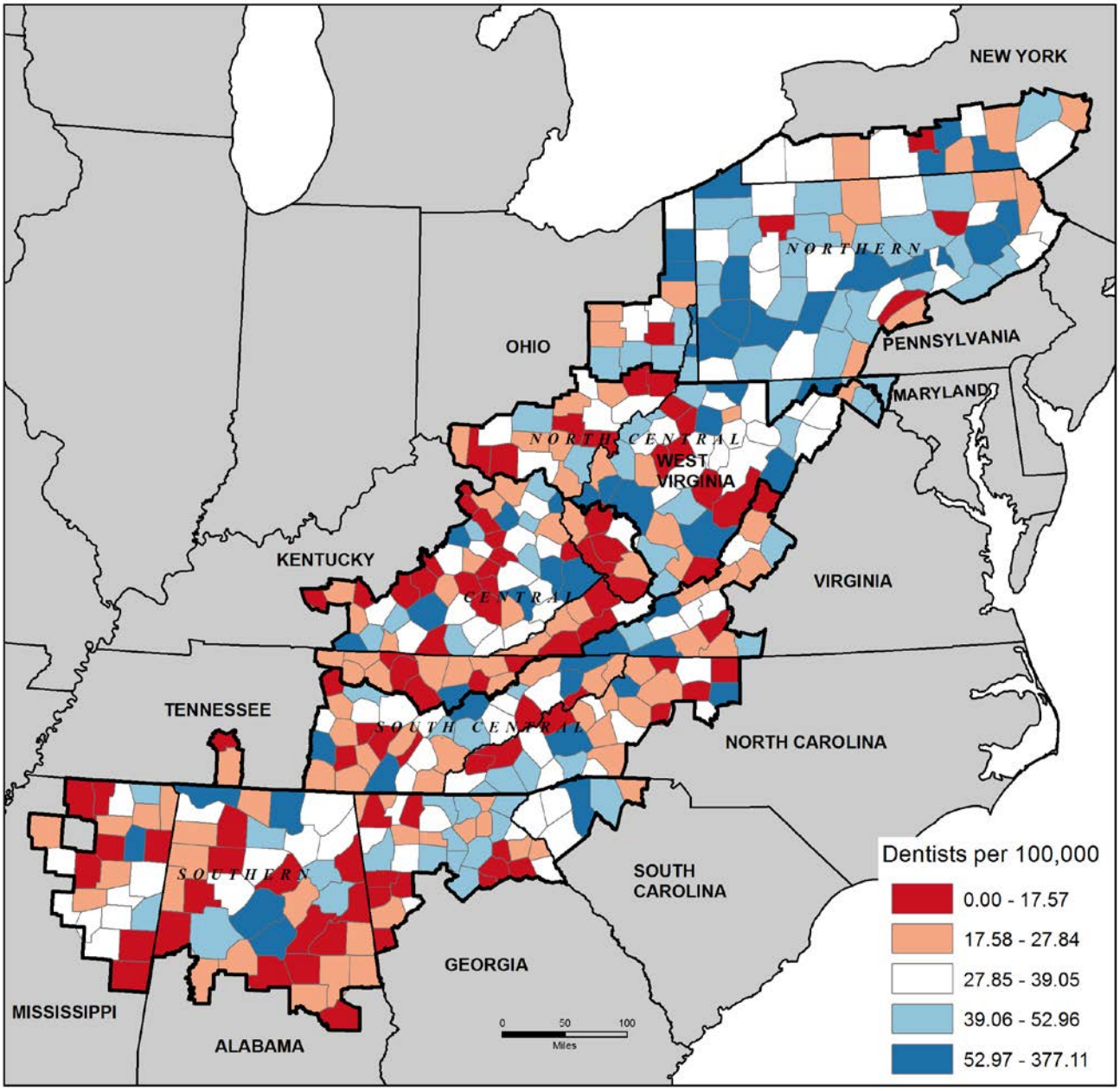


FIGURE 14 – COUNTY DENTISTS PER 100,000 PERSONS IN APPALACHIA, 2007



Source: American Dental Association 2007 as reported in Area Resource File (ARF), HRSA. 2011 with data from 2007. Scale is set to display counties by national quintile. Thus number of counties in the country not the number of dentists per 100,000 is evenly distributed. 2007.

Prepared by Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill in cooperation with PDA, Inc, Raleigh, North Carolina, 2011

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Fewer providers create potential workload issues for dentists in rural areas. In 2008, there was 36 percent less dental workforce capacity in rural than urban areas. There were only 22 generalist dentists per 100,000 people in rural areas, compared to 30 per 100,000 people in urban areas (Doescher, et al. 2009).

Improving the geographic distribution of dentists appears to require more than producing dental school graduates in the state. Speaking at the Appalachian Regional Commission (ARC) 2011 Healthy Families, Healthy Future conference, Julie McKee, DMD, Chief Dental Officer for the State of Kentucky, presented statistics on retention of dentists from Kentucky dental schools. She noted that in 2006, only 49 percent of University of Kentucky Dental School graduates remained in Kentucky; only 14 percent of University of Louisville Dental School graduates remained in the state (McKee. 2011).

Another issue plaguing the dental workforce in the United States is lack of diversity in regard to age, sex and racial/ethnic composition. Little data exist on the makeup of the dental workforce; existing data show the majority of dentists are male, white and middle-aged. As of 2004, men made up 81 percent of all dentists in the United States (Solomon. 2004). The American Dental Association (ADA) reports that while 25 percent of the United States population is of a racial/ethnic minority background, only 12 percent of United States dentists fit into this classification (ADA 2011). In 2008, the Washington, Wyoming, Alaska, Montana and Idaho (WWAMI) Rural Health Research Center at the University of Washington reported that 42 percent of non-metropolitan dentists were aged 56 or older, while only 15 percent were age 39 or younger. Considering the increased dental needs of the aging population over the next several decades, aging of the dental workforce is worrisome. Appendix G shows county trends and economic status in the dental workforce in Appalachian counties.

Diversity in the dental workforce is especially critical for underserved areas, where minority dentists see a very high number of minority patients (ADA, 2011). One study by Davidson, et al. (2007) looked at the American Dental Education Association's 2003 survey of dental graduates and found three characteristics associated with provision of care to minority patients: female gender, under-represented racial/ethnic minority group and lower parents' income. This can be considered a problem, or it may point to opportunities for enhancing the oral health workforce in underserved areas.

Workforce shortages call for creative alternatives, but these have been slow to emerge. Over the past decade, there has been a strong argument to place a greater focus on provision of culturally appropriate care in dental school curriculums (Haden, et al. 2003). Expanded roles for non-dentist oral health workers is gaining more national acceptance. Appalachian states have been generally more restrictive than others in regard to expanded practice for dental hygienists and other non-dentists. South Carolina, a notable exception, and Kentucky expanded practice opportunities in 2006. Pilot projects, started in Appalachian North Carolina, have demonstrated that pediatricians can also successfully provide topical dental fluoride and dental sealants to large numbers of children. Yet, the practice has been slow to translate to the general population of pediatricians.

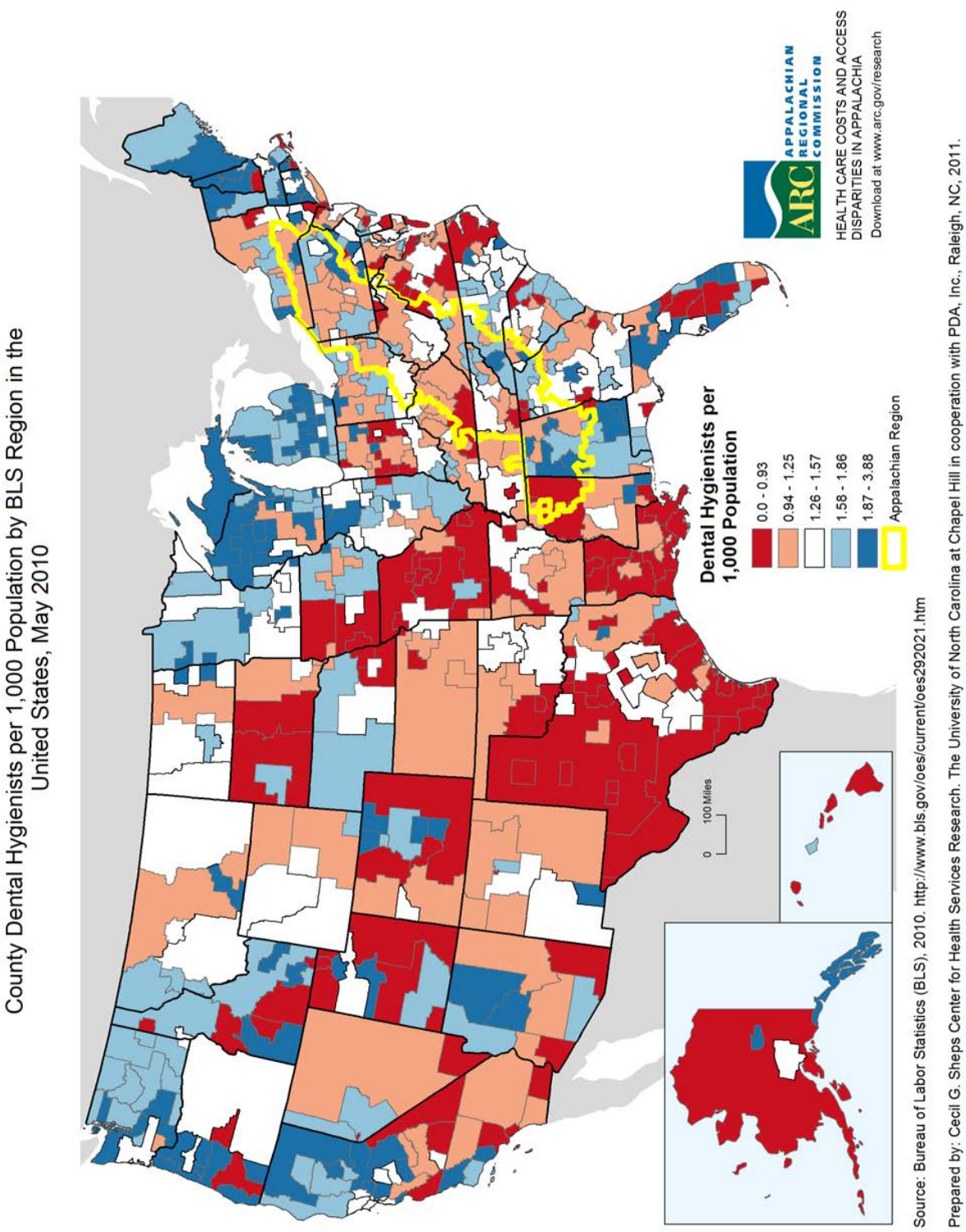
3.1.3 DENTAL HYGIENISTS

To compensate for workforce shortages and contain costs of providing care, the dental profession has always employed auxiliary dental providers. Over time, these oral health practitioners have separated into new professions, dental hygienists and dental assistants. Dental assistants make up the majority of the allied oral health workforce, and in most states, no formal training requirements for this role exist (BLS. 2010).

The Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES) program produces estimates of people employed in certain occupations. Figure 15 shows the estimates of self-reported (including non-credentialed) "dental hygienists" per 1,000 persons in the United States in 2010. BLS uses sub-state areas for aggregating, some of which include both Appalachian and non-Appalachian territory. The blue areas indicate the higher two quintiles, with 1.86 to 3.88 hygienists per 1,000 persons. The red areas indicate the lower two quintiles, with zero to 0.93 hygienist per 1,000 persons. The states in the Central and Southern United States, along with Alaska and Utah, have the fewest dental hygienists; the states in the Northern United States, from Washington to Michigan to Maine, have the most dental hygienists. The national average is one hygienist per 730 people. Because many of the sub-state BLS areas fall across Appalachian lines, it is difficult to draw regional conclusions; however, Figure 15 indicates that Alabama, Georgia, North Carolina and Pennsylvania are the Appalachian states with the highest ratios of dental hygienists per population.

Licensure for each is state governed. Gradually, some states are permitting auxiliary dental providers to perform tasks previously limited to dentists.

FIGURE 15 – DENTAL HYGIENISTS PER 1,000 POPULATION BY BLS REGION IN THE U.S., MAY 2010



Note: Areas with no reported data were registered as zero.

The scope of practice for dental hygienists is largely determined by regulations established by state licensing boards. The specific tasks dental hygienists can perform and the level of dentist supervision required to perform those tasks vary by state. Some states, typically Western states, are nationally recognized for placing fewer restrictions on dental hygienists, allowing them to perform a wider variety of functions with fewer requirements for direct supervision (HRSA. 2004; Kleiner, Park. 2008). Other states put many more restrictions on dental hygienists, often limiting their professional portfolio, wages, and permission to provide basic dental services needed in underserved communities (HSRA. 2004; Kleiner, Park. 2008). The American Dental Hygienists Association (ADHA) refers to the combination of permitted tasks and accompanying levels of dentist supervision as the "autonomy" of dental hygienists.

Most of the tasks permitted for dental hygienists fall under the umbrella of oral health assessment and education (HRSA. 2004). Some basic tasks typically performed by dental hygienists include cleaning (or prophylaxis) and administration of fluoride, x-rays and topical anesthesia. Other tasks, such as placing sutures and administering nitrous oxide (N_2O) and local anesthesia, are permitted for dental hygienists in only some states, and with varying levels of supervision. All permitted tasks are assigned supervision levels by states. According to the Health Resource and Services Administration (HRSA. 2004), the level of supervision a dentist provides can be categorized as personal, direct, indirect, general or unsupervised:

- Personal supervision implies the immediate presence and active participation of the dentist in the procedure or services being provided to the patient. Generally, this level of supervision applies when a dentist is the primary provider of a service and the hygienist is assisting.
- Direct supervision usually indicates that the dentist has prescribed and/or authorized the services being provided to the patient while the dentist is physically present in the office. In some states, this level of supervision requires that the dentist examine the patient after the hygienist has completed the service and prior to the patient's departure.
- Indirect supervision suggests that the dentist has authorized the work to be performed by the hygienist at some time in his interface with the patient (either immediately or at some prior point), and that the dentist is physically present and readily available to the hygienist.
- General supervision often means that the dentist has authorized a hygienist to perform a hygiene task that is not always a patient-specific authorization but may be a task-specific authorization, i.e., may perform a dental hygiene assessment on patients. The dentist is not required to be present in the facility where the services are performed, but should be available or have dental coverage available to the hygienist as needed. He may also authorize the performance of the task in a setting other than the dental office. In some cases, written authorization or a prescription from the authorizing dentist is required for the patient to receive hygiene services. This authorization may need to be patient-specific, or it may be part of a formal hygiene protocol for treating patients. In some states, dental boards or legislatures have appended a provision to general supervision that requires the patient be informed that the supervising dentist is not on the premises.
- Unsupervised indicates the most autonomous form of practice for a hygienist. When unsupervised practice is described in law, the tasks permitted are usually well defined and focused on special competencies of dental hygienists such as oral hygiene instruction and education, dental hygiene treatment planning, oral prophylaxis or fluoride treatments. In situations where unsupervised practice is permitted, as is the case in the state of Washington, there is often a stipulation for the hygienist to refer the patient to a dentist for any needed dental services or dental treatment (HRSA. 2004).

Under contract with HRSA, the Center for Health Workforce Studies at the School of Public Health at the University at Albany created the Dental Hygiene Professional Practice Index (DHPPI) to document variations in government regulations and practice conditions for the50 states and the District of Columbia. The baseline year was 2001. The DHPPI measures restrictions that affect access to hygiene services, particularly for underserved populations (HRSA 2004). The DHPPI rates states on the basis of restrictions on dental hygienists, including:

- Level of supervision
- Type of tasks hygienists are permitted to perform
- Reimbursement
- Legal influences

The DHPPI was summarized (Krause, et al. 2010), and is included in Appendices E and F.

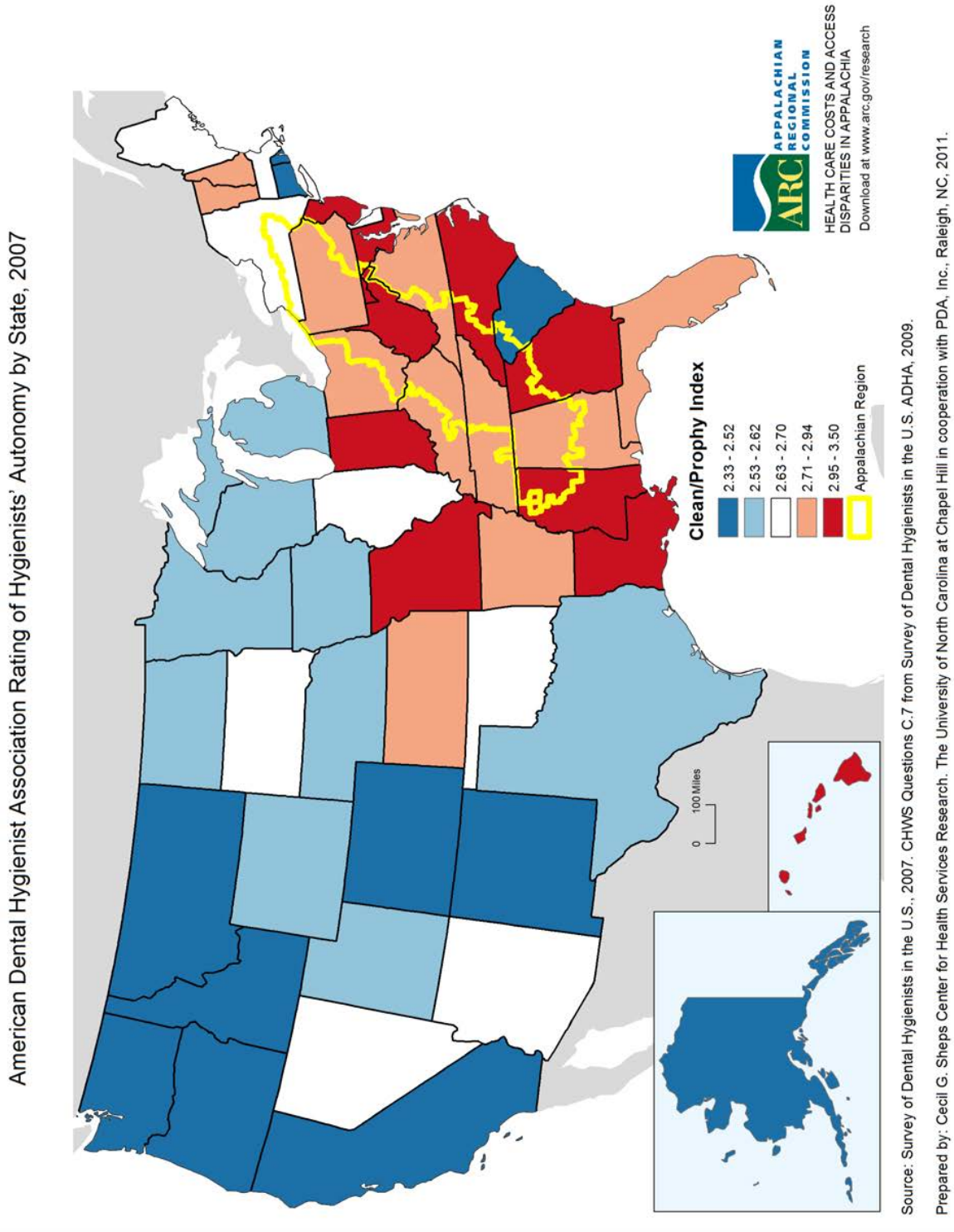
Gradually, between 2001 and 2007, state licensure boards have expanded the scope of oral health services that can be delivered by non-dentists, making oral health care available to more people, generally at lower costs (Kleiner. 2011). However, fear plays a role in expansion of non-dentist labor force capabilities. Most dental practices are small and involve substantial personal capital investment on the part of individual proprietors. With few people covered by generous dental insurance policies, dentists fear loss of paying customers to a less expensive workforce (Kleiner. 2011). The Kleiner report demonstrates that reallocation of tasks from dentists to hygienists reduces the need for dentists. In the Appalachian case, where dentists are in short supply, this could be a good thing.

Guided by the DHPPI, in 2001, HRSA rated states as excellent, favorable, satisfactory, limiting or restrictive on a variety of functions. Excellent represents the least restricted hygiene practices, up to completely unsupervised or independent practices.

The most recent update on state regulation of dental hygienists was produced by ADHA. Figure 16[5] compares the 2007 mean ADHA state supervision scores for cleaning and prophylaxis as assigned by the ADHA, and allows for comparison of the levels of restrictions placed on dental hygienists between the states in the Appalachian Region and the rest of the United States. Blue indicates areas where hygienists are afforded greater autonomy to perform cleaning and prophylaxis; red indicates areas where hygienists are more heavily supervised. The nation is split almost down the center, with western states allowing dental hygienists more autonomy and eastern states requiring higher levels of supervision. With the exception of South Carolina and New York, the Appalachian States are almost entirely red (in the lowest two national quintiles), meaning that dental hygienists' autonomy is more likely to be limited in the Appalachian region than in the nation as a whole.

[5] Note that the quantity of licensed dental hygienists in Figure 15 is 10-fold lower than the total number of hygienists in Figure 16.

FIGURE 16 - ADHA RATING OF HYGIENISTS' AUTONOMY BY STATE, 2007



3.2 METHODOLOGY

3.2.1 DATA SOURCES

The data on the oral health workforce are the most current in this report. Data on supply and distribution of dentists were drawn from the 2009-2010 United States DHHS, HRSA and ARF. This same information for dental hygienists was drawn from the BLS' May 2010 OES Survey. Statistics on the dentist labor force are maintained by the ADA and uploaded periodically, but not annually, to the ARF. State scores for permitted functions and supervision levels of dental hygienists were obtained from a survey conducted by, and used with permission from, the ADHA.

Assignment of hygienist permission scores was guided by the HRSA's DHPPI. Data on state licensure are available directly from the states, and in the 2004 HRSA's report "*The Professional Practice Environment of Dental Hygienists in the Fifty States and the District of Columbia, 2001*". The map in Figure 16 was provided directly by ADHA and is printed with its permission. We changed only the colors to provide consistency with the red/white/blue color-scheme used throughout this report.

3.2.2 DATA ANALYSIS

The supply of dentists and dental hygienists per state population was rank-ordered and separated into equal quintiles. The actual high and low ratios of professionals to population in each quintile were then summarized for indexing purposes. This permitted the UNC Sheps geographers to develop descriptive choroplethic maps in which red is assigned to low values, white to average values, and blue to high values.

The dataset for dental hygienist permissions was constructed from information available on the permitted functions and supervision levels of Registered Dental Hygienists on ADHA's website, and can be found in Appendix B.

3.2.3 MAPPING

Data on supply and distribution of dentists were merged with corresponding county boundaries, and displayed by aggregating data into national quintiles. The same information on dental hygienists required an additional step, whereby the BLS regions were mapped by using reference data on the BLS site to merge counties to the analysis regions. The available data were then merged to those boundaries, and displayed by aggregating data into national quintiles. The Mean State Supervision Scores for Cleaning and Prophylaxis by a Dental Hygienist data was taken as presented in a choroplethic map (ADHA. 2007). A map was then created using the categories of supervision outlined in the Findings section above, because individual state values were not available.

3.3 DISCUSSION

3.3.1 THE ORAL HEALTH WORKFORCE AND APPALACHIA

The ratios of both dentists and dental hygienists to population in the Appalachian Region are substantially lower than the national average. Communities in the Appalachian Region may have trouble recruiting enough providers for many reasons. Among these, the average new dental graduate in the United States is deeply in debt, and rural regions often lack the financial resources and other support systems to competitively recruit this new talent. Also, dental hygienists practicing in states in the Appalachian Region are bound by some of the most restrictive conditions in the country, limiting their roles and impact.

Incentives for dental professionals to work in the Appalachian Region are important. Speaking at ARC's 2011 Annual Conference, *Healthy Families, Healthy Future*, Julie Watts McKee, DMD, Kentucky State Dental Officer, noted that, because in 2006, fewer than half of Kentucky dental graduates remained in Kentucky, that state is refocusing its efforts to connect its dental school students with state opportunities (Shepherd, McKee. 2011). The American Recovery and Reinvestment Act of 2009 provided time-limited funds to increase National Health Service Corps loan forgiveness and salary stipends to dental professional who work in underserved areas. The Appalachian Region would benefit from an extension of this program.

The national oral health workforce is largely homogeneous, and there is an urgent need to diversify. Dentists who belong to underrepresented racial/ethnic minority groups and female dentists are more likely to serve those populations where some of the greatest disparities exist. As the population of the United States changes composition, there is a greater need to increase diversity within the dentist workforce. In 2002, the dentist workforce was overwhelmingly white, male and middle-aged (Mertz, O'Neil. 2002). Approximately 86 percent of the dentist workforce was non-Hispanic white (Mertz, O'Neil. 2002; Mitchell, Lassiter. 2006); about 80 percent of practicing dentists was between the ages of 35 and 65 (Mertz, O'Neil. 2002); and about 87 percent of practicing dentists was male (Mertz, O'Neil. 2002). There is evidence that more women are entering dental schools (DHHS. 2000; Mertz, O'Neil. 2002); however, dental school enrollments are not seeing the same level of increase in racially diverse students (DHHS. 2000), with the exception of an increased enrollment of Asian and Pacific Islander students (Haden, et al. 2003). Given the issue of lower enrollment of minority students in dental schools (DHHS. 2000; Valachovic. 2002), it may take great effort to diversify the dentist workforce.

Diversity in the dentist workforce is even less likely to be found in rural areas (Butters, Winter. 2002). Increased diversity in the dentist workforce may address issues related to access to care for the underserved, particularly minority patients, because minority dentists are more likely to have minority patients (Haden, et al. 2003). Dental school students who are minorities, who are female and who grew up in low income families are more likely to be willing to practice in underserved areas (Davidson, et al. 2007), further reinforcing the need to increase diversity in dental school enrollment. In an effort to provide adequate care to the underserved and to a more diverse population, changes to dental school curriculums have been argued to be necessary to include training students to provide culturally appropriate care (Haden, et al. 2003).

Addressing the supply of specialty dentists in Appalachia will be more difficult. They command higher salaries and need a larger population base. In 2009, Appalachia Kentucky had only 19 pediatric dentists (Shepherd, McKee. 2011). Programs that rely on specialists to lead non-specialists offer more promise. For example, Governor Steve Beshear's Healthy Smiles Kentucky, an all-out effort to improve dental health of Kentucky's children, particularly in Appalachia, confronts major labor shortages and is currently moving even beyond dental hygienists to create public awareness of good oral health hygiene practices through local oral health coalitions. There are similar stories from Tioga County, Pennsylvania Area Health Education Center.

3.3.2 Practice Conditions for Dental Hygienists

In many locations, non-dentist professionals are increasing access to preventive dental care. These non-dentists include persons trained in expanded practice roles, like hygienists and dental auxiliaries, as well as other medical professionals, like pediatricians. Change is occurring slowly and practice conditions for dental hygienists in the Appalachian Region, in 2007, were among the most restrictive in the nation. South Carolina, a notable exception, ranked among the most permissive in the United States. One other Appalachian state, New York, was average. However, more than half of the Appalachian states (seven of thirteen) rated among the most restrictive. Restrictive practice conditions prevent dental hygienists from independently providing services that could increase access to care.

3.3.3 Implications

Economics of supply and demand will work against changing the oral health workforce distribution nationally.

Easing the restrictions on dental hygiene practices in the Appalachian states may help to increase access to preventive care and treatment for remote populations in the Appalachian Region. It could also open the door for dental hygienists to provide oral hygiene education and make critical referrals to dentists when restorative services are necessary. Krause, Mosca and Livingston (2003) suggested that less restrictive environments for dental hygienists might alleviate some of the oral health disparities in underserved areas, assuming that tighter restrictions may block access to care. If more services can be provided without dentists physically present, especially to populations with compromised access, preventive oral health care might be made more immediately available in some cases.

The Appalachian Region would also benefit from a policy initiative setting goals for minimum dental care access for all residents. This necessity would involve workforce goals. Success would be measured in generational improvements and would require engagement of training institutions, state licensure boards, the insurance industry, dentists, and public health officials, among others.

Chapters 2 and 5 of this report discuss some promising state-level initiatives. Programs like those in Kentucky, West Virginia and Pennsylvania that involve multiple stakeholders: residents, dental providers and dental educators, bring changes that cross economic divides and are showing promise for sustained improvements in oral health status.

CHAPTER 4 ORAL HEALTH INSURANCE COVERAGE

4.1 FINDINGS

Dental care is not covered by most health insurance plans. With the exception of the Federal Employees Health Benefits Plan, similar plans offered to postal workers and children's Medicaid programs, dental coverage generally requires a separate insurance policy. It is not included in Medicare or in the basic military TriCare program. Veterans Health Administration (VHA) provides dental care for veterans with service-connected disabilities, and time-limited coverage for veterans and reservists who saw active duty in certain wars (Kuwait, Iraq and Afghanistan).

As a result, children and adults are less likely to have dental insurance than medical insurance (DHHS NIDCR. 2000). Two public programs designed to address the lack of insurance, and therefore, improve health status for eligible individuals, are Medicaid's Child Health Insurance Program and State Children's Health Insurance Program (CHIP, SCHIP). Generally designed for low income persons and families, Medicaid dental eligibility is not based strictly on income. Eligibility guidelines are established by each state (CMS. 2009). Under the Early and Periodic Screening, Diagnostic and Treatment Service (EPSDT), minimum dental coverage is mandatory for most Medicaid eligible individuals under the age of 21 in all states (CMS. 2009). All Medicaid states are required to offer a minimum dental service package: relief of pain and infections, restoration of teeth, and maintenance of dental health. Sealants are covered by most Medicaid children's programs. The net result is still very limited coverage. Approximately nine percent of Americans receive dental coverage from either Medicaid or SCHIP (DHHS. 2001). In December 2009, two percent of Americans were covered by CHIP programs (Kaiser. 2011).

However, insurance coverage alone is not enough to address oral health disparities. A Government Accountability Office (GAO) report, from September 2008, indicates that only one in three children enrolled in Medicaid received dental care in the prior year. On the positive side, only two Appalachian states, New York and Pennsylvania, reported less than 30 percent of eligibles using dental services (CMS. 2009). The report noted provider unwillingness to participate and lack of awareness among eligibles as the key barriers.

In 2004, dental care represented only two percent of state Medicaid budgets (Borchgrevink, et al. 2008). Dental coverage is optional for Medicaid eligible individuals age 21 or older. Most states provide only emergency dental services for eligible adults; a few states provide more comprehensive dental coverage (CMS. 2009(a)). SCHIP was established in 1997 to provide insurance coverage to uninsured children up to age 19 who did not qualify for Medicaid, but states control the benefits plans and both eligibility and coverage vary among the states (CMS. 2009(b)).

In the United States, the number one chronic disease among children is dental caries. Thus, programs such as Medicaid and SCHIP are correct in their intention to help reduce oral health disparities (CMS. 2009). However, these programs have restrictions that limit their potential to improve oral health status. After the narrow scope of services covered, a primary limitation is dentist participation in Medicaid. Private dentist participation in Medicaid is a challenge. In 2005, among the reporting states, dentist participation in Medicaid ranged from a low of zero to a high of 44 percent in states in the Appalachian Region (Association of State and Territorial Dental Directors. 2008). Medicaid payment is usually low, and Medicaid beneficiaries are more prone to cancel or be late for appointments.

National Academy of State Health Policy Comments on Harvard Study:

Dental problems may represent the biggest unmet health care need among adults as well, as reported by Pew Center on the States and the National Academy of State Health Policy by two Harvard researchers in their book, *Uninsured in America*. "[Researchers] talked to as many kinds of people as they could find, collecting stories of untreated depression and struggling single mothers and chronically injured laborers—and the most common complaint they heard was about teeth. People without health insurance have bad teeth because, if you're paying for everything out of your own pocket, going to the dentist for a checkup seems like a luxury. It isn't, of course."

The use of dental care rises by income: while 56 percent of adults from a high-income family had at least one dental visit during the year, only 27 percent of adults from low-income families had at least one dental visit during the year.

Two key underlying factors give rise to these unmet needs: the relatively low level of public financing to subsidize payments for care and the lack of an adequate safety net system for the roughly one-third of the population not served by the private dental care system. While poor children are guaranteed dental coverage through Medicaid, states are not required to provide dental benefits for adults also covered by Medicaid.

As state budgets wax and wane, this leads to on-again, off-again dental coverage for the adult population. Only 16 states provide dental coverage in all service categories for adult Medicaid enrollees. Additional 16 states offer coverage for emergency services only, and six states offer no dental coverage at all. In tighter fiscal climates, states often opt to limit or eliminate adult dental benefits. In addition, the number of adults and families with private dental insurance, dependent as it is on employment, rises and falls with the health of the economy. When times are tough, optional benefits such as dental care are among the first to be cut by employers. As the costs of health benefits have risen, costs may be passed on to employees, who may opt out of coverage. Of those who work in private industry, only 46 percent have access to dental coverage, with only 36 percent choosing to participate.

Of those who work in state and local government, 55 percent have access to coverage, while only 47 percent choose to participate.

To make matters worse, Medicare does not include dental benefits, so the over-65 population must purchase insurance individual market policies, pay out of pocket or forego care. Some individuals with private dental coverage must carry high deductibles and co-payments and low annual benefit caps. For example, the median national charge in 2005 for a root canal and a basic crown on a bicuspid tooth was $1,326. Kansas state employees would have a co-payment of $485.

Source: Help Wanted, A Policy Maker's Guide to New Dental Health Providers. The Pew Center for States, National Center for State Health Policy, WK Kellogg, Washington DC, 2009
http://www.nashp.org/sites/default/files/Dental_Report_final_Low%20Res.pdf

Dentists limit participation in Medicaid for multiple reasons. Low reimbursement rates and administrative challenges are starters (DHHS. 2000; Fisher, Mascarenhas. 2007; GAO. 2008; Guay. 2004). Limited dentist participation in Medicaid was also associated with low dental utilization by Medicaid-eligible patients. Simply having access to a dentist may not be sufficient to improve dental service utilization in a depressed area such as the Appalachian Region (Fisher, Mascarenhas. 2007; GAO. 2008). Other barriers include lack of information, failure of Medicaid beneficiaries to make scheduled appointments, limited supply of dentists and restrictions on services that can be provided by non-dentists.

Medicaid, SCHIP, and private dental insurance are the only third-party payers for dental care. Data for all of these are limited to state summaries collected by the Kaiser Family Foundation (KFF). Insurance eligibility can change from month to month, depending on a person's income status and employment status. Few non-governmental employers offer dental insurance.

4.2 Methodology

4.2.1 Data Sources

The BRFSS contains no survey questions related to dental insurance coverage, so comparison data on this topic is, at best, restricted to special studies and state level summaries. To compensate, we explored literature studies supported by the Pew Charitable Trust, the National Academy of State Policy and KFF and the GAO. Even these were limited to samples based on review of a limited number of states and a fixed time frame. The most complete pictures were provided by the National Academy of State Policy.

4.2.2 Data Analysis

Because data were so limited, we elected to report only conclusions from the literature search. Any data analysis for the Appalachian Region would rely on samples too limited for conclusive results.

4.3 Discussion

Historical separation of oral health from physical health is now memorialized in employer and government provided health insurance programs. The resultant isolation of dental coverage to an add-on policy, at a time when the costs of dental care are increasing, has moved oral health to a near luxury status. Low income populations are more likely to have a lifetime without dental care. Widespread solution to this national problem may not emerge until health reform initiatives better reflect the true root causes of community health status. Even then, change may require national dialogue on population costs and evidence based interventions.

CHAPTER 5 BEST PRACTICES IN ORAL HEALTH POLICIES

5.1 FINDINGS

5.1.1 POLICY LEVEL BEST PRACTICES

A research team from University of Mississippi attempted to identify sustainable programs and policies with effective results that have been, or could be, adopted in the Appalachian Region. PDA and UNC Sheps Center staff expanded on that work with additional research. Together, the efforts identified best practices from four sources: **1**) professional literature, **2**) the 2011 Institute of Medicine (IOM) report on best practices in oral health, **3**) anecdotal reports of professionals selected to participate in the Appalachian Regional Commission 2011 Annual Conference, Healthy Families, Healthy Future, and **4**) a limited survey of Appalachian health professionals conducted by Krause, et al. from University of Mississippi Medical Center (2010). Few of these practices have been subjected to professional peer review, but there is some consensus among the sources.

Health care research literature defines as best practices: any activity or process that is consistent with improving health promotion (Kahan and Goodstadt. 1999). Generally speaking, measures of clinical practice guidelines, health technology assessment and/or evidence-based medicine are used to assess best practices (Perleth, Jakubowski, Busse. 2001). In a recent CDC publication, Roeber and his colleagues argue that "a more common approach is the use of multiple sources of expertise to identify best practices in population-based health interventions" (2004:71). Previous studies have argued for the use of qualitative data to establish best practices related to health care. Sofaer (2002) argued that the application of qualitative methods may allow for an improved assessment of existing programs and policies. Leys (2003) argued that qualitative research is quite valuable in the assessment of health care programs and policies, particularly when the research evaluates perceptions of a program or practice.

To achieve sustained, affordable improvement in oral health, prevention returns the highest value for public investment.

- At the community level, fluoridation and culturally appropriate communication regarding what constitutes good oral hygiene practices were preferred.
- When direct care investments occur, most sources concurred that children should be the focus, with programs ranging from school-based screenings and education; sealants for children under six; education of new parents; and encouragement of expanded practice functions for dental assistants and dental hygienists.
- Sources surveyed provided little discussion of the results of programs that develop dietary and nutritional awareness of the role of vitamin D, calcium, and critical trace minerals play in good oral health; yet, dental professionals interviewed by PDA were quick to list these as recommended primary investments when budget is limited.

Supported by funding from HRSA, the IOM convened a national task force on oral health of underserved populations and released its first report in summer 2011. The report made several very specific recommendations with regard to vulnerable and underserved populations. It focused on two concerns:

- Six percent of the nation's children did not receive needed dental care because their families could not afford it, and
- The other parts of the population who do not get annual dental care face supply and affordability barriers. This group represents 25 percent, and more of the population in some states.

Reflecting the special interests of the report's funding source, the Health Resources and Services Administration (HRSA), many of its recommendations are focused on HRSA-funded programs. The report did not address the financial impact of recommendations.

Key recommendations include:

- Policy initiatives
  - Support state legislative efforts to amend laws to maximize access to oral health care.
  - State policy should focus on allowing professionals to practice to the full extent of their education and training in a variety of settings.
- Workforce initiatives
  - Train diverse populations in diverse communities.
  - Shift oral health provision beyond dentists to dental hygienists and dental assistants.
  - Develop a new profession (Dental Therapist), and delegate more oral health responsibilities to physicians.
  - Encourage development of new dental schools to train dentists closer to underserved populations.
  - Develop interdisciplinary teams that incorporate oral health in total health.
- Direct Care
  - Expand oral health services in public clinics and other non-traditional settings, like Federally Qualified Health Centers.
  - Contract with private dentists to care for low-income uninsured persons.
  - Develop dental school residency clinics in underserved areas.
  - Encourage school, health department and mobile dental clinics.
  - Use hospital emergency departments as sentinel sites for monitoring demand for emergency dental care.
- New Financing Mechanisms
  - Enhance Medicaid rates for dental care / physicians for oral health services.
  - Implement Medicaid payment to primary care providers for application of fluoride varnish on children.

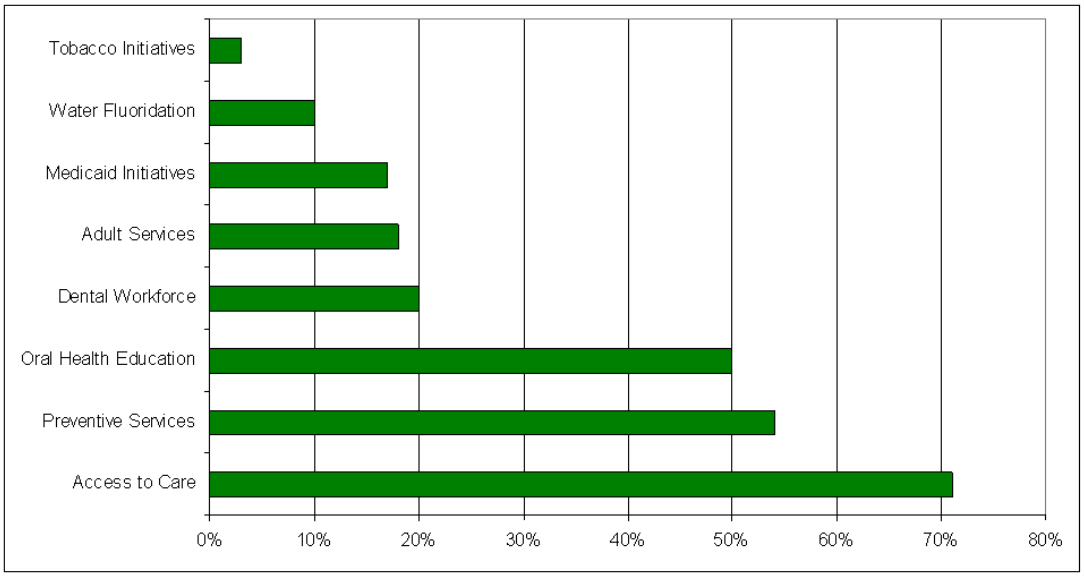
5.1.2 Appalachian Initiatives

Survey

Using direct interviews of 31 stakeholders in the 13 Appalachian states, a team of University of Mississippi researchers identified oral health initiatives underway in the region in 2009. They collapsed 134 different programs into eight themes by using a meticulous coding system that was blind checked by a second team. Detailed analyses of their interviews, coding and results are contained in Appendix F.

Figure 17 shows the eight intervention themes by frequency of mention. The low frequency for fluoridation suggests that the stakeholders interviewed may not have been personally involved in their state's fluoridation program, because most Appalachian states have a fluoridation program.

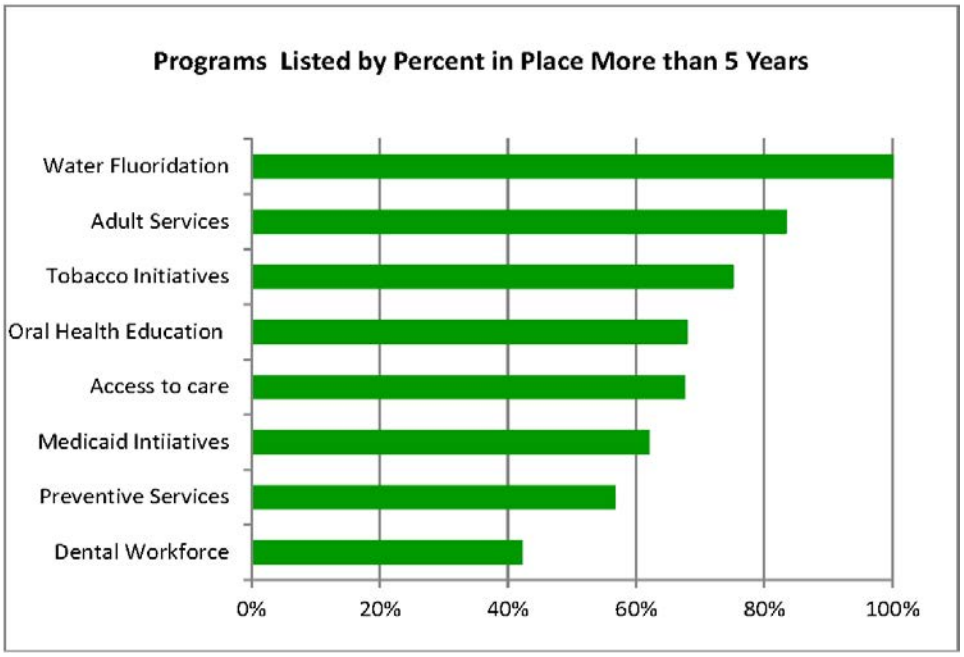
FIGURE 17 – ORAL HEALTH INITIATIVES AREAS BY FREQUENCY OF MENTION IN APPALACHIAN STATES, 2009



Source: Appendix F

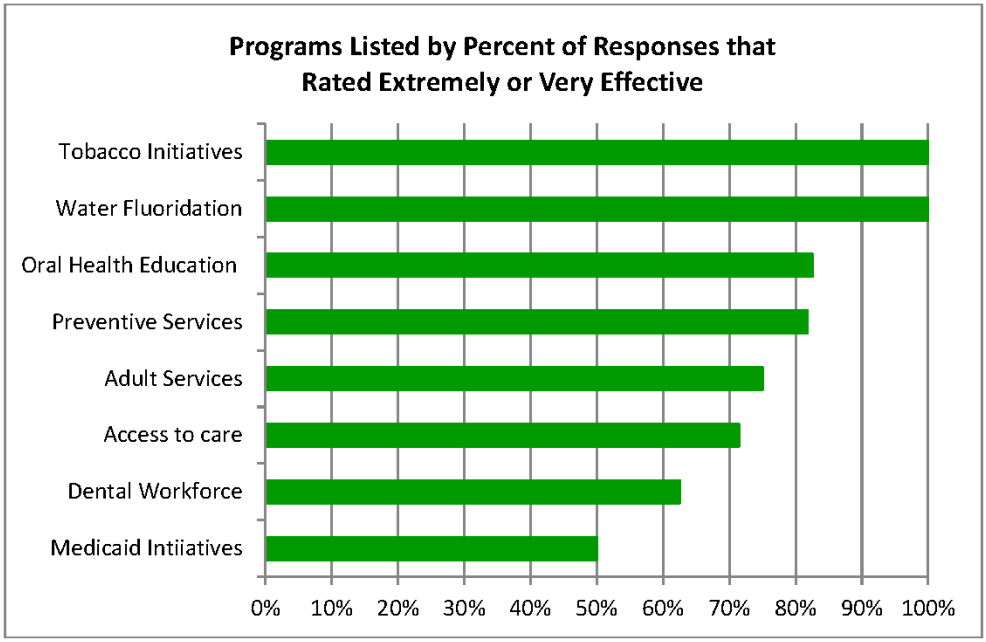
Interviewees were asked three questions about each program: 1) how long has the program been in effect; 2) how effective would you rate it on a 5-step scale ranging from Extremely Effective to Not Effective; and 3) how many people does the program reach? Figures 18, 19 and 20 summarize the responses of the interviewees.

FIGURE 18 – DURATION OF APPALACHIAN STATE ORAL HEALTH PROGRAMS



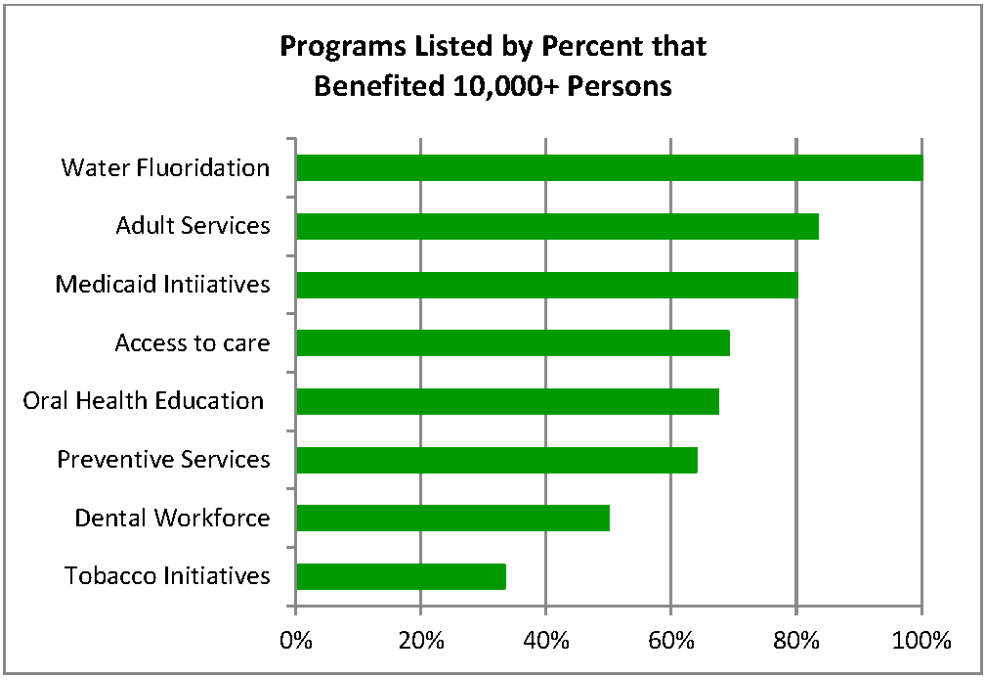
School-based sealant programs are included in the preventive programs. The eight reports of this program all rated 100 percent effective.

FIGURE 19 – EFFECTIVENESS OF STATE PROGRAMS IN APPALACHIA



Source: Appendix F.

FIGURE 20 – REACH OF APPALACHIAN STATE ORAL HEALTH PROGRAMS



Access to care seems to be one of the key challenges addressed by these programs and policies. This is not surprising given the distinctive geographic and socioeconomic characteristics of the Region as related to health care (Behringer, et al. 2007). Others agree. Access to care is deemed a barrier to improving oral health care by the United States Surgeon General (DHHS. 2000; Haden, et al. 2003). Many practices included in the sample seek creative ways to increase access to oral health care. For example, in areas with fewer dentists, allow primary care physicians to perform basic preventive services. At least four of the ARC states —Alabama, North Carolina, South Carolina and Virginia— have such programs in place for young children who are more likely to visit a primary care physician than a dentist. Furthermore, primary care physicians in some states may be reimbursed by Medicaid for providing these services. The use of mobile clinics may also provide basic access as well as assist patients in finding dental homes. At least one ARC state, North Carolina, considered this an effective practice; however, such a program often relies on volunteers and may, therefore, not be feasible. Lack of follow up is another problem with mobile screening clinics.

Preventive services mentioned in this study primarily focus on children. These services include dental sealants, dental screenings, and fluoride applications. Most, if not all, of these services are offered in some manner in the ARC states. Many of these services are administered at schools or by pediatricians in an effort to not only improve oral health, but to educate children about the importance of proper oral hygiene. Dye, et al. (2007) found that dental sealant prevalence among children age 6 to 11 has increased in recent years. Policies regarding dental screenings vary around the nation, yet many states require some sort of dental certificate prior to admittance into school (Booth, et al. 2008). Three states in the Appalachian Region —Georgia, Kentucky and New York— have the requirement (Booth, et al. 2008).

Oral health education and advocacy was somewhat linked to both access to care and preventive services in this analysis. Many of the practices categorized as educational aimed to teach patients about the importance of oral health care. Persons with the greatest need also seem to lack knowledge about its importance (Haden, et al. 2003). Thus, it is not unexpected that many state oral health practices seek to educate the population about oral health.

Efforts to maximize and continually educate the **dental workforce** are crucial in socioeconomically challenged areas like the Appalachian Region. Practices that encourage recent dental school graduates to work in rural areas at least one year, in exchange for tuition, make a small contribution to care in underserved areas. Haden, et al. (2003) argue that dental schools should support recent graduates who provide at least one year of service in underserved areas. The goal is both to increase access to care and have dentists acquire knowledge about providing culturally appropriate care. Other health care workers, such as primary care providers, if properly trained, can provide basic dental services geared toward prevention (Selwitz, Ismail and Pitts. 2007). Moreover, as discussed in Chapter 4, practice restrictions placed on dental hygienists vary by state (BHP. 2004). Reducing the restrictions on the level of supervision for dental hygienists is potentially beneficial for improving access to care in underserved areas (Krause, Mosca and Livingston. 2003). Few practices identified seek to diversify the dental workforce; however, that issue may be better addressed by dental schools in the recruitment of students.

Practices to improve **adult oral health** are critical, as well. Medicaid coverage for dental services for adults varies by state and is often quite limited (Ellis, et al. 2009). Adults are more likely to have medical insurance than dental insurance (DHHS. 2000). Therefore, some programs and policies have been implemented in ARC states such as Maryland, Mississippi, North Carolina, New York, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia, in order to provide some basic preventive dental services to uninsured adults or insured adults unable to afford costs associated with dental visits. Because the risk of dental caries continues throughout the lifespan, it is critical for adults to receive preventive dental care. Adults over the age of 40, who use tobacco, are at a greater risk of oral cancer (Selwitz, et al. 2007); this makes adult dental care important in oral cancer detection.

Medicaid programs and policies mentioned in the survey seek to increase the number of dental Medicaid providers, increase Medicaid reimbursement, or reduce the amount of paperwork necessary for providers to be reimbursed. These respond to concerns that children enrolled in Medicaid are more likely to have dental caries and untreated tooth decay compared to children enrolled in private insurance (GAO. 2008). Savage, et al. (2004) found evidence that children with Medicaid coverage in areas with lower dentist-to-population ratios were less likely to use dental services. Fewer dentists in an area could mean that even fewer dentists participate in Medicaid reimbursement. Thus, initiatives to increase the number of Medicaid providers seem warranted. About one-third of the practices included in the sample relating to Medicaid initiatives have been implemented within the last five years, possibly a response to findings from a 2000 survey administered by the American Dental Association, in which about 75 percent of dentists did not treat patients insured by Medicaid (Haden, et al. 2003).

Water fluoridation is one relatively inexpensive practice believed to benefit the population (Bailey, et al. 2008; Griffin, Jones and Tomar. 2001; Kohlway. 2008). Not only is community water fluoridation perceived as inexpensive for communities, but it is also perceived as a long term cost-saving mechanism by preventing future expenses related to tooth decay (Kohlway. 2008). However, as of 2006, the CDC reported that only 69 percent of the population had access to a fluoridated community water system (Bailey, et al. 2008). Given that the rate of water fluoridation varies from state to state, and from county to county in some states, it may be helpful to continue to move forward for those areas that lack community water fluoridation. While water fluoridation has its proponents, it also has its opponents; so, education regarding the benefits of water fluoridation may need to be continually addressed in some states (Kohlway. 2008).

Practices related to **tobacco initiatives** were the only theme not mentioned by at least one stakeholder in each of the 13 Appalachian states. Given the significant relationship between tobacco use and dental caries, oral cancer, and other oral diseases (Winn. 2001), this is somewhat surprising. However, it is possible that there are programs in place in the Appalachian states, but the programs are not specifically oral health initiatives.

The survey methodology for the study was not robust enough to quantify the effectiveness of these programs in the Appalachian Region. With the exception of West Virginia (in which all counties are included in the Appalachian Region), this methodology did not uncover to what extent practices were designed solely to improve the oral health of the residents of the Appalachian Region.

FOUNDATION SUPPORTED INITIATIVES

Throughout the Appalachian Region, private philanthropic foundations have supported grant-funded oral health initiatives that have made a difference. Unfortunately, these local initiatives often terminate when grant funding ends. Responding to the dilemma, states and foundations have shifted their focus to sustainable policy changes:

- The W.K. Kellogg Foundation is sponsoring a project to increase roles of dental therapists in five states, including **Ohio**.
- **Ohio** also focused state funds on sealants for children in low-income neighborhood schools, reaching 30,000 children in 2008 (Pew. 2010).
- Two new dental schools are opening in underserved areas in Appalachian states, **East Carolina University** in North Carolina and the **University of West Virginia** Rural Dentist Project.
- The DentaQuest Foundation and the Washington Dental Service Foundation are supporting a national multidisciplinary collaborative to train primary care providers in ways to protect and promote oral health. The project, National Interprofessional Initiative on Oral Health, engages professional associations, medical school residencies and other training programs to develop a common curriculum around oral health issues, especially for children (NIOH. 2011).

- **Kentucky** Governor Steve Beshear committed to an expanded Kentucky Children's Health Insurance Program (KCHIP) and a community partnership to improve the oral health of Kentucky children, particularly in Appalachia. In September 2011, the Kids' Health program provides screening, sealants and direct care, and engages families in maintaining children's oral health. The program targets families with incomes below 200 percent poverty level and uses a case manager approach to keep families involved. Healthy Smiles Kentucky is jointly funded by the state and ARC and works through the Department of Public Health. It targets particularly Appalachian communities. It also trains local dentists in ways to care for children, supports community oral health coalitions and has a school health component (McKee. 2011).
- **West Virginia** Marshall University Area Health Education Center, with help from ARC and the Benedum Foundation, developed small grants to community partnerships that work with local dentists and the dental society to establish dental homes. In 2011, the program was operating in 24 of the 55 counties, providing school education, dental screening and sealants to children. This program raised West Virginia's score on the Pew Child Oral Health scorecard from "F" to "A" in the course of five years. A common reporting system lets the program give feedback to participating communities. The program is moving from direct care to a full statewide plan and development of the expanded dental provider workforce. With sustainability as the goal, West Virginia is engaging funds from a tobacco tax to support the program (Muto. 2011).

> In four years, West Virginia moved from a score of "F" to "A" on child oral health.
>
> *Muto, 2011*

5.1.3 National Initiatives

The United States Department of Health and Human Services (DHHS) is investing in oral health program plans and workforce development.

- Centers for Disease Control (CDC) is providing funds to 19 states to develop state oral health plans. Grantees include four Appalachian states: Georgia, Maryland, New York and South Carolina. In 2011, three Appalachian states had no oral health plans: Alabama, Georgia and Tennessee.
- On a temporary basis, Health Resource Services Administration (HRSA) Behavioral Health Planning Council / Bureau of Clinician Recruitment Service National Health Service Corps expanded slots for dentists and dental hygienists in Appalachian states. However, this temporary stimulus funding ended in April 2011.

The Pew Charitable Foundation developed a state scorecard to encourage states to improve oral health of high-risk children. The **Pew Child Oral Health Initiative**, a multi-year initiative, grades states on eight policy indicators (Pew. 2010).

- Have sealant programs in at least 25 percent of high risk schools.
- Allow a hygienist to place sealants in a school-based program without requiring a dentist's exam.
- Provide optimally fluoridated water to at least 75 percent of residents who are served by public systems.
- Meet or exceed the 2007 national average, 38 percent, of Medicaid-enrolled children ages 1 to 18 receiving dental services.
- Pay dentists who serve Medicaid-enrolled children at least the 2008 national average (60.5 percent) of median retail fees.

- Reimburse medical care providers through state Medicaid program for preventive dental health services.
- Authorize a new type of primary care dental provider.
- Submit basic screening data to the national database that tracks oral health conditions.

On the 2010 Pew scorecard, Appalachian states ranked from best to worst. **Maryland** had the top score in the country. **South Carolina** also scored an "A". Most states had improved from the initial score. **West Virginia** had moved from "F" to "C", and recently reported an "A." (Muto. 2011). Work remains —in the Appalachian states, 46 percent received a "C" compared with only 27 percent nationwide.

FIGURE 21 - PEW CHILDREN'S DENTAL HEALTH REPORT CARD 2010

Appalachian State	Grade	Number of Benchmarks Met (of 8 possible)
Maryland	**A**	7
South Carolina	**A**	6
Ohio	**B**	5
New York	**B**	5
Georgia	**B**	5
West Virginia	**C**	4
Virginia	**C**	4
Tennessee	**C**	4
Mississippi	**C**	4
Kentucky	**C**	4
Alabama	**C**	4
Pennsylvania	**D**	3
North Carolina	**D**	3

Source: Pew. 2010.
Note that in 2011, West Virginia reported moving up to "A" on the Report Card.

Responses from 31 policy makers, who represented all Appalachian states, focused on seven areas they considered effective in addressing access to oral health care and improvement in oral health status.

- Access is important in areas with fewer dentists. Allowing primary care physicians to perform basic preventive services is one such mechanism to increase access. Mobile clinics may also provide basic access, as well as assist patients in finding dental homes.
- Preventive Services mentioned in this study primarily focus on children and include dental sealants, dental screenings, and fluoride applications. Most, if not all, of these services are offered in some manner in the Appalachian states.
- Oral Health Education and Advocacy are somewhat linked to both access to care and preventive services in this analysis, as many of the practices categorized as such also aimed to teach patients about the importance of oral health care.

- Dental Workforce Education practices that encourage recent dental school graduates to work in rural areas and that ease restrictions on scope of practice for dental hygienists improve access in underserved areas.
- Adult Oral Health Care services and coverage vary by state, but are quite limited. Some programs and policies implemented in many Appalachian states provide some basic preventive dental services to uninsured and underinsured adults.
- Medicaid Initiatives seek to increase the number of Medicaid providers, by enhancing Medicaid reimbursement or reducing the amount of paperwork necessary for providers to be reimbursed.
- Water Fluoridation remains an attractive means to improve a population's oral health and is relatively inexpensive. It also varies a great deal across Appalachia.
- Tobacco Initiatives were mentioned by a single stakeholder. Given the significant relationships between tobacco use and dental caries, oral cancer, and other oral diseases (Winn. 2001), this is somewhat surprising.

Details of the interviews are in Appendix F.

5.2 METHODOLOGY

5.2.1 DATA SOURCES

Information in this Section was drawn from presentations at the ARC 2011 Annual Conference, from national reports, website searches, and from a direct interview survey conducted by University of Mississippi research team in 2009, and contained in Appendix F, and from referenced published reports.

University of Mississippi researchers supplemented data provided by the Association of State and Territorial Dental Directors (ASTDD) by briefly interviewing stakeholders in each Appalachian state. Stakeholders included, but were not limited to, a representative from each state's oral health division; a representative from each state's dental association; and a representative from each state's Medicaid Dental Division. Contact information for these stakeholders was obtained from an internet search of websites such as the ASTDD's website (http://www.astdd.org), each state's dental association website, and each state's Medicaid website. Stakeholders were interviewed by telephone or email. The interview was tested and approved by the Institutional Review Board for the Protection of Human Subjects in Research at Mississippi State University prior to its implementation.

Overall, 31 individuals agreed to the interview for a response rate of 79 percent.

The primary interview question was "What programs or practice policies are in place in your state related to oral health?" This was followed by a brief explanation of what types of programs and policies we were interested in for this project, namely fluoridation, screening, sealants, smoking or community oral health initiatives of which the stakeholder had some knowledge. Respondents were asked to provide the name of the program and a brief program description.

Three additional questions were asked regarding each practice mentioned by stakeholders.

1. "How long has this practice been in place?" Responses fell into one of four categories: more than 5 years; between 1 and 5 years; less than 1 year; or still being implemented.
2. "How effective would you say this program/policy is?" Responses were scored on a 5-point scale: extremely effective, very effective, effective, somewhat effective, or not effective at all.
3. "How many people would you say benefit by this program/policy?" Respondents were asked to categorize responses into one of five categories: 1-100; 101-1,000; 1,001-9,999; 10,000 or more; or there is no benefit.

Surveys identified 134 programs and policies related to oral health. Each was coded according to the themes, and scored for effectiveness. Population-based initiatives were favored over those involving direct service.

Categorizing into themes was not necessarily mutually exclusive; some programs and policies addressed more than one area. A code book was created to assist coding of cases into the various themes.

Two methods were used to insure the reliability of the coding. The first method involved a test-retest format, in which all cases were coded by a single individual. Two weeks after the initial coding, the same individual re-coded all cases. A comparison of each set of coding was conducted, and a reliability score of approximately 92 percent was achieved. The second method used to determine the reliability of the coding involved a random sampling of 10 percent of the cases. A second individual was asked to code these randomly selected cases, and a reliability score of 91 percent was achieved. Given the two reliability scores, it was determined that the coding was largely consistent.

5.3 Discussion

In the Appalachian Region, policy makers face the daunting challenge of limited knowledge base, low income and workforce shortages. Policy makers found programs that focused on community health or direct care more effective than ones focused on general prevention or work force. Unfortunately, the survey did not provide opportunities to probe reasons for low effectiveness ratings. Both reducing workforce shortages and causing behavior changes in oral health practices are critical to improved oral health in the Appalachian Region. Further exploration of obstacles and opportunities in both areas should be encouraged. Both issues are complex and progress will require engagement of oral health professionals and experts in behavioral change.

States and foundations have naturally gravitated to programs aimed at stabilizing children's oral health, building on families' desire to give their children good foundations. Even then, most states are working on low cost interventions, expansion of roles of non-dentists, engagement of local practicing dentists and scorecards with feedback. The scorecards appear to be effective in drawing comparative attention to oral health disparities in the Appalachian Region. In the case of West Virginia, a low scorecard motivated significant program improvement.

Going forward, investments in children should improve educational performance and build foundations for a productive workforce. States like Maryland, South Carolina, West Virginia and Kentucky are pace setters for children's oral health in the Appalachian Region.

CHAPTER 6 SUMMARY FINDINGS AND RECOMMENDATIONS

6.1 CONCLUSIONS AND FINDINGS

Oral health in the Appalachian Region is closely tied to the region's economic status. Following national trends, Appalachian communities with low economic status are more likely to have shortages of dental health providers. This affects everyone in the community. Dentists in these areas are at risk of higher case loads and a higher proportion of low-income or non-paying patients.

Nationwide, the number of dentists in general practice is inadequate to meet the population's need for care. The Appalachian Region has 36 percent fewer dentists per 100,000 population than the United States average. Retention of dentists in underserved areas is made difficult by low pay and high workloads. Recent state licensure board movements to increase scope of practice for non-dentist assistants and licensed dental hygienists offer hope for increased care access, but even an increase in work force cannot overcome the financial barriers associated with high dental care costs and low insurance coverage.

Medicaid and government employee programs are the only predictable sources of dental insurance benefits. Private insurers offer dental as an optional, additional policy but the coverage is often excluded from employer-provided benefits.

Oral health remains the primary health issue for children, and a major issue for adults. Oral health and physical health are directly associated with one another, and dental pain has been associated with poor school performance and low workplace productivity. Use of services nationally is directly associated with insurance coverage. Fluoridation of public water supplies can help strengthen community teeth, but not all of the population is served by public water sources. More rural populations are less likely to have community water.

Data on dental health services and dental health insurance coverage are limited to national interview surveys. Sampling frames are too small to support county or sub-regional analyses. Behavioral Risk Factor Surveillance System (BRFSS) samples are too small and too inconsistent for even an Appalachian Region-wide analysis.

Most of the data on oral health status is collected by probability sampled telephone interviews. Appalachian households without telephones have plagued research efforts for decades. The new phenomenon of eliminating land lines in favor of cell phones, many of which have temporary numbers, will present even more challenges to inferences drawn from these surveys.

6.2 IMPLICATIONS

Poor oral health will likely remain a problem throughout the United States, particularly in low income and rural areas. Consequently, the best public investments will be those aimed at coupling public awareness of good oral hygiene practices with well-being. Because oral health problems surface early in children, oral hygiene practices that begin in infancy and are reinforced at the family and community level are important. Investments in fluoridation can offset some but not all failures of oral hygiene.

Health reform resulting from the Patient Protection and Affordable Care Act of 2010 will expand state Medicaid program enrollment and increase state costs for the basic benefit packages (Lane, 2011). In this environment, there is little likelihood that states will be able to consider expanding benefits to increase dental coverage in the absence of other cost saving initiatives. Most of the new enrollees will be adults with low incomes, who are likely to have many years of accumulated dental care needs.

6.3 RECOMMENDATIONS

In order to monitor success of any initiatives, the Appalachian Regional Commission needs baseline information. ARC should issue a formal request to CDC to modify the BRFSS sampling procedure to develop a sample frame and consistent questions to provide year to year information about the Appalachian Region, and its sub-regions. A larger sample and consistent questions would provide independent feedback on the impact of state, federal and private initiatives to address oral health disparities in the Appalachian Region. This may take significant time to negotiate, because CDC relies on states to share funding for BRFSS surveys and permits each state to select or change the questions asked.

A systematic study of the economic costs of poor oral health might be helpful to policy makers who are considering ways to stabilize this important component of good community health. In the interim shared studies and anecdotes will be the primary sources of information for oral health improvement.

Similarly, collaboration among the ARC, Appalachian states, the Appalachian charitable foundations and the National Academy of State Health Policy to regularly support and convene the groups working on this important issue will help all of the investors to focus their limited resources on oral health investments, in the Appalachian Region, that are most likely to improve school performance and improve worker productivity. Particularly in the areas of non-dentist workforce deployment and engagement of the dental workforce that has committed to work and invest in the Appalachian Region, such collaborative effort may surface new ways to engage total communities in good oral hygiene. The task is too large for investments that focus on limited sectors.

ARC should work with Health Resource Services Administration and the National Health Service Corps to set specific goals for placing loan forgiveness and subsidized professionals with dental professionals who are committed to the Appalachian Region. These initiatives should occur with careful consideration to their impact on sustainability of these existing practices. ARC should build on the communications started at the Healthy Families, Healthy Future conference to provide a support network to the individuals and groups who are working with expanded practice for non-dentists.

Local initiatives focused on preventive interventions have made significant contributions. However, most require grant subsidies to be sustained. The grant program grantees should be supported in continued dialogue, to identify their common threads of sustainable initiatives.

6.4 AREAS FOR FURTHER STUDY

An Appalachian Region-wide study of oral health hygiene literacy and cultural practices that support or challenge it would help move from anecdotal information to evidence-based guidance for health investments. Similar benefits could accrue from careful study and documentation of the impact of communications campaigns similar to Kentucky's Healthy Smiles and Mississippi's community wide oral health programs. To assist with outcome measurement, CDC should be asked to tailor BRFSS sampling frames to produce annual survey information that can be attributed to the five Appalachian sub-regions: North, South, North Central, Central and South Central, and to the five rural-urban county types.

CHAPTER 7 REFERENCES

Allukian, Myron, Jr. 2008. "The Neglected Epidemic and the Surgeon General's Report: A Call to Action for Better Oral Health." *American Journal of Public Health* 98(Supplement 1):S82-85.

American Cancer Society (ACS). 2008. *Cancer Facts and Figures*. Atlanta, GA: American Cancer Society.

American Dental Association (ADA). 2009. *Dentist Workforce Data*. Chicago, IL: Organization/American Dental Association.

American Dental Hygienists Association (ADHA). 2009. *Dental Hygiene Practice Act Overview: Permitted Functions and Supervision Levels by State*. Chicago, IL: Organization. (http://www.adha.org/governmental_affairs/downloads/fiftyone.pdf).

American Medical Association (AMA) 2011. "Medical Student Debt". http://www.ama-assn.org/ama/pub/about-ama/our-people/member-groups-sections/medical-student-section/advocacy-policy/medical-student-debt/background.page.

Appalachian Regional Commission (ARC). 2009. *The Appalachian Region*. Washington, D.C.: Appalachian Regional Commission. Retrieved September 15, 2009 (http://www.arc.gov/index.do?nodeId=1).

Association of State and Territorial Dental Directors (ASTDD). 2008. *Synopses of State Dental Public Health Programs, Data for FY 2006-2007*. Sparks, NV: Association of Sate and Territorial Dental Directors (ASTDD).

Association of State and Territorial Dental Directors (ASTDD). 2009. *About ASTDD*. Sparks, NV: Association of State and Territorial Dental Directors. Retrieved September 16, 2009 (http://www.astdd.org/index.php?template=aboutastdd.html&tier1=About%20ASTDD).

Bailey, W., L. Barker, K. Duchon, and W. Maas. 2008. "Populations Receiving Optimally Fluoridated Public Drinking Water--United States, 1992-2006." *The Journal of the American Medical Association* 300(8):892-894.

Behringer, Bruce and Gilbert H. Friedell. 2006. "Appalachia: Where Place Matters in Health." *Preventing Chronic Disease* 3(4):1-4.

Behringer, Bruce, Gilbert H. Friedell, Kelly A. Dorgan, Sadie P. Hutson, Charley Naney, Amber Phillips, Koyamangalath Krishnan, and Eleanor S. Cantrell. 2007. "Understanding the Challenges of Reducing Cancer in Appalachia: Addressing a Place-Based Health Disparity Population." *Californian Journal of Health Promotion* 5(Special Issue: Health Disparities and Social Justice):40-49.

Beltran-Aguilar, Eugenio D., Laurie K. Barker, Maria Teresa Canto, Bruce A. Dye, Barbara F. Gooch, Susan O. Griffin, Jeffrey J. Hyman, Freder Jaramillo, Albert Kingman, RuthE. Nowjack-Raymer, Robert H. Selwitz, and Tianxia Wu. 2005. "Surveillance for Dental Caries, Dental Sealants, Tooth Retention, Edentulism, and Enamel Fluorosis: United States, 1988-1994 and 1999-2002." *Morbidity and Mortality Weekly Report (MMWR)* 54(3):1-44.

Bloom, Sandra and R. Cohen, Dental Insurance for Persons Under Age 65 Years with Private Health Insurance: United States, 2008, NCHS Data Brief, No. 40, June 2010.

Booth, Meg, Marcy Frosh, Burton L. Edelstein, Robert Isman, and Christine Wood. 2008. *Emerging Issues in Oral Health: State Laws on Dental "Screening" for School-Aged Children*. Washington, D.C.: Children's Dental Health Project.

Borchgrevink, Alison, Andrew Snyder and Shelly Gehshan. 2008. "The Effects of Medicaid Reimbursement Rates on Access to Dental Care". *National Academy for State Health Policy.* www.nashp.org/Files/CHCF_ dental_rates.pdf.

Bureau of Health Professionals (BHP). 2004. *The Professional Practice Environment of Dental Hygienists in the Fifty States and the District of Columbia, 2001*. Rockville, MD: Health Resources and Services Administration.

Bureau of Labor Statistics (BLS). 2010. "Dental Assistants". *Occupational Outlook Handbook*, 2010-11 Edition. http://www.bls.gov/oco/ocos163.htm#training.

Butters, Janice M. and Paul A. Winter. 2002. "Professional Motivation and Career Plan Differences between African-American and Caucasian Dental Students: Implications for Improving Workforce Diversity." *Journal of the National Medical Association* 94(6):492-504.

Casto, Bruce C., Smita Sharma, James L. Fisher, Thomas J. Knobloch, Amit Agrawal, and Christopher M. Weghorst. 2009. "Oral Cancer in Appalachia." *Journal of Health Care for the Poor and Underserved* 20(1):274-285.

The Center for Health Workforce Studies (CHWS). 2002. *Health Care Employment Projections: An Analysis of Bureau of Labor Statistics Occupational Projections, 2000-2010*. Rensselaer, NY: The Center for Health Workforce Studies.

Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System (BRFSS)*. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.cdc.gov/brfss/technical_infodata/surveydata.htm. Retrieved Feburary 2009.

Centers for Disease Control and Prevention (CDC). 2009. *Community Water Fluoridation*. Atlanta, GA: Centers for Disease Control and Prevention. Retrieved September 15, 2009 (http://www.cdc.gov/fluoridation/index.htm).

Centers for Disease Control and Prevention (CDC) 2007. "National Survey of Children's Health (NSCH)." *State and Local Area Integrated Telephone Survey (SLAITS).* http://www.cdc.gov/nchs/slaits/nsch.htm

Centers for Medicare and Medicaid Services (CMS). 2009a. *Medicaid Dental Coverage*. Baltimore, MD: Centers for Medicare and Medicaid Services, Department of Health and Human Services. Retrieved March 25, 2009 (http://www.cms.hhs.gov/MedicaidDentalCoverage/).

Centers for Medicare and Medicaid Services (CMS). 2009b. *National CHIP Policy*. Baltimore, MD: Centers for Medicare and Medicaid Services, Department of Health and Human Services. Retrieved March 25, 2009 (http://www.cms.hhs.gov/NationalCHIPPolicy/).

Cheng, Nancy F., Pamela Z. Han, and Stuart A. Gansky. 2008. "Methods and Software for Estimating Health Disparities: The Case of Children's Oral Health." *American Journal of Epidemiology* 168(8):906-914.

Davidson, Pamela L., Daisy C. Carreon, Sebastian E. Baumeister, Terry T. Nakazono, John J. Gutierrez, Abdelmonem A. Afifi, and Ronald M. Andersen. 2007. "Influence of Contextual Environment and Community-Based Dental Education on Practice Plans of Graduating Seniors." *Journal of Dental Education* 71(3):403-418.

de la Fuente-Hernandez, Javier and A. Enrique Acosta-Gio. 2007. "The Effect of Poverty on Access to Oral Health Care." *Journal of the American Dental Association* 138(11):1443-1445.

Department of Health and Human Services (DHHS). 2000. *Oral Health in America: A Report of the Surgeon General*. Rockville, MD: National Institutes of Health.

Department of Health and Human Services (DHHS). 2001. *Healthy People 2010, 2nd Edition. With Understanding and Improving Health and Objectives for Improving Health. 2 volumes.* Washington, D.C.: U.S. Government Printing Office.

Dietrich, Thomas, Corinna Culler, Raul I. Garcia, and Michelle M. Henshaw. 2008. "Racial and Ethnic Disparities in Children's Oral Health: The National Survey of Children's Health." *Journal of the American Dental Association* 139(11):1507-1517.

Doescher, Mark P., MD MSPH, Gina A. Keppel, MPH, Susan M. Skillman MS, Roger A. Rosenblatt, MD, MPH, MFR. “The Crisis in Rural Dentistry” *Washington, Wyoming, Alaska, Montana and Idaho (WWAMMI), Rural Health Research Center (RHRC)*. Policy Brief. April 2009. http://depts.washington.edu/uwrhrc/uploads/ Rural_Dentists_PB_2009.pdf .

Dye, Bruce A., Sylvia Tan, Vincent Smith, Brenda G. Lewis, Laurie K. Barker, Gina Thornton-Evans, Paul I. Eke, Eugenio D. Beltran-Aguilar, Alice M. Horowitz, and Chien-Hsun Li. 2007. "Trends in Oral Health Status: United States, 1988-1994 and 1999-2004." *Vital Health Statistics 11* 248:1-92.

Edelstein, Burton L. 2002. "Disparities in Oral Health and Access to Care: Findings of National Surveys." *Ambulatory Pediatrics* 2(2):141-147.

Ellis, Eileen R., Dennis Roberts, David M. Rousseau, and Tanya Schwartz. 2009. *Medicaid Enrollment in 50 State: June 2008 Data Update*. Washington, D.C.: The Henry J. Kaiser Family Foundation.

Fisher, Monica A. and Ana K. Mascarenhas. 2007. "Does Medicaid Improve Utilization of Medical and Dental Services and Health Outcomes for Medicaid-Eligible Children in the United States?" *Community Dentistry and Oral Epidemiology* 35:263-271.

Fisher, Robin and Joanna Turner. 2003. *Health Insurance Estimates for Counties*. Washington, D.C.: U.S. Census Bureau.

Flores, Glenn and Sandra C. Tomany-Korman. 2008. "Racial and Ethnic Disparities in Medical and Dental Health, Access to Care, and Use of Services in US Children." *Pediatrics* 121(2):e286-e298.

Government Accountability Office (GAO). 2008. *Medicaid: Extent of Dental Disease in Children has not Decreased, and Millions are Estimated to Have Untreated Tooth Decay*. Washington, D.C.: U.S. Government Accountability Office.

Griffin, Susan O., Kari Jones, and Scott L. Tomar. 2001. "An Economic Evaluation of Community Water Fluoridation." *Journal of Public Health Dentistry* 61(2):78-86.

Guay, Albert H. 2004. "Access to Dental Care: The Triad of Essential Factors in Access-to-Care Programs." *Journal of the American Dental Association* 135(6):779-785.

Haden, N. Karl, Frank A. Catalanotto, Charles J. Alexander, Howard Bailit, Ann Battrell, Jack Broussard, Jr., Judith Buchanan, Chester W. Douglass, Claude E. Fox , 3rd, Paul Glassman, R. Ivan Lugo, Mary George, Cyril Meyerowitz, Edward R. Scott, 2nd, Newell Yaple, Jack Bresch, Zlata Gutman-Betts, Gina G. Luke, Myla Moss, Jeanne C. Sinkford, Richard G. Weaver, and Richard W. Valachovic. 2003. "Improving the Oral Health Status of All Americans: Roles and Responsibilities of Academic Dental Institutions: The Report of the Adea President's Commission." *Journal of Dental Education* 67(5):563-583.

Health Resources and Services Administration (HRSA). 2004. *The Professional Practice Environment of Dental Hygienists in the Fifty States and the District of Columbia, 2001*. Rockville, MD: U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professionals.

Health Resources and Services Administration (HRSA). 2006. *Area Resource File*. Rockville, MD: U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professionals.

Hudson, Kenneth, Jean Stockard, and Zach Ramberg. 2007. "The Impact of Socioeconomic Status and Race-Ethnicity on Dental Health." *Sociological Perspectives* 50(1):7-25.

Huttinger, Kathleen, Jennifer Schaller-Ayers, and Tony Lawson. 2004. "Health Care in Appalachia: A Population-Based Approach." *Public Health Nursing* 21(2):103-110.

Jackson, SL, WF Vannm JB Kothcm BT Pahel, JY Lee. 2011. “ NC CHAMP: Impact of Oral Helath on School Attendance and Performance”. *American Dental Assistants Association (ADAA).* Chicago, IL. http://www.dentalassistant.org/enews_general.htm#top.

Kagihara, Lynette E., Victoria P. Niederhauser, and Marialiana Stark. 2009. "Assessment, Management, and Prevention of Early Childhood Caries." *Journal of the American Academy of Nurse Practitioners* 21(1):1-10.

Kahan, Barbara and Michael Goodstadt. 1999. "Continuous Quality Improvement and Health Promotion: Can CQI Lead to Better Outcomes?" *Health Promotion International* 14(1):83-91.

Kaiser Family Foundation (KFF). 2006. *Medicaid Benefits:Online Database*. Washington, D.C.: The Henry J. Kaiser Family Foundation. Retrieved from (http://medicaidbenefits.kff.org/service.jsp?yr=3&caat=6&nt=on&so=0&tg=0).

Kaiser Family Foundation (KFF). 2007. *Statehealthfacts.org: Health Status*. Menlo Park, CA: The Henry J. Kaiser Family Foundation. Retrieved March 18, 2009 (http://www.statehealthfacts.org/comparemapdetail.jsp?cat=2&ind=584&typ=2).

Kaiser Family Foundation, State Health facts, Monthly CHIP Enrollment, www.statehealthfacts.org, accessed November 9, 2011.

Kenney, Genevieve M., Joshua R. McFeeters, and Justin Y. Yee. 2005. "Preventive Dental Care and Unmet Dental Needs Among Low-Income Children." *American Journal of Public Health* 95(8):1360-1366.

Kentucky Department of Public Health (DPH). 2011."Oral/Dental Health". *Kentucky Cabinet for Health and Family Services.* http://chfs.ky.gov/dph/mch/cfhi/oralhealth.htm

Kleiner, Morris M. and Kyoung Won Park. 2008. "Battles Among Licensed Occupations: Analyzing Government Regulations on Labor Marktet Outcomes for Dentists and Hygienists". *University of Minnesota and The National Bureau of Economic Research (NBER).* Accessed August 9, 2011.

Kohlway, Elizabeth. 2008. "Water Fluoridation Approaches Healthy People 2010 Objectives." *Nation's Health* 38(7):9-11.

Krause, Denise D, Ph.D., Jeralynn S. Cossman, Ph.D., Amy Gwin, B.S., Jamie Boydstun, M.S., and Warren May, Ph.D., "An Analysis of Oral Health Disparities and Access to Services in the Appalachian Region". Contract #CO-16034-2008. *Appalachian Regional Commission (ARC).* July 2010.

Krause, Denise D., Nicholas Mosca, and Mark Livingston. 2003. "Maximizing the Dental Workforce." *The Journal of Dental Hygiene* 77(4):253-261.

Krol, David M. 2003. "Dental caries, oral health, and pediatricians." *Current Problems in Pediatric and Adolescent Health Care* 33(8):253-270.

Krol, David M. and Michael P. Nedley. 2007. "Dental Caries: State of the Science for the Most Common Chronic Disease of Childhood." *Advances in Pediatrics* 54(1):215-239.

Lane, Nancy M., MA., Thomas R. (Bob) Konrad, Ph.D., Randy Randolph, MRP, Andrew Y. Lutz, BS, Kimberly Baker, BS, Charles Tran, BS, and Christopher A. Beadles, MD. "Health Care Costs and Access Disparities in Appalachia". PDA, Inc. in collaboration with The Cecil G. Sheps Center for Health Services Research University of North Carolina at Chapel Hill. Contract #CO-16835-2010. *Appalachian Regional Commission (ARC).* December 2011.

Lewis, Charlotte, Wendy Mouradian, Rebecca Slayton, and Alexis Williams. 2007. "Dental insurance and its impact on preventive dental care visits for U.S. children." *Journal of the American Dental Association* 138(3):369-380.

Leys, Mark. 2003. "Health Care Policy: Qualitative Evidence and Health Technology Assessment." *Health Policy* 65(3):217-226.

Lichter, Daniel T. and Lori Ann Campbell. 2005. *Demographic and Socioeconomic Change in Appalachia : Changing Patterns of Poverty and Spatial Inequality in Appalachia*. Washington, D.C.: Population Reference Bureau and the Appalachian Regional Commission.

Martinez, Michael and R.A. Cohen. Health Insurance Coverage: early Release of Estimates from the National Health Interview Survey (NHIS). January- June 2011. *Centers for Disease Control (CDC), National Center for Health Statistics*, http://www.cdc.gov/nchs/data/nhis/earlyrelease/insur201112.htm

Martin, Amy B., Eric Wang, Janice C. Probst, Nathan Hale, and Andrew O. Johnson. 2008. *Dental Health and Access to Care among Rural Children: A National and State Portrait*. Columbia, SC: South Carolina Rural Health Research Center.

Mckee, Julie Watts, DMD, State Dental Director, State of Kentucky Presenter at Appalachian Regional Commission's (ARC) 2011 Annual Conference, Health Families, Healthy Future, Prestonsburg, K.Y. *Appalachian Regional Commission.* September 7, 2011.

Mertz, Elizabeth and Edward O'Neil. 2002. "The Growing Challenge of Providing Oral Health Care Services to All Americans." *Health Affairs* 21(5):65-77.

Meyer, Mara S., Kaumudi Joshipura, Edward Giovannucci, and Dominique S. Michaud. 2008. "A Review of the Relationship between Tooth Removal, Periodontal Disease, and Cancer." *Cancer Causes Control* 19:895-907.

Mitchell, Dennis A. and Shana L. Lassiter. 2006. "Addressing Health Care Disparities and Increasing Workforce Diversity: The Next Step for the Dental, Medical, and Public Health Professions." *American Journal of Public Health* 96(12):2093-2097.

Mofidi, Mahyar, Rebecca Slifkin, Victoria Freeman, and Pam Silberman. 2002. "The Impact of a State Children's Health Insurance Program on Access to Dental Care." *Journal of the American Dental Association* 133(6):707-714.

Mouradian, Wendy E., Elizabeth Wehr, and James J. Crall. 2000. "Disparities in Children's Oral Health and Access to Dental Care." *Journal of the American Medical Association* 284(20):2625-2631.

Muto, Bobbi Jo, RDH, BS, Marshall University. West Virginia Presenter at Appalachian Regional Commission's (ARC) 2011 Annual Conference, Health Families, Healthy Future, Prestonsburg, KY *Appalachian Regional Commission.* September 7, 2011.

National Institute of Dental and Craniofacial Research (NCIDR*).* "Community Water Fluoridation Status by State". *National Institute of Health (NIH).* Maryland data 2011. http://www.nidcr.nih.gov/DataStatistics/FindDataByTopic/WaterFluoridation/CommunityWaterFluoridationState.htm

National Institute of Dental and Craniofacial Research (NCIDR). 2000. "Oral Health in America: A Report of the Surgeon General." *National Institute of Health (NIH).* http://www.nidcr.nih.gov/nidcr2.nih.gov/Templates/CommonPage.aspx?NRMODE=Published&NRNODEGUID={7A6ABF55-F4F9-4FF9-9FC4-3BF6A423CD4F}&NRORIGINALURL=%2fdatastatistics%2fsurgeongeneral%2freport%2fexecutivesummary.htm&NRCACHEHINT=Guest#execSumm

National Institutes of Health (NIH). 2009. *MedlinePlus Medical Encyclopedia: Oral Cancer*. Bethesda, MD: U.S. National Library of Medicine, National Institutes of Health, Department of Health and Human Services. Retrieved May 18, 2009 (http://www.nlm.nih.gov/medlineplus/ency/article/001035.htm).

National Institutes of Health (NIH) and The Centers for Disease Control and Prevention (CDC). 2002. *Oral Health U.S.*: The National Institute of Dental and Craniofacial Research, The National Institutes of Health and the Division of Oral Health, Centers for Disease Control and Prevention. Retrieved August 17, 2009 (http://drc.hhs.gov/report/pdfs/OralHealthfigures.pdf).

National Interprofessional Initiative on Oral Health. 2011. http://www.niioh.org/content/about-us Accessed December 9, 2011.

Ohio Department of Health. 2011. "School-based Fluoride Mouthrinse (FMR) Program". *At-a-Glance: Ohio Department of Health Oral Health Section*. www.odh.ohio.gov/.../...

Perleth, Matthias, Elke Jakubowski, and Reinhard Busse. 2001. "What is 'Best Practice' in Health Care? State of the Art and Perspectives in Improving the Effectiveness and Efficiency of the European Health Care Systems." *Health Policy* 56(3):235-250.

Petersen, Poul Erik, Denis Bourgeois, Hiroshi Ogawa, Saskia Estupinan-Day, and Charlotte Ndiaye. 2005. "The Global Burden of Oral Diseases and Risks to Oral Health." *Bulletin of the World Health Organization* 83(9):661-669.

Pizzo, Giuseppe, Maria R. Piscopo, Ignazio Pizzo, and Giovanna Giuliana. 2007. "Community Water Fluoridation and Caries Prevention: A Critical Review." *Clinical Oral Investigations* 11(3):189-193.

Roeber, Carter, Matthew Hora, Kerry Weeda, John Massad, and Cathleen Crain. 2004. *Lessons Learned and Emerging Best Practices from the The National Syphilis Elimination Program Assessment*. Washington, D.C.: Department of Health and Human Services, Centers for Disease Control and Prevention.

Sabbah, W., G. Tsakos, T. Chandola, A. Sheiham, and R.G. Watt. 2007. "Social Gradients in Oral and General Health." *Journal of Dental Research* 86(10):992-996.

Sanders, Anne E., A. John Spencer, and Gary D. Slade. 2006. "Evaluating the Role of Dental Behaviour in Oral Health Inequalities." *Community Dentistry and Oral Epidemiology* 34(1):71-79.

Saunders, Jr Ralph H. and Cyril Meyerowitz. 2005. "Dental Caries in Older Adults." *Dental Clinics of North America* 49(2):293-308.

Savage, Matthew F., Jessica Y. Lee, Jonathan B. Kotch, and William F. Vann. 2004. "Early Preventive Dental Visits: Effects on Subsequent Utilization and Costs." *Pediatrics* 114(4):e418-e423.

Sciubba, James J. 2001. "Oral Cancer and Its Detection: History-Taking and the Diagnostic Phase of Management." *Journal of the American Dental Association* 132(1):12S-18S.

Selwitz, Robert H., Amid I. Ismail, and Nigel B. Pitts. 2007. "Dental Caries." *The Lancet* 369(9555):51-59.

Sgan-Cohen, Harold D., and Jonathan Mann. 2007. "Health, Oral Health and Poverty." *Journal of the American Dental Association* 138(11):1437-1442.

Shepherd, Ruth Ann, MD and Julie Watts McKee, DMD, Oral Public Health Programs in Kentucky, Appalachian Regional Commission Annual Conference, Prestonsburg, Kentucky, 2011.

Sofaer, Shoshanna. 2002. "Qualitative Research Methods." *International Journal for Quality in Health Care* 14(4):329-336.

Solomon, Eric S., DDS, MA. 2004. “The Future of Dentistry”. ETS Dental. Dental Economics. http://www.etsdental.com/articles/future2.htm.

The Pew Center for States. 2009. “A Policy Maker’s Guide to New Dental Health Providers” *National Center for State Health Policy.* WK Kellogg Foundation. Washington, D.C. 2009. http://www.nashp.org/sites/default/files/Dental_Report_final Low%20Res.pdf

The Pew Center for States 2010. “The Cost of Delay: State Dental Policies Fail One in Five Children”. *W.K. Kellog Foundation.* Washington, D.C. www.pewtrusts.org/uploadedFiles/Cost_of_Delay_web.pdf

Thornton, Timothy N., Carole A. Craf, Linda L. Dahlberg, Barbara S. Lynch, and Katie Baer. 2006. *Youth Violence Prevention: A Sourcebook for Community Action*. Hauppauge, NY: Nova Science Publishers, Inc.

Tomar, Scott L. and Samira Asma. 2000. "Smoking-Attributable Periodontitis in the United States: Findings From NHANES III." *Journal of Periodontology* 71(5):743-751.

Tu, Yu-Kang and Mark S. Gilthrope. 2005. “Commentary: Is tooth loss good or bad for general health?” *International Journal of Epidemiology.* Doi:10.1093/lje/dyi005. http://ije.oxfordjournals.org. Accessed December 27, 2011.

United States Census Bureau. 2008. *Current Population Survey (CPS): 2008 Annual Social and Economic Supplement*. Washington, D.C.: U.S. Census Bureau, Urban Institute, and Kaiser Commission on Medicaid and the Uninsured.

United States Census Bureau. Washington, D.C.:Bureau of the Census. Retrieved 02/2009. (http://www.census.gov/).

United States Department of Agriculture (USDA). 2003. *Rural-Urban Continuum Codes*. Washington, D.C.: Economic Research Service, United States Department of Agriculture. (http://www.ers.usda.gov/data/ruralurbancontinuumcodes/).

United States Department of Health and Human Services, CMS, 2008 National Dental Summary, January 2009.

United States Environmental Protection Agency (EPA) and U.S. Department of Health and Human Services (DHHS). "EPA and HHS Announce New Scientific Assessments and Actions on Fluoride / Agencies working together to maintain benefits of preventing tooth decay while preventing excessive exposure". *EPA.* Released January 7, 2011. http://yosemite.epa.gov/opa/admpress.nsf/3881d73f4d4aaa0b8525735 9003f5348/86964af577c37ab28 5257811005a8417!OpenDocument

Valachovic, Richard W. 2002. "Dental Workforce Trends and Children." *Ambulatory Pediatrics* 2(2):154-161.

Watt, R. and A. Sheiham. 1999. "Inequalities in Oral Health: A Review of the Evidence and Recommendations for Action." *British Dental Journal* 187(1):6-12.

White, Judy A., Laurie K. Barker, and Stuart A. Lockwood. 2004. *Annual Synopses of State and Territorial Oral Health Programs: Five-Year Trends Report 1998 to 2002.* Atlanta, GA: Centers for Disease Control and Prevention.

Winn, Deborah M. 2001. "Tobacco Use and Oral Disease." *Journal of Dental Education* 65(4):306-312.

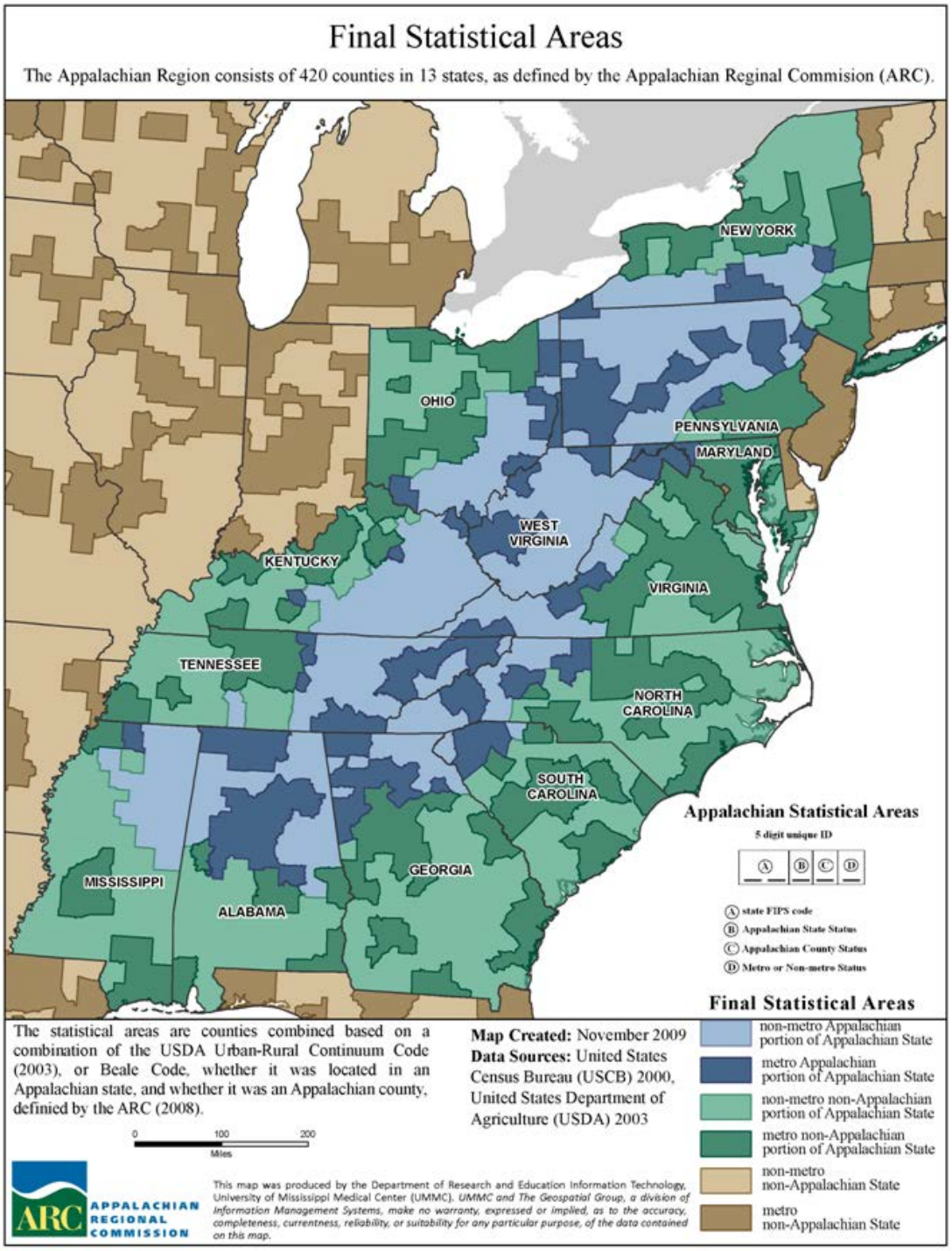
Yanagisawa, T., T. Marugame, S. Ohara, M. Inoue, S. Tsugane, and Y. Kawaguchi. 2009. "Relationship of Smoking and Smoking Cessation with Number of Teeth Present: JPHC Oral Health Study." *Oral Diseases* 15(1):69-75.

APPENDICES

Appendices A through C, and Appendices E through G were prepared, in 2010, by a research team associated with the University of Mississippi Medical Center, under contract CO-16034-2008 to the Appalachian Regional Commission.

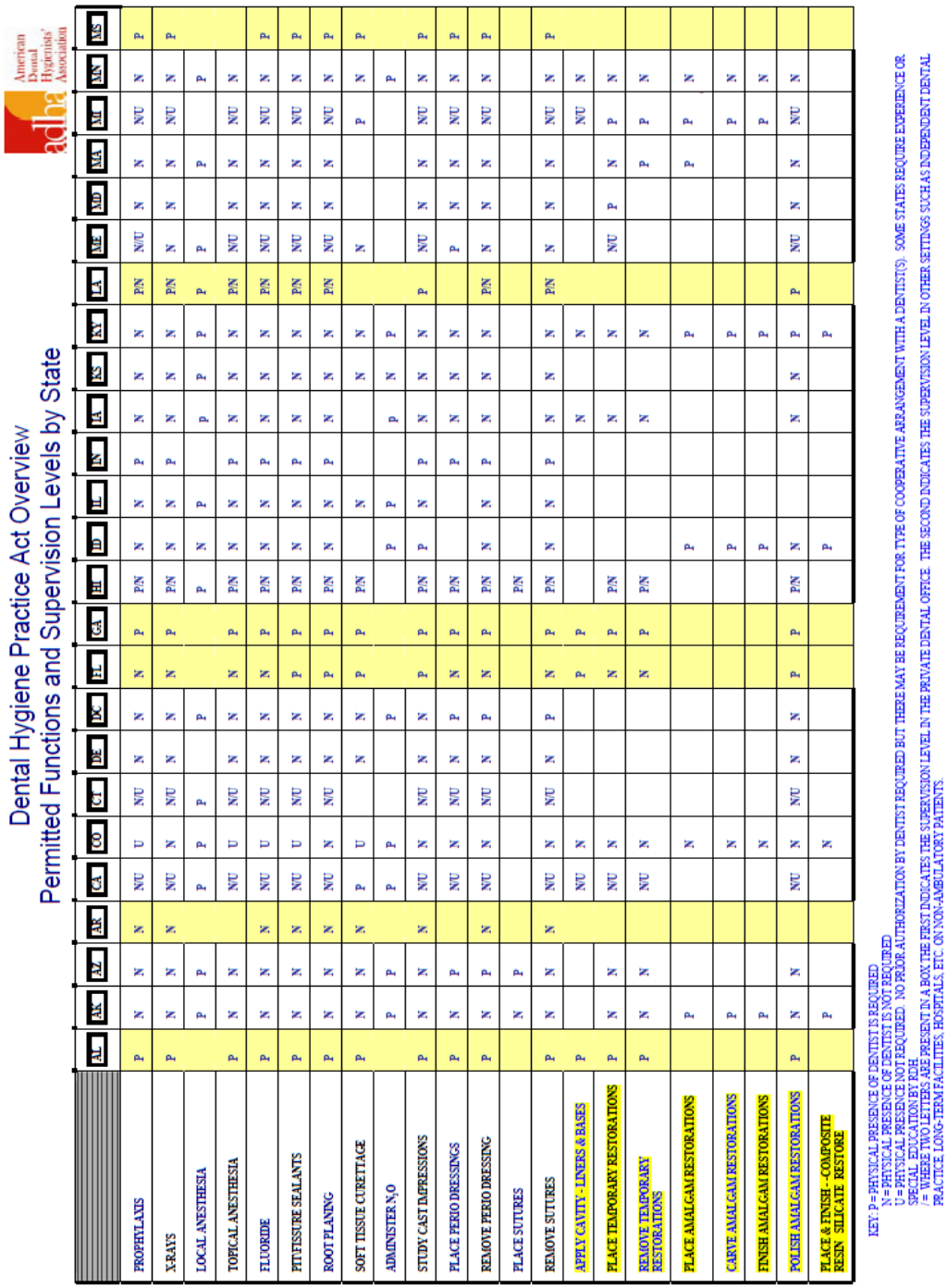
APPENDIX A: METROPOLITAN AND NON-METROPOLITAN AREAS IN APPALACHIA

FIGURE 22 - METROPOLITAN AND NON-METROPOLITAN AREAS, APPALACHIAN REGION



APPENDIX B: PERMITTED FUNCTIONS AND SUPERVISION LEVELS BY STATE REGISTERED DENTAL HYGIENISTS

FIGURE 23- DENTAL HYGIENE PRACTICE ACT OVERVIEW



Dental Hygiene Practice Act Overview
Permitted Functions and Supervision Levels by State

	MO	MT	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR	PA	RI	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY
PROPHYLAXIS	N/U	N	N/U	N/U	N	P/N	N/U	N	P/N	N	N	N	N/U	P/N	N	N	N	N	N	N	N	N	N/U	P	N/U	N
X-RAYS	N	N	N	N/U	N	P/N	N/U	N	P/N	N	N	N	N/U	P/N	N	N	N	N	N	N	N	N	N	P	N	N
LOCAL ANESTHESIA	P	P	P	P/U	P*		P	P			P	P	N		P	P	P	P		P	P	P	P	P	p	P
TOPICAL ANESTHESIA	N	N	N	N/U	N	P/N	N	N	P	N	N	N	N/U	P/N	N	P	N	N	N	N	N	N	N	P	N	N
FLUORIDE	N/U	N	N/U	N/U	N	P/N	N/U	N	P/N	N	N	N	N/U	P/N	N	N	N	N	N	N	N	N	N/U	P	N	N
PIT/FISSURE SEALANTS	N/U	N	N/U	N/U	N	P	N	N	P/N	N	P	N	N/U	P/N	N	P/N	N	N	N	N	N	N	N/U	P	N	P
ROOT PLANING	N	N	N	P/U	N	N	N	N	P	N	P	N	N/U	P/N	N	P/N	N	N	N	N	N	N	N/U	P	N	N
SOFT TISSUE CURETTAGE	N	N	N	N			N			N	P	N	N/U				N	N		N			P/U			
ADMINISTER N_2O	P			P/U	P			P			P	P	P				P	P		P		P	P			P
STUDY CAST IMPRESSIONS	N	N	N	N/U	N	P	N	P	P	P	N	N	N/U	P	P	P		P	N	N	N	N	N	P	N	N
PLACE PERIO DRESSINGS	N	N	N	N/U		P		P		P	P	N	N/U		P				N	N	N	N	P	P	N	P
REMOVE PERIO DRESSING	P	N	N	N/U	N	P	N	P	P	P	N	N	N/U		P	P	N	P	N	N	N	N	P	P	N	P
PLACE SUTURES									P											N						
REMOVE SUTURES	N	N	N	N/U	N	P		P	P	P	P	N	N/U	P	P	P		P	N	N	N	N	P	P	N	N
APPLY CAVITY - LINERS & BASES	P				N				P									P						P		
PLACE TEMPORARY RESTORATIONS	P	N	N	N/U	N	P		P	P	P		N	N/U			P/N		P	N					P	N	N
REMOVE TEMPORARY RESTORATIONS	P	N	N		N			P	P	P								P	N							
PLACE AMALGAM RESTORATIONS	N				N								P					P					P			P
CARVE AMALGAM RESTORATIONS	P												P										P	P		P
FINISH AMALGAM RESTORATIONS	P												P										P			N
POLISH AMALGAM RESTORATION	N	N	N	N/U	N	P	N		P	P	P	N	N/U		P	P	N	P	N	N			U	P		N
PLACE & FINISH – COMPOSITE RESIN SILICATE RESTORE	P												P										P			P

KEY: P = PHYSICAL PRESENCE OF DENTIST IS REQUIRED
N = PHYSICAL PRESENCE OF DENTIST IS NOT REQUIRED
U = PHYSICAL PRESENCE NOT REQUIRED. NO PRIOR AUTHORIZATION BY DENTIST REQUIRED BUT THERE MAY BE REQUIREMENT FOR TYPE OF COOPERATIVE ARRANGEMENT WITH A DENTIST(S). SOME STATES REQUIRE EXPERIENCE OR SPECIAL EDUCATION BY RDH.
/ = WHERE TWO LETTERS ARE PRESENT IN A BOX THE FIRST INDICATES THE SUPERVISION LEVEL IN THE PRIVATE DENTAL OFFICE. THE SECOND INDICATES THE SUPERVISION LEVEL IN OTHER SETTINGS SUCH AS INDEPENDENT DENTAL PRACTICE, LONG-TERM FACILITIES, HOSPITALS, ETC. ON NON-AMBULATORY PATIENTS.
* = RULES PENDING

PDA, Inc., Cecil. G. Sheps Center/UNC-Chapel Hill, University of Mississippi Medical Center, and Mississippi State University
ARC Contract Nos.: CO-16034-2008 and CO-16835-2010

APPENDIX C: STATISTICAL ANALYSIS OF SOCIOECONOMIC STATUS AND ORAL HEALTH INDICATORS

DATA AND METHODS

Four of the socioeconomic variables used for this study came from the 2007 Area Resource File (ARF). The ARF is maintained by the Health Resources and Services Administration of the U.S. Department of Health and Human Services (HRSA. 2006). It provides national county-level health resource information. The four indicators of socioeconomic status obtained from the ARF for this study included unemployment, percent urban population median household Income and percent of adults living in poverty. Because the ARF does not contain the most up-to-date information for some variables, a fifth indicator of socioeconomic status—percent of persons without health insurance—was downloaded from the Small Area Health Insurance Estimates (SAHIE) at www.census.gov/did/www/sahie. The SAHIE are prepared by the Census Bureau to provide state- and county-level estimates of health insurance coverage (Fisher and Turner 2003). These indicators provide an examination of county-level differences within the Appalachian Region.

The complete Behavioral Risk Factor Surveillance System (BRFSS) dataset for 1999-2006 contains 2,085,241 individual records based on yearly probability samples aimed at estimating prevalence of health indicators and health behaviors for all 50 states. Of these, 543,204 individuals from the Appalachian Region in the 13 states responded to the survey. Four oral health indicators were obtained from the BRFSS datasets: dental visits within one year, any tooth removal for ages 35 to 44, six or more teeth removed for ages 35 to 44, and all teeth missing for ages 65 and older. The socioeconomic status indicators for the Appalachian Region consisted of data collected over several years; however, the oral health indicators are not collected each year in every state. The prevalence estimates for dental visits within one year are based on all who responded that their most recent visit to a dentist or dental clinic was in the past 12 months; however, age-specific estimates of prevalence of health indicators/behaviors for the remaining three variables are based on respondents within each specified age categorization. Table 10 lists the number of respondents to each oral health/behavior question per year in the Appalachian Region.

TABLE 10 – SAMPLE SIZES FOR ORAL HEALTH BEHAVIOR INDICATORS, BRFSS, 1999-2006

Oral Health Indicator			
Year	Visit < 1 year	Tooth Removal	
		(35-44)	(65+)
1999	40,898	8,919	7,864
2000	9,766	2,268	1,578
2001	15,599	3,306	2,901
2002	67,931	13,747	14,273
2003	23,965	4,840	4,660
2004	79,227	14,771	18,082
2005	9,511	1,638	2,293
2006	95,441	16,614	25,230
Total	**342,338**	**65,614**	**76,881**

Source: CDC BRFSS survey database. Note sum of (35-44) should be 65,614.

METHODS

Oral health indicators were obtained from the BRFSS survey, which is an extensive, continuous telephone health survey used for monitoring health conditions and health-risk behaviors across the entire United States, the District of Columbia, Puerto Rico, U.S. Virgin Islands, and Guam. The survey is designed to estimate state-level information on health behaviors and disease prevalence through the use of a probability sample accomplished through a random selection of telephone numbers. For this study, we were interested in estimating oral health status in much smaller geographic regions. The CDC supplies county of residence for individuals as the smallest available geographic region for the BRFSS. Because population and socioeconomic data are available from the U.S. Census for individual counties, counties would be the ideal basic geographic unit to use for this study. The BRFSS survey was not intended to be used for county level analysis, but in recent years researchers and statisticians have harnessed its wealth of information to do just that.

Because of the length and expense of the questionnaire, some modules are optional, and are not asked every year in every state. It is left up to the discretion of individual states. Unfortunately, the oral health module is typically an optional module made up of only three oral health questions. The CDC suggests that estimates based on fewer than 50 individual observations are not reliable and should not be used. This makes it difficult to gain enough responses per county to be usable. In order to obtain large enough sample sizes for the oral health questions, data were merged from several years of BRFSS survey data (1999-2006). Even after merging several years of survey data, there were still many counties that did not have sufficient sample sizes to be included in this study.

In order to aggregate up to larger, but analyzable geographic areas, we chose to use four geographic regions within each state for those states that contain an Appalachian Region as part of their territory. Within each of the 13 states, counties were coded as either belonging to the Appalachian Region or not. In addition, Beale codes, obtained from the Census Bureau, were used to classify counties as metropolitan or non-metropolitan areas. Thus, our four geographic regions within each state that are of interest are: metropolitan/Appalachian, metropolitan/non-Appalachian, non-metropolitan/Appalachian, and non-metropolitan/non-Appalachian.

Note that West Virginia is entirely within the Appalachian Region. In addition, Ohio does not report county identifiers for smaller rural counties, so it is not possible to separately estimate the Appalachian and non-Appalachian regions for non-metropolitan areas in that state. Therefore, there are a total of eleven states that provide estimates of all four defined regions, one state (WV) that provides estimates for only two regions (metro/non-metro), and one state (OH) that provides estimates for non-metro, metro/non-Appalachian and metro/Appalachian regions. That is, there are 49 separate regions to be estimated for these 13 states.

The analysis is, therefore, multi-level. The first level of estimation uses individual responses for the BRFSS on each of the four oral health/behavior indicators as dependent variables in a simple estimation of the prevalence proportions. The indicators were dichotomized to 0 for a negative response and 1 for a positive response. For example, if the individual respondent to the BRFSS survey that they had visited the dentist within the past year, they were coded as “1” and if they responded otherwise, they were coded as “0”. Those who did not respond were coded as missing and do not contribute to the analysis. Similar definitions were made for each of the other variables with the appropriate restriction to specific age categories based on self-reported age in the BRFSS dataset.

The simple model for the first level estimation is a basic cell means model aimed at estimating, within each state, the prevalence estimates for each of the geographic regions.

$$E(Y_{ii}) = \pi_i$$

Where Y_{ij} represents the j^{th} individual BRFSS respondent for one of the four oral health indicators within the i^{th} geographic region, i = 1,2,…,49, and π_i (i=1,2,…,49) represents the 49 separate prevalence proportions. That is, the first level of analysis estimates the prevalence proportion for the four oral health/behavior indicators in each of the 49 regions. Based on the sample data, therefore, we have a collection of 49 observed proportions, pi. The Central Limit Theorem guarantees that these estimates are approximately distributed as N (π_{ij}, σ) due to the large number of individuals within each region on which the estimates are based. These estimates are carried forward into the next level of analysis.

Next, county-level census data were aggregated to the larger geographic region using a similar model to find averages for each of the 49 defined geographic regions. That is, Average (Yij)=πi, where Yij represents the county-level census data for each economic indicator for the jth county in the ith region (i=1,2,…49). Here, all county-level data within a region are aggregated to the larger region defined earlier. We point out that, theoretically, the census variables are not random variables but represent true population values.

By aggregating the BRFSS data to a geographic unit smaller than the state but larger than the county, we satisfy the CDC sample size requirements for small area estimation using a simple approach that is suitable for our purposes. The first-level estimates are well-estimated as evidenced by the small standard errors seen in the reports. The BRFSS uses a probability-based sampling approach and prevalence estimates require the use of the sample weights. For our analyses, we used the final sample weights derived by the CDC and distributed with the raw data. Data were analyzed using Survey Procedures in the SAS system.

The second level of analysis assumes the $p_{ij} \sim N(\pi_{ij}, \sigma)$ (ij=1,2,…,49). Several models of interest are investigated using the estimated prevalence proportions as outcomes in the second level models. Our basic model for analysis is the cell means model

$$E(p_{ii}) = \alpha_i$$

Where α_i are the average prevalence proportions for Appalachian/metro, non-Appalachian/metro, Appalachian/non-metro, non-Appalachian/non-metro. This can be accomplished in a regression setting using three indicator variables with non-Appalachian/non-metro as the baseline and coding 0/1 for the other groups. Although the design could be considered a two-way ANOVA design with main effects for Appalachian/non-Appalachian and metro/non-metro, we chose to model the means directly in order to estimate simple effects. That is, we are most interested in comparing the means for Appalachian Region to non-Appalachian Region for metro areas and the same comparison within non-metro areas. As an example, suppose the four means are $\pi 1$, $\pi 2$, $\pi 3$, and $\pi 4$ for Appalachian/metro, non-Appalachian/metro, Appalachian/non-metro, non-Appalachian / non-metro, respectively. We are most interested in the contrasts of $\pi 1$-$\pi 2$ and $\pi 3$-$\pi 4$ that represent simple effects comparing Appalachian to non-Appalachian regions within each metro/non-metro grouping.

In addition to the ANOVA models, we also used the estimated proportions and aggregated Census data to investigate correlations between the variables. Each of these, therefore, uses the 49 estimated or aggregated data values as variables. To identify those economic indicators that are associated with better oral health/behaviors, we used the aggregated data in several regressions using dental indicators as outcomes and economic indicators as predictors. Models for these regressions follow the form:

$$E(p_{ii}) = \beta_0 + \beta_1 X_i$$

Where p_{ij} are the estimated prevalence proportions for oral health/behavior indicators, β_0 is the intercept and β_1 is the slope. Tests of the slope parameters are performed using a traditional Fisher's "F" statistic.

Finally, stepwise regression models using significant economic indicators were performed to identify the best predictive models for each of the oral health/behavior indicators. Least squares means are reported for these models so that estimates of relationship between predictor and outcome are adjusted for all other variables in that particular model and tested using Type III analyses that are, basically, regression approaches to the General Linear Model.

RESULTS

The BRFSS uses a probability-based sampling approach and prevalence estimates require the use of the sample weights. For our analyses, we used the final sample weights derived by the CDC and distributed with the raw data. The following estimates for all 13 states that encompass the Appalachian Region utilize those weights:

TABLE 11 - PREVALENCE ESTIMATES FOR ORAL HEALTH/BEHAVIOR INDICATORS, APPALACHIAN STATES

Variable	N	Prevalence	Std. Error	95% CI
Visit within 1 year	342,338	68.70%	0.13%	68.4 %-69.0 %
Any teeth removed (ages 35-44)	65,614	43.50%	0.30%	42.9 %-44.0 %
Major tooth removal (ages 35-44)	76,881	24.20%	0.25%	23.7 %-24.7 %
Major/all tooth removal (age 65+)	65,614	9.63%	0.19%	9.26 %-10.00 %

Of the respondents to each of the oral health/behavior indicators, only 68.7 percent have seen the dentist for a regular yearly check-up in the past year. Of those aged 65 or older, nearly 10 percent have all teeth removed. For those in the 35 to 44 year age range, a large proportion has experienced at least some tooth removal as a result of disease or decay (43.5%), defined here as having had any teeth removed, while almost one-fourth have experienced major tooth removal (24.2%), defined here as having had six or more teeth removed. Since tooth removal is preventable through proper hygiene and care, the magnitudes of the prevalence estimates oral health/behavior indicators for the states that encompass the Appalachian Region are of some concern.

The above estimates are regional estimates for all states that encompass the Appalachian Region. For the next level, we estimated the prevalence for each state. As illustrated in Tables 12-15, the BRFSS estimates are reasonably well-estimated at the state level by using data across years, assuming there is little year-to-year change within each state. There is considerable state-by-state variability in all four indicators. For example, 73.0 percent visited the dentist within the past year for Maryland, while only 59.4 percent had a visit for West Virginia. Any tooth removal within the 35-44 year olds ranged from a low of 36.6 percent for Virginia, to a high of 56.3 percent for Mississippi. Major tooth removal in the 35-44 year olds ranged from 5.5 percent for Maryland, to 18.2 percent for West Virginia, over 3 times the prevalence. For those over age 65, all teeth removed ranged from 18.3 percent for New York to a high of 41.9 percent for West Virginia. Overall, it appears that West Virginia scores very low in terms of the oral health/behavior indicators.

These are limited measures that do not shed much light on the underlying causes. Other studies indicate that poor oral health is often a reflection of a lifetime of poor oral health hygiene, limited exposure to dental professionals and limited knowledge of good oral health practices.

Next, in Tables 12 through 15, we examined the state-level prevalence associated with each of the four dependent variables.

TABLE 12 - PREVALENCE OF DENTAL VISIT WITHIN THE PAST YEAR, APPALACHIAN STATES

State	N	Prevalence	Std Error	Rank
Alabama	12,076	64.7%	0.6%	9
Georgia	20,082	66.2%	0.5%	8
Kentucky	27,422	63.8%	0.5%	10
Maryland	30,494	73.0%	0.4%	1
Mississippi	21,812	57.7%	0.4%	12
New York	24,191	70.0%	0.4%	4
North Carolina	45,953	66.8%	0.4%	7
Ohio	25,747	70.8	0.5%	3
Pennsylvania	39,970	70.0%	0.4%	4
South Carolina	32,794	67.1%	0.3%	5
Tennessee	14,412	67.0%	0.5%	6
Virginia	34,213	71.1%	0.4%	2
West Virginia	13,172	59.4%	0.5%	11

*Note that New York and Pennsylvania are tied for 4th place in this ranking.

Variations across Appalachian states in dental visits in the previous year are wide. Maryland tops the list at 73.0 percent, and Mississippi has the lowest rate at 57.7 percent. The top four states (Maryland, Virginia, Ohio and Pennsylvania) are all in Northern and Central Appalachian regions; while the four states with the lowest rates of dental visits in the previous year (Mississippi, West Virginia, Kentucky and Alabama) were all in Central and Southern Appalachia.

TABLE 13 - PREVALENCE OF ANY TEETH REMOVED (AGES 35-44), APPALACHIAN STATES

State	N	Prevalence	Std Error	Rank
Alabama	2,134	52.8%	0.1%	11
Georgia	4,042	45.3%	1.0%	6
Kentucky	4,935	48.4%	1.0%	9
Maryland	6,470	35.0%	0.8%	1
Mississippi	3,863	56.3%	0.9%	12
New York	4,850	43.9%	0.9%	5
North Carolina	8,599	49.4%	0.8%	10
Ohio	4,828	40.8%	1.1%	3
Pennsylvania	7,583	41.4%	0.8%	4
South Carolina	6,095	47.3%	0.8%	8
Tennessee	2,749	47.0%	1.2%	7
Virginia	7,131	36.6%	0.8%	2
West Virginia	2,335	57.2%	0.1%	13

State variations in the prevalence of any teeth removed in young adults (ages 35-44) also show wide variation (Table 13). The top ranked states are Maryland, Virginia, Ohio and Pennsylvania. In these states, more than one-third of the residents between 35 and 44 years of age have some teeth removed. At the other extreme, West Virginia has the highest rate of any teeth removed among young adults, followed by Mississippi and Alabama, where more than half of the young adults aged 35-44 have had at least one tooth removed.

TABLE 14 - PREVALENCE OF SIX OR MORE TEETH REMOVED (AGES 35-44), APPALACHIAN STATES

State	N	Prevalence	Std Error	Rank
Alabama	2,134	12.5%	0.8%	10
Georgia	4,042	10.2%	0.6%	7
Kentucky	4,935	15.0%	0.7%	11
Maryland	6,470	5.5%	0.4%	1
Mississippi	3,863	16.7%	0.7%	12
New York	4,850	7.9%	0.5%	2
North Carolina	8,599	9.7%	0.5%	5
Ohio	4,828	9.8%	0.7%	6
Pennsylvania	7,583	8.5%	0.5%	3
South Carolina	6,095	11.5%	0.5%	8
Tennessee	2,749	12.1%	0.8%	9
Virginia	7,131	8.9%	0.5%	4
West Virginia	2,335	18.2%	0.9%	13

The rankings for the average rates of six or more teeth removed for young adults (ages 35-44) (Table 14) indicate that the states with the lowest rates of major tooth removal in young adults are Maryland (5.5%), New York (7.9%), and Pennsylvania (8.5%), the states that comprise Northern Appalachia. The states with the highest rates of major tooth removal in young adults are West Virginia (18.2%), Mississippi (16.7%) and Kentucky (15.0%).

TABLE 15 - PREVALENCE OF MAJOR TOOTH REMOVAL (65+), APPALACHIAN STATES

State	N	Prevalence	Std Error	Rank
Alabama	2,820	29.8%	1.0%	9
Georgia	4,041	26.4%	1.0%	7
Kentucky	6,956	39.5%	0.8%	12
Maryland	5,929	18.5%	0.7%	2
Mississippi	5,326	30.8%	0.8%	10
New York	5,182	18.3%	0.7%	1
North Carolina	10,824	27.3%	0.7%	8
Ohio	5,764	23.4%	0.9%	5
Pennsylvania	9,578	25.9%	0.7%	6
South Carolina	7,149	23.3%	0.7%	4
Tennessee	3,262	31.2%	1.0%	11
Virginia	6,723	18.9%	0.7%	3
West Virginia	3,327	41.9%	1.0%	13

The fourth and final dependent variable is a measure of all teeth removed among the elderly population (65+), and is presented in Table 15. New York (18.3%), Maryland (18.5%) and Virginia (18.9 %) represent the Appalachian states with the lowest prevalence of all teeth removed among the elderly. West Virginia (42%), Kentucky (39.5%) and Tennessee (31.2%) are the states with the highest prevalence of all teeth removed among the elderly.

SUB-STATE ANALYSES

The BRFSS survey was designed for state-level estimation of health behaviors, as in the previous tables, and the yearly estimates are reasonably good approximations of the state-level population prevalence. Areas of estimation smaller than the state level require attention to sample size issues. The data may become sparse when estimating small local areas, particularly for the three age-specific oral health/behavior indicators. As previously mentioned, the CDC suggests that estimates be based on at least 50 individual observations for a specific small area. As a first attempt at analysis, we estimated the prevalence proportions for each of the four indicators at the county level. In the Appalachian Region, there are a total of 1,099 areas, 1,070 individual counties and 29 independent cities. Of these, only 531 areas had at least one respondent to at least one of the oral health/behavior indicator questions. The strict requirement of at least 50 observations retains estimates for a reduced number of counties as listed in the following table:

TABLE 16 - ASSESSMENT OF APPALACHIAN COUNTIES AND INDEPENDENT CITIES REPRESENTED IN BRFSS DATA

Indicator	Number of areas with 1+ observations	Number of areas with 50+ observations
Visit Within 1 Year	504	496
Any/Major Removal (35-44)	503	260
Major Removal (65+)	503	311

Therefore, difficulties with sample size requirements for the BRFSS county-level estimates warranted other approaches for identifying differences between Appalachian and non-Appalachian Regions within the Appalachian states. Initially, we considered using the county-level prevalence estimates of the oral health/behavior indicators from the 1999-2006 BRFSS data. The removal of nearly half of the county-level estimates due to small sample sizes, however, warranted other approaches to the small area estimation.

Because of suspected differences in behaviors based on proximity to services, we considered separating the counties into those in close proximity versus those farther from large population centers. Beale codes are codes that are assigned to each county of the United States according to its proximity to a metropolitan area and provided a reasonable approach to the analysis. Because dental services may differ for metro and non-metro areas, we used the Beale codes to assign each of the 1,099 counties within states that encompass the Appalachian Region to either a metropolitan area or a non-metropolitan area within the state. Because the BRFSS data provides the county of residence for each participant if demanded, each individual observation of the BRFSS data was assigned according to the county-level or independent city Beale code, to belong to either a metro or non-metro area within a state.

We were most interested in comparing Appalachian Regions to non-Appalachian regions within a state. The BRFSS data, using county identifiers, were assigned to one of the two regions, Appalachian or non-Appalachian, within each state.

Again, using this scheme, we estimated the prevalence proportions for each of the four oral health/behavior indicators for four geographic regions within each state: Appalachian/metro, Appalachian/non-metro, non-Appalachian/metro and non-Appalachian/non-metro. All counties in West Virginia are listed as belonging to the Appalachian Region, so West Virginia has only prevalence estimates for metro and non-metro regions. All 12 other states have four prevalence estimates, with the exception of Ohio that provides estimates for non-metro, metro/non-Appalachian and metro/Appalachian regions. Thus, we estimated 49 separate oral health/behavior prevalence proportions for the described geographic regions.

The tables on the following few pages give the prevalence estimates for each of the four oral health/behavior indicators for each of the geographic regions described in the previous paragraph. As mentioned, West Virginia does not include a non-Appalachian Region. In addition, Ohio does not appear to list the county of residence for those in rural counties and, so, the estimate for non-metropolitan Appalachian regions is not available for further analysis.

As evidenced in the tables, the prevalence estimates for dental visit within the last year range from a low of 54.4 percent to a high of 74.2 percent. The standard errors, however, indicate that the estimates are relatively precise in their estimation. This is understandable since the aggregation to the four geographic regions is nearer to that of state-level data than of county-level data, a reminder that the original intention of the BRFSS study is to estimate state-level prevalence.

Only those states with Appalachian regions were used in the main analyses, although a separate comparison of Appalachian regions to the rest of the states is also reported. West Virginia is entirely within the Appalachian Region but the other 12 states had Appalachian and non- Appalachian regions. County-level census data were merged with the BRFSS data. The data was aggregated from the county level to the Appalachian and non-Appalachian regions within each state. Beale codes were added to the data and separated into metro and non-metro areas in the analyses. Four groups were formed from the aggregated data: metro Appalachian, metro non-Appalachian, non-metro Appalachian and non-metro non-Appalachian. Comparisons of the aggregated data were made using ANOVA models with pre-specified contrasts to compare the proportions for metro versus non-metro areas as well as Appalachian versus non-Appalachian areas. Analyses based on the ANOVA contrasts comparing Appalachian versus non-Appalachian areas, separately for metro and non-metro areas, are also reported.

Univariate normal probability plots of most of the proportions did not show gross departures, so the parametric ANOVA models were assumed robust enough to determine differences. In the initial screening of the variables, we reported $p<0.05/4 = 0.0125$ as evidence of difference by adjusting for multiple contrasts ($k=4$) but without adjusting multiple outcomes. Pearson's correlations between economic indicators and dental outcomes are reported along with p-values. Finally, stepwise selection was performed to identify predictive models of each of the four outcome variables and those were further investigated in ANCOVA models that included a variable to compare the groups, metro/Appalachia, metro/non-Appalachia, non-metro/Appalachia and non-metro/non-Appalachia. Each dental outcome was considered separately with $p<0.05$ as an indication of significant differences followed by Bonferroni post-hoc procedure for the pairwise comparisons of the four least-squares adjusted means.

The first set of tables compares means on all pertinent variables, but only Appalachian states divided into metro/non-metro and Appalachian/non-Appalachian Region. Respondents who reside in states that do not fall into the Appalachian Region are not included in these analyses. Only significant results are discussed (the p values are in bold when they fall below 0.05).

Table 17 shows the results for the mean comparisons of metro residents in Appalachian states to non-metro residents in Appalachian states; therefore, residents in areas that are not considered to be in Appalachia are included in these analyses, as long as they live in a state that is at least partially in Appalachia.

Non-metro Appalachian state residents are slightly older (mean age 37.7) than metro Appalachian state residents (mean age 36.3). In part, this mean age difference would be related to the fact that non-metro Appalachian state residents are more likely to be 65+ (14.5%) than metro Appalachian state residents (12.5%). Non-metro Appalachian state residents are also more likely to be in poverty (17.5%) than metro Appalachian state residents (14.3%), as median household income is lower for those non-metro residents ($35,211) than for metro residents ($42,281).

As for the oral health variables, non-metro Appalachian state residents are less likely to have had a dental visit in the last year, more likely to have lost teeth between the ages of 35 and 44, more likely to experience six or more teeth removed in that same age range and more likely to have had experienced all teeth removed among the elderly population. In other words, all four measures of oral health are statistically significantly worse in the non-metro areas of the Appalachian states than in the metro areas of these same states.

TABLE 17 - COMPARING MEANS, METRO VERSUS NON-METRO AREAS, APPALACHIAN STATES

Variables	Metro	Non-metro	P Value
Percent males	48.7	49.0	0.107
Percent whites	77.4	83.9	0.060
Percent other race	1.4	0.8	0.071
Median age	36.3	37.7	**0.004**
Percentage > 65	12.5	14.5	**<0.001**
Percent adults poverty	14.3	17.5	**0.013**
Percent urban	52.6	28.3	**<0.001**
Unemployment rate	5.0	5.8	0.048
Median household income	42,281	35,211	**<0.001**
Percent uninsured	16.3	16.9	0.352
Dental visit within past year	67.9	63.8	**0.011**
Any tooth removal (35-44)	42.9	51.4	**0.001**
Six or more teeth removed (35-44)	9.5	14.5	**0.001**
Complete tooth removal (>65)	24.2	31.2	**0.001**

Source: Appalachian states divided by metropolitan and non-metropolitan areas

Table 18 shows the results for the mean comparisons of Appalachian residents in Appalachian states to non-Appalachian residents in Appalachian states; therefore, all residents in Appalachian states are included in these analyses and the table compares those who live in Appalachian counties to those who do not live in Appalachian counties (but who live in an Appalachian state).

Residents of non-Appalachian regions of Appalachian states are less likely to be white (72.7%) than those residing in Appalachian regions of Appalachian states (88%). Also, residents of Appalachian regions of Appalachian states are more likely to be 65+ (14.2%) than those residing in non-Appalachian regions of Appalachian states (12.8%). Residents of Appalachian regions of Appalachian states are less likely to live in an urban area (36.3%) than those who reside in non-Appalachian regions of Appalachian states (44.8%); that is, Appalachian counties have a higher rural population than those that are not in Appalachia. Finally, household income is higher among residents of non-Appalachian regions of Appalachian states ($41,523) than it is among Appalachian regions in Appalachian states ($36,183); in other words, Appalachian residents are poorer, on average, than residents in non-Appalachian counties.

As for the dental variables, residents of Appalachian and non-Appalachian regions of Appalachian states do not experience significantly different oral health status, using these four measures (dental visits, any tooth removal, six or more teeth removed and all teeth removed in old age). That is, residents of Appalachian states have similar oral health whether they are living in an Appalachian county or not. Although there are numerical differences, the tests of statistical significance indicate that these differences are within the realm of statistical probability.

TABLE 18 - COMPARING MEANS, APPALACHIA VERSUS NON-APPALACHIA, APPALACHIAN STATES

Variables	Appalachia	Non-Appalachia	P Value
Percent males	49.1	48.8	0.239
Percent whites	88.0	72.7	**<0.001**
Percent other race	0.8	1.5	0.026
Median age	37.5	36.4	0.013
Percentage > 65	14.2	12.8	**0.003**
Percent adults poverty	16.3	15.5	0.520
Percent urban	36.3	44.9	**0.009**
Unemployment rate	5.5	5.3	0.485
Household income	36,183	41,523	**0.003**
Percent uninsured	16.8	16.3	0.510
Dental visit within past year	64.6	67.2	0.110
Any tooth removal (35-44)	48.3	45.8	0.283
Six or more teeth removed (35-44)	12.9	10.9	0.164
Complete tooth removal (>65)	29.5	25.7	0.062

Source: Appalachian states divided by metropolitan and non-metropolitan areas

Table 19 shows the results of the mean comparisons of Appalachian residents in Appalachian states to non-Appalachian residents in Appalachian states, but only compares those who live in metropolitan areas. Therefore, all metropolitan residents in Appalachian states are included in these analyses and the table compares metropolitan residents who live in Appalachian counties to metropolitan residents who do not live in Appalachian counties (but who live in an Appalachian state).

Residents of metropolitan areas in non-Appalachian regions of Appalachian states are less likely to be white (69.1%) than are those living in metropolitan areas in Appalachian regions of Appalachian states (85.1%). Also, residents of metropolitan areas in Appalachian regions of Appalachian states are more likely to be 65+ (13.7%) than those residing in metropolitan areas in non-Appalachian regions of Appalachian states (11.3%). Finally, household income is higher among those living in metropolitan areas in non-Appalachian regions of Appalachian states ($46,523) than it is among those living in metropolitan areas in Appalachian regions of Appalachian states ($38,539).

As for the dental variables, residents of metropolitan areas in Appalachian regions and those living in metropolitan areas in non-Appalachian regions of Appalachian states do not experience significantly different oral health status, using these four measures (dental visits, any teeth removed for ages 35-44, six or more teeth removed for ages 35-44 and all teeth removed in old age). That is, metropolitan residents of Appalachian states have similar oral health whether they are living in an Appalachian county or not. Although there are numerical differences, the tests of statistical significance indicate that these differences are within the realm of statistical probability.

TABLE 19 - COMPARING MEANS, APPALACHIAN VERSUS NON-APPALACHIAN METRO AREAS, APPALACHIAN STATES

Variable	Appalachian	Non-Appalachian	P-Value
Percent males	48.9	48.5	0.076
Percent whites	85.1	69.1	**0.001**
Percent other race	0.8	2.0	0.014
Median age	37.1	35.5	0.019
Percentage > 65	13.7	11.3	**0.001**
Percent adults poverty	15.0	13.5	0.394
Percent urban	48.3	57.2	0.050
Unemployment rate	5.2	4.9	0.606
Household income	38,539	46,335	**0.002**
Percent uninsured	16.4	15.9	0.701
Dental visit within past year	65.8	70.2	0.059
Any tooth removal (35-44)	45.0	40.8	0.224
Six or more teeth removed (35-44)	10.9	8.0	0.178
Complete tooth removal (>65)	26.5	21.7	0.097

Source: All data divided by metropolitan and non-metropolitan areas.

Table 20 shows the results for the mean comparisons of Appalachian residents in Appalachian states to non-Appalachian residents in Appalachian states, but only compares those who live in non-metropolitan areas. Therefore, all non-metropolitan residents in Appalachian states are included in these analyses and the table compares non-metropolitan residents who live in Appalachian counties to non-metropolitan residents who do not live in Appalachian counties (but who live in an Appalachian state).

Residents of non-metropolitan areas of non-Appalachian regions in Appalachian states are less likely to be white (76.3%) than those living in non-metropolitan areas of Appalachian regions in Appalachian states (90.9%). Other than this distinction, there are no statistically significant variations in measures of demographics and socioeconomics when comparing non-metropolitan residents of Appalachian states who are or are not in Appalachian counties.

Non-metropolitan Appalachian residents and non-metropolitan non-Appalachian residents in Appalachian states do not experience significantly different oral health status, using these four measures (dental visits, any teeth removed for ages 35-44, six or more teeth removed for ages 35-44 and all teeth removed in old age). So, non-metropolitan residents of Appalachian states have similar oral health status whether they are living in an Appalachian county or not. Although there are numerical differences, the tests of statistical significance indicate that these differences are within the realm of statistical probability.

TABLE 20 - COMPARING MEANS, APPALACHIAN VERSUS NON-APPALACHIAN NON-METRO AREAS, APPALACHIAN STATES

Variables	Appalachian	Non-Appalachian	P Value
Percent males	49.0	49.0	0.8985
Percent whites	90.9	76.3	**0.0034**
Percent other race	0.7	1.0	0.4926
Median age	38.0	37.3	0.2287
Percentage > 65	14.8	14.2	0.4226
Percent adults poverty	17.5	17.5	0.9595
Percent urban	24.3	32.6	0.0678
Unemployment rate	5.9	5.6	0.6362
Household income	33,827	36,711	0.2308
Percent uninsured	17.1	16.6	0.5827
Dental visit within past year	63.6	64.2	0.7007
Any tooth removal (35-44)	51.9	50.9	0.7560
Six or more teeth removed (35-44)	15.2	13.8	0.5241
Complete tooth removal (>65)	32.7	29.7	0.3137

Source: Appalachian states divided by metropolitan and non-metropolitan areas.

Table 21 shows the results for the mean comparisons of Appalachian residents in all states to non-Appalachian residents in all states, but only compares those who live in metropolitan areas. Therefore, all metropolitan residents in the United States are included in these analyses and the table compares metropolitan residents who live in Appalachian counties to metropolitan residents who do not live in Appalachian counties.

Metropolitan Appalachian residents are less likely to report being an "other" race (less than 1%) than are metropolitan non-Appalachian residents (3.6%). Also, metropolitan Appalachian residents are more likely to be age 65+ (13.7 %) than metropolitan non-Appalachian residents (11.6 %). The percent living in urban areas is much higher in metropolitan areas outside of Appalachia (64.7%) than it is in metropolitan areas within Appalachia (48.3%), which indicates a higher concentration of population in non-Appalachian metropolitan areas than in Appalachian metropolitan areas. Finally, household income is higher among metropolitan non-Appalachian residents ($47,838) than it is among metropolitan Appalachian residents ($38,539). In other words, metropolitan residents in Appalachian counties are, on average, poorer than residents in non-Appalachian counties, nationwide.

Compared to metropolitan residents outside of Appalachia, metro Appalachian residents are less likely to have had a dental visit in the last year, more likely to have had teeth removed between the ages of 35 and 44, more likely to experience six or more teeth removed in that same age range and more likely to have experienced all teeth removed among the elderly population. In other words, all four measures of oral health are statistically significantly worse in the metro areas of the Appalachian Region than in the metro areas across the United States.

TABLE 21 - COMPARING MEANS, APPALACHIAN VERSUS NON-APPALACHIAN IN METRO AREAS, ALL STATES

Variable	Appalachian	Non-Appalachian	P Value
Percent males	48.9	49.0	0.791
Percent whites	85.1	76.6	0.056
Percent other race	0.8	3.6	**0.007**
Median age	37.1	35.6	0.016
Percentage > 65	13.7	11.6	**0.001**
Percent adults poverty	15.0	12.1	0.026
Percent urban	48.3	64.7	**<0.001**
Unemployment rate	5.2	4.4	0.073
Household income	38,539	47,838	**<0.001**
Percent uninsured	16.4	14.7	0.273
Dental visit within past year	65.8	70.9	**0.004**
Any tooth removal (35-44)	45.0	36.3	**0.001**
Six or more teeth removed (35-44)	10.9	6.8	**0.001**
Complete tooth removal (>65)	26.5	19.6	**0.000**

Source: All BRFSS database separated by Appalachia and non-Appalachia, and divided by metropolitan and non-metropolitan areas.

Table 22 shows the results of the mean comparisons of Appalachian residents in all states to non-Appalachian residents in all states, but only compares those who live in non-metropolitan areas. Therefore, all non-metropolitan residents in the United States are included in these analyses and the table compares non-metropolitan residents who live in Appalachian counties to non-metropolitan residents who do not live in Appalachian counties.

There is a slight difference in the gender distribution of non-metropolitan Appalachian county residents compared to non-metropolitan residents in the rest of the country. Although this is statistically significant, substantively this is not a meaningful variation. The remaining demographic and socioeconomic characteristics do not vary by whether a non-metropolitan resident is in an Appalachian county or in a non-Appalachian county, nationwide. In other words, Appalachian non-metropolitan residents are strikingly similar to non-metropolitan non-Appalachian residents across the nation. However, there are statistical and substantive differences in oral health when comparing Appalachian residents and non-Appalachian residents nationwide.

Compared to non-metropolitan residents outside of Appalachia, non-metro Appalachian residents are more likely to have had teeth removed between the ages of 35 and 44, more likely to experience having six or more teeth removed in that same age range and more likely to have had all teeth removed among the elderly population. Appalachian non-metropolitan residents were no more or no less likely to have had a dental visit in the previous year, compared to non-Appalachian non-metropolitan residents. Though there are clear differences in tooth removal, we do not find associated differences in dental visits.

TABLE 22 - COMPARING MEANS, APPALACHIAN VERSUS NON-APPALACHIAN IN NON-METRO AREAS, ALL STATES

Variable	Appalachian	Non-Appalachian	P Value
Percent males	49.0	49.7	**0.008**
Percent whites	90.5	83.1	0.109
Percent other race	0.7	2.4	0.111
Median age	38.2	38.2	0.982
Percentage > 65	14.8	14.6	0.710
Percent adults poverty	17.6	15.2	0.078
Percent urban	24.3	34.0	0.019
Unemployment rate	5.9	5.0	0.051
Household income	33,827	38,410	0.027
Percent uninsured	17.2	17.0	0.762
Dental visit within past year	63.6	65.0	0.376
Any tooth removal (35-44)	51.9	43.7	**0.001**
Six or more teeth removed (35-44)	15.2	10.4	**0.000**
Complete tooth removal (>65)	32.7	25.3	**0.000**

Source: All BRFSS database separated by Appalachia and non-Appalachia and divided by metropolitan and non-metropolitan areas.

The next set of tables presents the prevalence for each of the four oral health indicators from the BRFSS data for each of the 49 regions (determined by state, metropolitan status, and Appalachian Region status) across the 13 Appalachian states. Each of tables includes a ranking of the 49 regions in order to identify patterns.

Table 23 for the oral health indicator 'Dental Visit in Last Year' shows the range of prevalence at a high of 74.2 percent having visited the dentist within the past year for non-Appalachia, metropolitan Virginia to a low of 39.2 percent having visited a dentist in Appalachia, metropolitan Mississippi. The lowest prevalence (rank 49) is substantially lower than the 48th rank of 54 percent in non-Appalachia, non-metropolitan Mississippi. For the most part, the metropolitan regions have a higher prevalence than the non-metropolitan areas. In other words, there is little difference in the prevalence of visits to the dentist in the past year between Appalachia and non-Appalachia metropolitan areas.

Table 24, 'Adults Ages 35-44 with Any Teeth Removed', shows the range of prevalence from a low of 31.1 percent in non-Appalachia, metropolitan Virginia to a high of 71.5 percent in Appalachia, metropolitan Mississippi. In general, metropolitan areas have a lower prevalence of adults aged 35 to 44 with any teeth removed than non-metropolitan areas, although there is little difference in prevalence between Appalachian and non-Appalachian areas. Within the Appalachian areas of the 13 Appalachian states, the prevalence ranges from 32.3 percent in metropolitan Georgia to 71.5 percent in metropolitan Mississippi. This indicates, again, that in metropolitan areas within the Appalachian Region, there is a lower likelihood that adults aged 35 to 44 will have had any teeth removed compared to adults aged 35 to 44 in non-metropolitan areas within the Appalachian Region.

Table 25, "Adults Ages 35-44 with 6 or More Teeth Removed", shows the range of prevalence from a low of 2.9 percent in Appalachian, non-metropolitan Georgia to a high of 30.7 percent in Appalachian, metropolitan Mississippi. Interestingly, the lowest and the highest prevalence are both in Appalachian areas. Metropolitan areas have a lower prevalence of adults aged 35 to 44 with 6 or more teeth missing than non-metropolitan areas. There is little difference in prevalence between Appalachian and non-Appalachian areas. Within the Appalachian areas of the 13 Appalachian states, the prevalence seems to be lower in the northern-most states, with the exception of Georgia which is located in the southern portion of the Appalachian Region. This does not appear to be the case for the non-Appalachian areas.

Table 26 presents the prevalence for the oral health indicator 'Adults 65+ with All Teeth Removed' and shows the range of prevalence from a low of 14.2 percent in Appalachia, non-metropolitan Tennessee to a high of 54.3 percent in Appalachia, non-metropolitan Kentucky. As with the previous table, metropolitan areas have a lower prevalence of adults age 65 or older with all teeth removed than non-metropolitan areas. There is also little difference in prevalence between Appalachian and non-Appalachian areas. An examination of the Appalachian Region only finds that metropolitan areas within the Appalachian Region are also more likely to have a lower prevalence than the non-metropolitan areas.

These findings suggest that, at least for some parts of the Appalachian Region, classification as being within the Appalachian Region is not a sufficient explanation for higher prevalence. For the most part, however, metropolitan status within the Appalachian states does matter. This is most likely due to the issue of access to dentists in non-metropolitan areas, although it may also be linked to higher rates of uninsurance, poverty, and unemployment in non-metropolitan areas.

TABLE 23 - DENTAL VISIT IN THE PAST YEAR BY REGION, STATE, AND METROPOLITAN STATUS

State	Beale	Region	N	Prevalence	Std. Error	Rank
Alabama	Metro	AR	4935	67.3%	0.8%	25
Alabama	Non-metro	AR	617	61.0%	2.4%	43
Georgia	Metro	AR	2259	70.3%	1.3%	9
Georgia	Non-metro	AR	115	69.1%	5.0%	17
Kentucky	Metro	AR	1252	63.8%	1.7%	36
Kentucky	Non-metro	AR	7750	55.5%	0.8%	47
Maryland	Metro	AR	2319	70.2%	1.1%	11
Maryland	Non-metro	AR	504	65.8%	2.7%	31
Mississippi	Metro	AR	107	39.2%	5.6%	49
Mississippi	Non-metro	AR	2548	57.6%	1.3%	45
New York	Metro	AR	401	67.5%	3.1%	24
New York	Non-metro	AR	266	67.9%	3.5%	21
North Carolina	Metro	AR	5183	66.7%	1.0%	28
North Carolina	Non-metro	AR	1511	64.8%	1.9%	33
Ohio	Metro	AR	2759	70.9%	1.1%	7
Pennsylvania	Metro	AR	15036	69.0%	0.6%	18
Pennsylvania	Non-metro	AR	3049	67.6%	1.55%	22
South Carolina	Metro	AR	6377	67.3%	0.7%	26
South Carolina	Non-metro	AR	989	62.7%	1.1%	38
Tennessee	Metro	AR	3300	68.9%	1.0%	19
Tennessee	Non-metro	AR	145	70.6%	4.3%	8
Virginia	Metro	AR	361	70.2%	2.9%	10
Virginia	Non-metro	AR	781	60.8%	2.2%	44
West Virginia	Metro	AR	6052	64.6%	0.7%	34
West Virginia	Non-metro	AR	3539	56.3%	1.0%	46
Alabama	Metro	Non-AR	1872	66.4%	1.4%	29
Alabama	Non-metro	Non-AR	4652	62.0%	0.9%	40
Georgia	Metro	Non-AR	7727	69.8%	0.8%	13
Georgia	Non-metro	Non-AR	9981	62.0%	0.7%	41
Kentucky	Metro	Non-AR	7185	69.8%	0.8%	12
Kentucky	Non-metro	Non-AR	11235	61.0%	0.7%	42
Maryland	Metro	Non-AR	23859	73.5%	0.4%	2
Maryland	Non-metro	Non-AR	3812	69.2%	1.2%	16
Mississippi	Metro	Non-AR	7627	62.9%	0.7%	37
Mississippi	Non-metro	Non-AR	11530	54.4%	0.6%	48
New York	Metro	Non-AR	18328	71.0%	0.4%	6
New York	Non-metro	Non-AR	5196	67.1%	0.8%	27
North Carolina	Metro	Non-AR	23601	69.7%	0.5%	14
North Carolina	Non-metro	Non-AR	15658	64.3%	0.6%	35
Ohio	Metro	Non-AR	16358	72.4%	0.6%	4
Ohio	Non-metro	Non-AR	6630	69.3%	0.7%	15
Pennsylvania	Metro	Non-AR	15319	72.7%	0.5%	3
Pennsylvania	Non-metro	Non-AR	6566	65.9%	0.8%	30
South Carolina	Metro	Non-AR	16260	68.4%	0.5%	20
South Carolina	Non-metro	Non-AR	9168	65.1%	0.7%	32
Tennessee	Metro	Non-AR	5121	71.2%	0.9%	5
Tennessee	Non-metro	Non-AR	5846	62.5%	0.8%	39
Virginia	Metro	Non-AR	16923	74.2%	0.5%	1
Virginia	Non-metro	Non-AR	16148	67.5%	0.59%	23

TABLE 24 - ADULTS AGES 35-44 WITH ANY TEETH REMOVED BY REGION, STATE, AND METROPOLITAN STATUS

State	Beale	Region	N	Prevalence	Std. Error	Rank
Alabama	Metro	AR	903	47.9%	1.9%	32
Alabama	Non-metro	AR	117	56.3%	5.0%	39
Georgia	Metro	AR	517	32.3%	2.5%	2
Georgia	Non-metro	AR	30	32.8%	8.8%	3
Kentucky	Metro	AR	197	49.6%	4.5%	35
Kentucky	Non-metro	AR	1343	65.2%	1.7%	48
Maryland	Metro	AR	448	40.5%	2.7%	12
Maryland	Non-metro	AR	93	46.3%	6.4%	27
Mississippi	Metro	AR	25	71.5%	9.7%	49
Mississippi	Non-metro	AR	419	52.2%	2.8%	36
New York	Metro	AR	67	40.8%	6.5%	14
New York	Non-metro	AR	39	40.4%	8.5%	11
North Carolina	Metro	AR	914	45.9%	2.2%	25
North Carolina	Non-metro	AR	263	58.8%	4.0%	43
Ohio	Metro	AR	446	35.9%	3.9%	5
Pennsylvania	Metro	AR	2674	41.2%	1.4%	15
Pennsylvania	Non-metro	AR	561	48.8%	3.1%	33
South Carolina	Metro	AR	1211	45.4%	1.7%	24
South Carolina	Non-metro	AR	171	57.0%	4.5%	40
Tennessee	Metro	AR	621	41.5%	2.4%	17
Tennessee	Non-metro	AR	29	37.5%	10.6%	7
Virginia	Metro	AR	60	44.6%	7.6%	23
Virginia	Non-metro	AR	135	63.6%	4.5%	46
West Virginia	Metro	AR	1063	47.6%	1.7%	30
West Virginia	Non-metro	AR	622	64.3%	2.1%	47
Alabama	Metro	Non-AR	323	46.7%	3.1%	29
Alabama	Non-metro	Non-AR	791	59.7%	2.0%	44
Georgia	Metro	Non-AR	1601	40.5%	1.6%	13
Georgia	Non-metro	Non-AR	1894	53.3%	1.5%	38
Kentucky	Metro	Non-AR	1376	41.5%	1.8%	16
Kentucky	Non-metro	Non-AR	2019	49.2%	1.6%	34
Maryland	Metro	Non-AR	5261	34.6%	0.9%	4
Maryland	Non-metro	Non-AR	668	36.6%	2.4%	6
Mississippi	Metro	Non-AR	1454	47.6%	1.6%	31
Mississippi	Non-metro	Non-AR	1965	62.9%	1.3%	45
New York	Metro	Non-AR	3751	43.2%	1.0%	20
New York	Non-metro	Non-AR	993	46.6%	1.9%	28
North Carolina	Metro	Non-AR	4689	40.2%	1.0%	10
North Carolina	Non-metro	Non-AR	2733	58.4%	1.4%	42
Ohio	Metro	Non-AR	3137	37.6%	1.4%	8
Ohio	Non-metro	Non-AR	1245	44.2%	1.7%	21
Pennsylvania	Metro	Non-AR	3110	38.9%	1.2%	9
Pennsylvania	Non-metro	Non-AR	1238	45.9%	1.9%	26
South Carolina	Metro	Non-AR	3159	42.7%	1.1%	18
South Carolina	Non-metro	Non-AR	1554	57.7%	1.6%	41
Tennessee	Metro	Non-AR	1066	44.3%	2.0%	22
Tennessee	Non-metro	Non-AR	1033	52.5%	1.8%	37
Virginia	Metro	Non-AR	3783	31.1%	1.0%	1
Virginia	Non-metro	Non-AR	3153	43.2%	1.1%	19

TABLE 25 - ADULTS AGES 35-44 WITH SIX OR MORE TEETH REMOVED BY APPALACHIAN REGION, STATE, AND METROPOLITAN STATUS

State	Beale	Region	N	Prevalence	Std. Error	Rank
Alabama	Metro	AR	903	9.7%	1.2%	21
Alabama	Non-metro	AR	117	20.1%	4.1%	43
Georgia	Metro	AR	517	4.5%	1.0%	2
Georgia	Non-metro	AR	30	2.9%	2.8%	1
Kentucky	Metro	AR	197	14.3%	3.6%	38
Kentucky	Non-metro	AR	1343	25.0%	1.6%	48
Maryland	Metro	AR	448	8.6%	1.4%	15
Maryland	Non-metro	AR	93	8.8%	2.9%	16
Mississippi	Metro	AR	25	30.7%	10.4%	49
Mississippi	Non-metro	AR	419	13.6%	2.0%	36
New York	Metro	AR	67	5.0%	2.5%	3
New York	Non-metro	AR	39	13.4%	6.2%	35
North Carolina	Metro	AR	914	11.8%	1.6%	29
North Carolina	Non-metro	AR	263	14.1%	3.3%	37
Ohio	Metro	AR	446	5.7%	1.7%	5
Pennsylvania	Metro	AR	2674	8.4%	0.8%	13
Pennsylvania	Non-metro	AR	561	9.7%	1.9%	20
South Carolina	Metro	AR	1211	11.7%	1.1%	27
South Carolina	Non-metro	AR	171	9.6%	2.8%	19
Tennessee	Metro	AR	621	9.8%	1.4%	22
Tennessee	Non-metro	AR	29	22.9%	10.5%	47
Virginia	Metro	AR	60	7.7%	4.5%	11
Virginia	Non-metro	AR	135	20.6%	4.2%	44
West Virginia	Metro	AR	1063	13.3%	1.2%	33
West Virginia	Non-metro	AR	622	21.7%	1.9%	46
Alabama	Metro	Non-AR	323	8.2%	1.9%	12
Alabama	Non-metro	Non-AR	791	15.9%	1.4%	40
Georgia	Metro	Non-AR	1601	8.5%	0.9%	14
Georgia	Non-metro	Non-AR	1894	13.3%	1.0%	34
Kentucky	Metro	Non-AR	1376	9.3%	1.2%	17
Kentucky	Non-metro	Non-AR	2019	16.9%	1.2%	42
Maryland	Metro	Non-AR	5261	5.0%	0.4%	4
Maryland	Non-metro	Non-AR	668	9.8%	1.8%	23
Mississippi	Metro	Non-AR	1454	11.7%	1.0%	28
Mississippi	Non-metro	Non-AR	1965	20.6%	1.1%	45
New York	Metro	Non-AR	3751	7.2%	0.6%	8
New York	Non-metro	Non-AR	993	10.2%	1.2%	25
North Carolina	Metro	Non-AR	4689	6.0%	0.5%	6
North Carolina	Non-metro	Non-AR	2733	12.4%	1.0%	30
Ohio	Metro	Non-AR	3137	7.3%	0.8%	9
Ohio	Non-metro	Non-AR	1245	12.5%	1.2%	32
Pennsylvania	Metro	Non-AR	3110	7.4%	0.8%	10
Pennsylvania	Non-metro	Non-AR	1238	11.0%	1.2%	26
South Carolina	Metro	Non-AR	3159	9.5%	0.7%	18
South Carolina	Non-metro	Non-AR	1554	16.0%	1.2%	41
Tennessee	Metro	Non-AR	1066	10.0%	1.2%	24
Tennessee	Non-metro	Non-AR	1033	14.9%	1.3%	39
Virginia	Metro	Non-AR	3783	6.1%	0.6%	7
Virginia	Non-metro	Non-AR	3153	12.5%	0.8%	31

TABLE 26 - ADULTS AGES 65 OR OLDER WITH ALL TEETH REMOVED BY REGION, STATE, AND METROPOLITAN STATUS

State	Beale	Region	N	Prevalence	Std. Error	Rank
Alabama	Metro	AR	1106	29.2%	1.6%	30
Alabama	Non-metro	AR	148	35.1%	4.4%	44
Georgia	Metro	AR	362	22.4%	2.8%	12
Georgia	Non-metro	AR	20	24.3%	11.3%	18
Kentucky	Metro	AR	358	34.3%	2.8%	42
Kentucky	Non-metro	AR	1824	54.3%	1.6%	49
Maryland	Metro	AR	560	24.9%	2.1%	19
Maryland	Non-metro	AR	123	33.8%	5.8%	41
Mississippi	Metro	AR	27	28.5%	9.4%	27
Mississippi	Non-metro	AR	641	30.4%	2.2%	34
New York	Metro	AR	114	18.4%	4.5%	6
New York	Non-metro	AR	87	28.6%	5.8%	29
North Carolina	Metro	AR	1305	25.3%	1.6%	20
North Carolina	Non-metro	AR	445	29.9%	2.8%	33
Pennsylvania	Metro	AR	3950	29.6%	1.2%	31
Pennsylvania	Non-metro	AR	780	29.7%	2.5%	32
South Carolina	Metro	AR	1350	26.6%	1.5%	25
South Carolina	Non-metro	AR	252	28.0%	3.4%	26
Tennessee	Metro	AR	817	28.6%	1.8%	28
Tennessee	Non-metro	AR	44	14.2%	5.2%	1
Virginia	Metro	AR	66	14.7%	4.7%	3
Virginia	Non-metro	AR	167	34.8%	4.3%	43
West Virginia	Metro	AR	1505	37.0%	1.4%	46
West Virginia	Non-metro	AR	937	49.2%	1.8%	48
Alabama	Metro	Non-AR	419	21.9%	2.3%	11
Alabama	Non-metro	Non-AR	1147	32.5%	1.6%	38
Georgia	Metro	Non-AR	1393	21.0%	1.6%	8
Georgia	Non-metro	Non-AR	2266	30.7%	1.4%	36
Kentucky	Metro	Non-AR	1794	32.4%	1.4%	37
Kentucky	Non-metro	Non-AR	2980	40.9%	1.2%	47
Maryland	Metro	Non-AR	4270	17.4%	0.8%	5
Maryland	Non-metro	Non-AR	976	24.0%	2.5%	17
Mississippi	Metro	Non-AR	1686	26.1%	1.4%	23
Mississippi	Non-metro	Non-AR	2972	33.4%	1.1%	40
New York	Metro	Non-AR	3819	16.3%	0.8%	4
New York	Non-metro	Non-AR	1162	23.8%	1.6%	15
North Carolina	Metro	Non-AR	5093	23.1%	0.9%	14
North Carolina	Non-metro	Non-AR	3981	30.5%	1.2%	35
Ohio	Metro	Non-AR	3525	21.1%	1.1%	10
Ohio	Non-metro	Non-AR	1468	25.4%	1.3%	21
Pennsylvania	Metro	Non-AR	3286	18.9%	0.9%	7
Pennsylvania	Non-metro	Non-AR	1562	33.0%	1.6%	39
South Carolina	Metro	Non-AR	3363	21.1%	1.0%	9
South Carolina	Non-metro	Non-AR	2184	23.8%	1.3%	16
Tennessee	Metro	Non-AR	1012	26.4%	1.8%	24
Tennessee	Non-metro	Non-AR	1389	36.2%	1.5%	45
Virginia	Metro	Non-AR	2943	14.4%	0.9%	2
Virginia	Non-metro	Non-AR	3547	22.5%	0.9%	13

There are strong associations between socioeconomic indicators —poverty, percent urban, unemployment, income and uninsurance status— as shown in Table 27. With higher rates of poverty, residents are less likely to have had a dental visit in the last year and more likely to have teeth removed. With higher levels of percent of residents living in urban areas, the likelihood of a dental visit is higher and tooth removal is lower; that is, those living in rural populations are less likely to have had a dental visit and are more likely to experience tooth removal. Unemployment patterns are identical to those seen for poverty, but the magnitude or strength of the relationship is slightly lower. As for median household income, populations with higher incomes are more likely to have visited a dentist in the last year and less likely to experience tooth removal (using all three measures). Finally, percent uninsured is correlated negatively with dental visit (uninsured populations are less likely to have been to the dentist in the last year) and positively correlated with adult tooth removal (ages 35-44).

TABLE 27 - BIVARIATE CORRELATIONS OF DENTAL OUTCOMES WITH SOCIOECONOMIC INDICATORS

	Dental visit (1 year)		Any Tooth Removal (35-44)		Six or More Teeth Removed (35-44)		Complete Tooth Removal (65+)	
Percent adults in poverty	-0.72	***	0.73	***	0.70	***	0.48	***
Percent urban	0.61	***	-0.59	***	-0.60	***	-0.55	***
Unemployment ratio	-0.55	***	0.52	***	0.52	***	0.31	*
Median household income	0.69	***	-0.72	***	-0.67	***	-0.57	***
Percent uninsured	-0.45	***	0.32	*	0.17		0.19	

*** p < .001, ** p < .01, * p < .05

A regression model with outcome, dental visit in the past year, was fit to the data using the non-metro / Appalachian group as a referent group. Results are presented in Table 28.

For all states in the Appalachian Region, the estimates were created for the four groups as follows: (1) metro counties in Appalachian regions of Appalachian states, (2) metro counties in non-Appalachian regions of Appalachian states, (3) non-metro counties in Appalachian regions of Appalachian states, and (4) non-metro counties in non-Appalachian regions of Appalachian states. These are expressed in all tables as metro Appalachia, metro non-Appalachia, non-metro Appalachia and non-metro non-Appalachia, respectively.

Other predictor variables entered into the initial model were percent adults living in poverty, unemployment rate, median household income, percent uninsured, median age, percent male, percent white, percent other, and percent > 65. A stepwise regression model that forced inclusion of the Appalachian/metro variables was performed and all predictors except percent adults living in poverty were eliminated due to non-significance. ANOVA table results for the final model follow:

TABLE 28 - STEPWISE REGRESSION, DENTAL VISIT IN PAST YEAR
(MODEL $R^2 = 0.56$)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Group	3	0.01	0.00	1.51	0.23
Percent Adults in Poverty	1	0.06	0.06	37.37	0.00

Group	Mean % Annual Visit
Metro/Appalachia	0.65
Metro/Non-Appalachia	0.68
Non-metro/Appalachia	0.65
Non-metro/Non-Appalachia	0.66

Pairwise p-values i/j	Metro/ Appalachia	Metro/ Non-Appalachia	Non-metro/ Appalachia	Non-metro/ Non-Appalachia
Metro/Appalachia		0.08	0.85	0.79
Metro/Non-Appalachia	0.08		0.07	0.16
Non-metro/Appalachia	0.85	0.07		0.65
Non-metro/Non-Appalachia	0.79	0.15	0.65	

After adjusting for percent adults living in poverty, the four groups no longer are significantly different (p=0.23). The least squares means are similar with metro/non-Appalachia being slightly higher than the others in terms of magnitude. This is seen in the table of pairwise p-values (unadjusted) where we see some slight indication that metro/non-Appalachia differs from metro/Appalachia and non-metro/Appalachia, but the difference is not significant after adjusting for percent adults living in poverty.

A regression model with outcome, any tooth removal for adults (ages 35-44), was fit to the data using the non-metro/Appalachia group as a referent group. Results are presented in Table 29. Other predictor variables entered into the initial model were percent adults living in poverty, unemployment rate, median household income, percent uninsured, median age, percent male, percent white, percent other, and percent > 65. A stepwise regression model that forced inclusion of the Appalachia/metro variables was performed and all predictors except percent adults living in poverty were eliminated due to non-significance. ANOVA table results for the final model follow:

TABLE 29 - STEPWISE REGRESSION, ANY TEETH REMOVED, ADULTS AGED 35-44
(MODEL $R^2 = 0.58$)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Group	3	0.02	0.01	1.84	0.15
Percent Adults in Poverty	1	0.15	0.15	36.72	0.00

Group	Mean % Any Tooth Removal
Metro/Appalachia	0.46
Metro /Non-Appalachia	0.44
Non-metro/ Appalachia	0.50
Non-metro/Non-Appalachia	0.49

Pairwise p-values i/j	Metro/ Appalachia	Metro/ Non-Appalachia	Non-metro/ Appalachian	Non-metro/ Non-Appalachian
Metro/Appalachia		0.39	0.17	0.30
Metro/Non-Appalachia	0.39		0.04	0.08
Non-metro/Appalachia	0.17	0.04		0.72
Non-metro/Non-Appalachia	0.30	0.08	0.72	

After adjusting for percent adults living in poverty, the four groups no longer are significantly different (p=0.15). The least squares means are similar with non-metro Appalachia and non-metro non-Appalachia being slightly higher than the two metro estimates.

A regression model with outcome, major tooth removal for young adults (age 35-44), was fit to the data using the non-metro/Appalachia group as a referent group. Results are presented in Table 30. Other predictor variables entered into the initial model were percent adults living in poverty, unemployment rate, median household income, percent uninsured, median age, percent male, percent white, percent other, and percent > 65. A stepwise regression model that forced inclusion of the Appalachia/metro variables was performed and all predictors except percent adults living in poverty were eliminated due to non-significance. ANOVA table results for the final model follow:

TABLE 30 - STEPWISE REGRESSION, MAJOR TOOTH REMOVAL, ADULTS AGED 35-44
(MODEL $R^2 = 0.56$)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Group	3	0.01	0.00	2.02	0.12
Percent Adults in Poverty	1	0.05	0.05	31.93	0.00

Group	Mean % Major Tooth Removal
Metro/Appalachia	0.12
Metro /Non-Appalachia	0.10
Non-metro/ Appalachia	0.14
Non-metro/Non-Appalachia	0.13

Pairwise p-values i/j	Metro/ Appalachia	Metro/ Non-Appalachia	Non-metro/ Appalachian	Non-metro/ Non-Appalachian
Metro/Appalachia		0.30	0.14	0.48
Metro/Non-Appalachia	0.30		0.02	0.10
Non-metro/Appalachia	0.14	0.02		0.44
Non-metro/Non-Appalachia	0.48	0.10	0.44	

After adjusting for percent adults in poverty, the four groups no longer are significantly different (p=0.12). The least squares means are similar with non-metro Appalachian and non-metro non-Appalachian being slightly higher than the two metro estimates, but the difference is not significant after adjusting for percent adults living in poverty.

A regression model with outcome, major tooth removal for elderly adults (age 65+), was fit to the data using the non-metro/Appalachia group as a referent group. Results are presented in Table 31. Other predictor variables entered into the initial model were percent adults living in poverty, unemployment rate, median household income, percent uninsured, median age, percent male, percent white, percent other, and percent > 65. A stepwise regression model that forced inclusion of the Appalachian/metro variables was performed and all predictors except percent white and percent adults living in poverty were eliminated due to non-significance. ANOVA table results for the final model follow:

TABLE 31 - STEPWISE REGRESSION, MAJOR TOOTH REMOVAL, ADULTS AGED 65 OR OLDER
(MODEL R^2 = 0.49)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Group	3	0.01	0.00	0.58	0.63
Percent Adults in Poverty	1	0.07	0.07	18.20	0.00
Percent White	1	0.04	0.04	10.54	0.00

Group	Mean % Major Tooth Removal (65+)
Metro/Appalachia	0.30
Metro /Non-Appalachia	0.28
Non-metro/ Appalachia	0.28
Non-metro/Non-Appalachia	0.29

Pairwise p-values i/j	Metro/ Appalachia	Metro/ Non-Appalachia	Non-metro/ Appalachian	Non-metro/ Non-Appalachian
Metro/Appalachia		0.57	0.50	0.20
Metro/Non-Appalachia	0.57		0.99	0.59
Non-metro/Appalachia	0.50	0.99		0.59
Non-metro/Non-Appalachia	0.20	0.59	0.59	

After adjusting for percent white and percent adults living in poverty, the four groups no longer are significantly different (p=0.63). The least squares means are with three percentage points, with non-metro non-Appalachia experiencing the highest rate of tooth removal among the elderly and metro Appalachia experiencing the lowest rate of tooth removal among the elderly. However, the difference is not significant after adjusting for percent white and percent adults living in poverty.

SUMMARY

Two-thirds (69%) of people living in Appalachia have seen a dentist in the previous year, but nearly half of adults ages 35-44 (43.5%) also have experienced some tooth removal. Nearly one-quarter have experienced six or more teeth removed (6 or more teeth) and nearly 10 percent of persons ages 65 or older living in Appalachia have had all their teeth removed. However, examining the region as a whole provides limited value as there are wide variations by state and even sub-state regions.

The first level of analysis involved looking at each Appalachian state. Maryland and other Northern and Central Appalachian states had the highest rates of dental visits in the past year, while Mississippi and other Central and Southern Appalachian states had the lowest rates. The highest rates of tooth removal are seen in Central and Southern Appalachian states while the lowest rates of tooth removal are found in Northern Appalachian states.

Looking at other sub-regional variations, we found that all four measures of oral health are statistically significantly worse in the non-metro areas of the Appalachian states than in the metro areas of these same states, but comparing residents in Appalachian states who are not in the Appalachian Region to those who do live in the Appalachian Region finds no meaningful differences (even when metropolitan status is also taken into account). We also compared metropolitan Appalachian residents to metropolitan residents elsewhere in the country, finding that Appalachian residents are less likely to have had a dental visit in the last year and more likely to experience all measures of tooth removal. However, in comparing non-metropolitan Appalachian residents to non-metropolitan residents elsewhere in the nation, differences are seen on all measures of tooth removal, but non-metropolitan non-Appalachian residents are not more likely to have seen a dentist than are non-metropolitan Appalachian residents. These findings suggest that, at least for some parts of the Appalachian Region, classification as being within the Appalachian Region is not a sufficient explanation for higher prevalence of tooth removal. All of these results were confirmed in separate state-by-state metropolitan/nonmetropolitan analyses (Tables19 through 22). For the most part, however, metropolitan status within the Appalachian states does appear to be a predictor of oral health status. This is most likely due to the issue of lack of access to dentists in non-metropolitan areas, although it may also be linked to higher rates of uninsurance, poverty, and unemployment in non-metropolitan areas.

Prior to regression analyses, correlations were examined. All results indicate strong positive correlations between measures of socioeconomic status and oral health. Regression results were presented for each oral health indicator in Tables 28 through 31. In all regression analyses, for each of the four oral health indicators (dependent variables), Appalachian Region, metropolitan status and percent living in poverty explain half or more of the variation in oral health indicators. Only on one oral health indicator (tooth removal among the elderly) did another independent variable (percent white) have a significant effect on its variation. These results imply that access to oral health care providers (rurality and poverty) are important predictors (half of variation) in oral health.

APPENDIX D: DENTAL VISITS IN THE PAST YEAR, BY SELECTED CHARACTERISTICS: UNITED STATES, SELECTED YEARS 1997-2009

[Data are based on household interviews of a sample of the civilian noninstitutionalized population]

Characteristic	2 years and over			2–17 years			18–64 years			65 years and over[1]		
	1997	2008	2009	1997	2008	2009	1997	2008	2009	1997	2008	2009
	Percent of persons with a dental visit in the past year[2]											
Total[3]	65.1	63.9	65.4	72.7	77.3	78.4	64.1	60.4	62.0	54.8	57.6	59.6
Sex												
Male	62.9	61.3	62.6	72.3	76.8	77.6	60.4	56.4	57.9	55.4	56.4	58.4
Female	67.1	66.5	68.0	73.0	77.9	79.3	67.7	64.4	65.9	54.4	58.6	60.5
Race[4]												
White only	66.4	64.9	66.3	74.0	77.6	79.1	65.7	61.8	63.1	56.8	59.4	61.8
Black or African American only	58.9	58.7	59.9	68.8	78.5	76.7	57.0	52.7	55.9	35.4	39.5	38.1
American Indian or Alaska Native only	55.1	55.2	53.1	66.8	70.7	68.5	49.9	48.5	47.3	*	*39.9	*44.2
Asian only	62.5	64.7	67.6	69.9	74.8	76.2	60.3	61.6	65.8	53.9	65.7	62.1
Native Hawaiian or Other Pacific Islander only	---	*	*	---	*	*	---	*	*	---	*	*
2 or more races	---	62.1	63.5	---	72.9	80.0	---	55.1	50.0	---	*35.0	58.5
Black or African American; White	---	63.3	67.1	---	65.6	78.7	---	58.9	45.3	---	*	*
American Indian or Alaska Native; White	---	52.1	56.0	---	77.7	76.5	---	45.0	47.9	---	*	58.3
Hispanic origin and race[4]												
Hispanic or Latino	54.0	53.3	56.0	61.0	69.9	73.0	50.8	45.6	48.1	47.8	46.2	47.9
Not Hispanic or Latino	66.4	65.9	67.1	74.7	79.3	80.0	65.7	63.0	64.5	55.2	58.5	60.5
White only	68.0	67.4	68.6	76.4	80.2	81.4	67.5	65.2	66.3	57.2	60.3	62.8
Black or African American only	58.8	58.8	59.8	68.8	78.6	76.7	56.9	52.9	55.9	35.3	39.3	38.4
Percent of poverty level[5]												
Below 100%	50.5	49.5	51.7	62.0	70.1	71.7	46.9	41.3	42.7	31.5	31.1	39.0
100%–199%	50.8	49.1	52.8	62.5	70.1	75.2	48.3	40.9	45.3	40.8	41.2	42.3
200%–399%	66.2	61.8	63.3	76.1	78.1	77.1	63.4	56.7	59.1	60.7	58.5	60.9
400% or more	78.9	78.5	79.5	85.7	86.9	87.8	77.7	76.6	77.9	74.7	77.9	77.5
Hispanic origin and race and percent of poverty level[4,5]												
Hispanic or Latino:												
Below 100%	45.7	48.8	51.7	55.9	68.1	71.7	39.2	36.1	37.6	33.6	32.4	42.7
100%–199%	47.2	46.0	51.7	53.8	66.2	72.4	43.5	33.7	41.4	47.9	44.9	37.5
200%–399%	61.2	55.1	57.1	70.5	72.0	73.8	57.5	48.6	51.3	57.0	49.6	54.4
400% or more	73.0	68.2	69.2	82.4	81.1	76.9	70.8	65.3	67.1	64.9	62.2	63.5
Not Hispanic or Latino:												
White only:												
Below 100%	51.7	48.6	51.3	64.4	67.5	69.6	50.6	45.3	46.3	32.0	31.4	42.2
100%–199%	52.4	49.2	52.7	66.1	71.3	76.2	50.4	43.5	46.4	42.2	41.1	44.4
200%–399%	67.5	63.5	64.7	77.1	79.4	79.1	65.0	59.1	60.7	61.9	60.5	62.4
400% or more	79.7	80.2	81.1	86.8	88.1	89.9	78.5	78.4	79.4	75.5	79.4	79.4
Black or African American only:												
Below 100%	52.8	51.4	52.6	66.1	76.4	74.0	46.2	38.3	42.1	27.7	23.1	28.8
100%–199%	48.7	52.1	53.0	61.2	74.6	79.2	46.3	43.2	45.1	26.9	37.2	26.9
200%–399%	63.3	59.8	61.6	75.0	82.1	74.4	60.7	53.6	59.5	41.5	42.5	46.7
400% or more	74.6	72.9	74.3	81.8	85.2	85.0	73.4	71.3	74.1	66.1	60.3	55.3

See footnotes at end of table.

[Data are based on household interviews of a sample of the civilian noninstitutionalized population]

Characteristic	2 years and over			2–17 years			18–64 years			65 years and over[1]		
	1997	2008	2009	1997	2008	2009	1997	2008	2009	1997	2008	2009
Disability measure[6]	Percent of persons with a dental visit in the past year[2]											
Any basic actions difficulty or complex activity limitation	. . .	. . .	. . .	. . .	. . .	. . .	55.1	52.3	55.8	49.0	50.1	53.3
Any basic actions difficulty	. . .	. . .	. . .	. . .	. . .	. . .	54.7	52.8	56.1	48.7	49.8	53.6
Any complex activity limitation	. . .	. . .	. . .	. . .	. . .	. . .	51.0	44.9	50.4	44.6	42.0	47.6
No disability	. . .	. . .	. . .	. . .	. . .	. . .	67.4	63.4	64.4	64.2	70.7	70.2
Geographic region												
Northeast	69.6	70.9	71.1	77.5	82.4	82.6	69.6	68.4	69.3	55.5	63.8	60.9
Midwest	68.4	66.2	67.6	76.4	79.0	80.5	67.4	63.3	64.2	57.6	57.3	62.0
South	60.2	59.2	60.8	68.0	75.3	76.8	59.4	55.2	56.7	49.0	51.0	54.0
West	65.0	63.9	65.9	71.5	75.0	75.8	62.9	59.8	62.4	61.9	63.8	65.2
Location of residence[7]												
Within MSA	66.7	65.1	66.5	73.6	77.7	79.0	65.7	61.5	63.1	57.6	60.3	61.8
Outside MSA	59.1	57.9	59.5	69.3	75.1	75.5	58.0	54.5	55.9	46.1	48.3	51.3

* Estimates are considered unreliable. Data preceded by an asterisk have a relative standard error (RSE) of 20%–30%. Data not shown have an RSE greater than 30%.
- - - Data not available.
. . . Category not applicable.
[1]Based on the 1997–2009 National Health Interview Surveys, about 24%–30% of persons 65 years and over were edentulous (having lost all their natural teeth). In 1997–2009, about 69%–73% of older dentate persons compared with 17%–21% of older edentate persons had a dental visit in the past year.
[2]Respondents were asked "About how long has it been since you last saw or talked to a dentist?" See Appendix II, Dental visit.
[3]Includes all other races not shown separately and unknown disability status.
[4]The race groups white, black, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and 2 or more races include persons of Hispanic and non-Hispanic origin. Persons of Hispanic origin may be of any race. Starting with 1999 data, race-specific estimates are tabulated according to the 1997 Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity and are not strictly comparable with estimates for earlier years. The five single-race categories plus multiple-race categories shown in the table conform to the 1997 Standards. Starting with 1999 data, race-specific estimates are for persons who reported only one racial group; the category 2 or more races includes persons who reported more than one racial group. Prior to 1999, data were tabulated according to the 1977 Standards with four racial groups, and the Asian only category included Native Hawaiian or Other Pacific Islander. Estimates for single-race categories prior to 1999 included persons who reported one race or, if they reported more than one race, identified one race as best representing their race. Starting with 2003 data, race responses of other race and unspecified multiple race were treated as missing, and then race was imputed if these were the only race responses. Almost all persons with a race response of other race were of Hispanic origin. See Appendix II, Hispanic origin; Race.
[5]Percent of poverty level is based on family income and family size and composition using U.S. Census Bureau poverty thresholds. Missing family income data were imputed for 1997 and beyond. See Appendix II, Family income; Poverty; Table VII.
[6]Any basic actions difficulty or complex activity limitation is defined as having one or more of the following limitations or difficulties: movement difficulty, emotional difficulty, sensory (seeing or hearing) difficulty, cognitive difficulty, self-care (ADL or IADL) limitation, social limitation, or work limitation. For more information, see Appendix II, Basic actions difficulty; Complex activity limitation. Starting with 2007 data, the hearing question, a component of the basic actions difficulty measure, was revised. Consequently, data prior to 2007 are not comparable with data for 2007 and beyond. For more information on the impact of the revised hearing question, see Appendix II, Hearing trouble.
[7]MSA is metropolitan statistical area. Starting with 2006 data, MSA status is determined using 2000 census data and the 2000 standards for defining MSAs. For data prior to 2006, see Appendix II, Metropolitan statistical area (MSA) for the applicable standards.

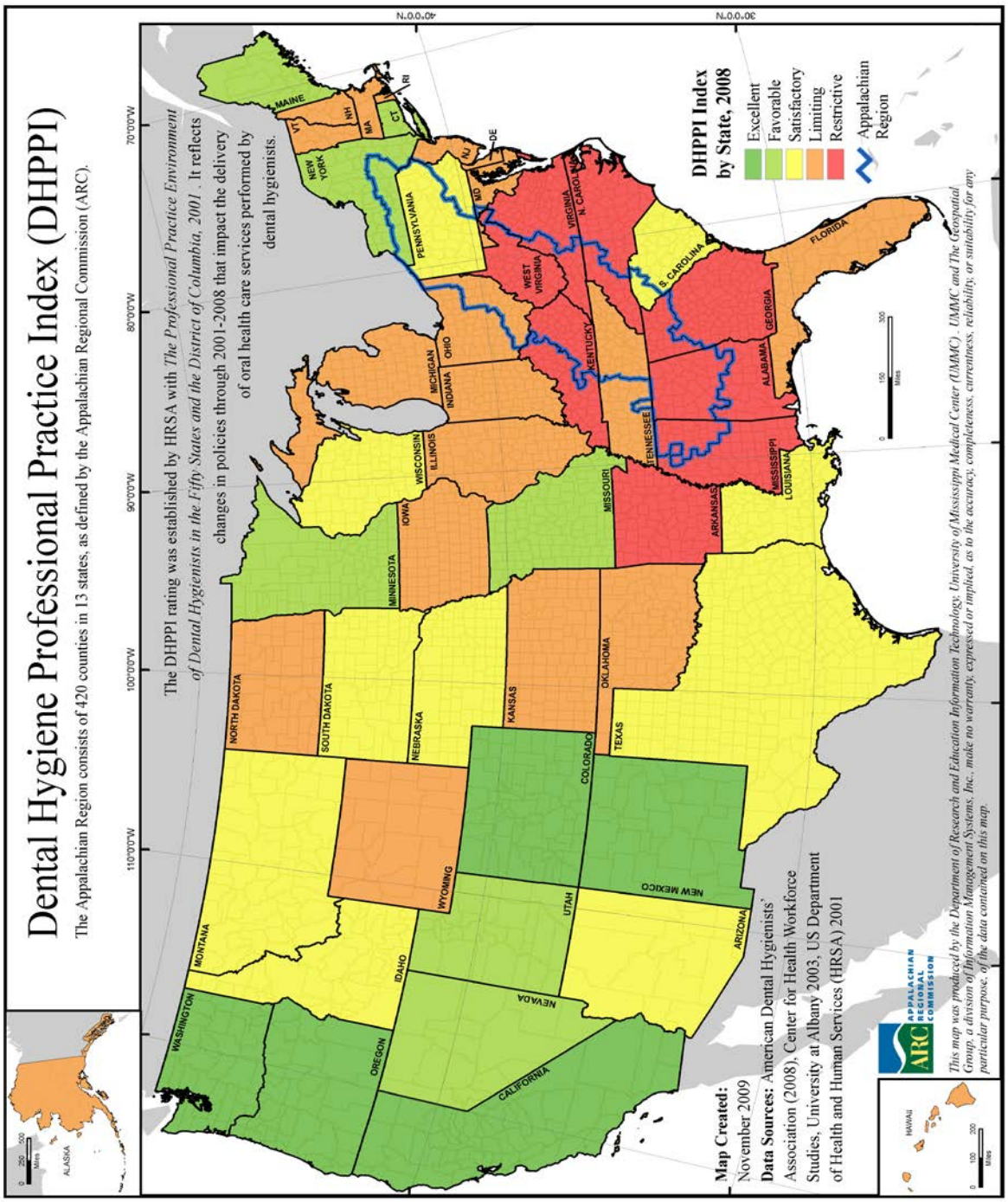
NOTES: In 1997 the National Health Interview Survey questionnaire was redesigned. See Appendix I, National Health Interview Survey. Standard errors for selected years are available in the spreadsheet version of this table. Available from: http://www.cdc.gov/nchs/hus.htm. Data for additional years are available. See Appendix III.

SOURCE: CDC/NCHS, National Health Interview Survey, sample child and sample adult questionnaires.

Source: http://www.cdc.gov/nchs/data/hus/hus10.pdf#093 Health United States 2010, Centers for Disease Control and Prevention.

APPENDIX E: DHPPI BY STATE

FIGURE 24 - DENTAL HYGIENE PROFESSIONAL PRACTICE INDEX BY STATE



APPENDIX F: BEST PRACTICES IN STATE ORAL HEALTH POLICIES

BACKGROUND

According to Thornton, et al., "[b]est practices are the elements and activities of intervention design, planning, and implementation that are recommended on the basis of the best knowledge currently available" (2006:33). Best practices can also be defined as any activity of process that is consistent with improving health promotion (Kahan and Goodstadt. 1999). Generally speaking, measures of clinical practice guidelines, health technology assessment and/or evidence-based medicine are used to assess best practices (Perleth, Jakubowski and Busse. 2001). In a recent CDC publication, Roeber and his colleagues argue that "a more common approach is the use of multiple sources of expertise to identify best practices in population based health interventions" (2004:71). Previous studies have argued for the use of qualitative data to establish best practices related to health care. Sofaer (2002) argued that the application of qualitative methods may allow for an improved assessment of existing programs and policies. Leys (2003) argued that qualitative research is quite valuable in the assessment of health care programs and policies, particularly when the research evaluates perceptions of a program or practice.

The objective of the analyses in this section is to identify programs and policies within the Appalachian Region that seek to improve oral health. The limitations of our methods are outlined here, prior to the presentation of the results. First, the survey was administered to a small number of participants. In order to minimize risk of identification and maintain confidentiality, we were unable to provide specifics such as which stakeholders we interviewed and which states offered which programs. Second, many stakeholders raised concerns over the wording of the close-ended questions. For example, concerning the question regarding the effectiveness of each program and policy, responses frequently discussed were often followed with comments relating to the population served by the program or policy. The categories provided for some of the close ended questions were also rather limiting. An example of this can be found in the responses for the question regarding number of people who benefited from the program or policy. Given the overwhelming response that more than 10,000 individuals benefited from a service, it seems that larger categories were needed. Since many of the practices discussed are state-wide, it may have been more beneficial to create additional categories to where the maximum category would have been 100,000 people or more. Despite a pre-test and revision of the survey instrument, this issue was not raised until the survey was underway.

METHODOLOGY

A supplement to the data provided by the Association of State and Territorial Dental Directors (ASTDD) was obtained by briefly interviewing at least three stakeholders in each of the Appalachian states. These stakeholders included, but are not limited to, a representative from each Appalachian state's oral health division of the Department of Health; a representative from each state's Dental Association; and a representative from each state's Medicaid Dental Division. Contact information for these stakeholders was obtained from an internet search of websites such as the ASTDD's website (http://www.astdd.org), each state's dental association website, and each state's Medicaid website. Stakeholders were interviewed by telephone or email. The interview was tested and approved by the Institutional Review Board for the Protection of Human Subjects in Research at Mississippi State University prior to its implementation.

A total of three individuals in each of the thirteen Appalachian states were contacted for a total of 39 stakeholders. At least one stakeholder from each of Appalachian state agreed to the interview. Overall, 31 individuals agreed to the interview for a response rate of 79%.

Table 32 shows response rates for each of the stakeholder groups. Interview participation rates varied by stakeholder group, and only one stakeholder group had 100% participation. The participation rate for the second stakeholder group was about 85%, while the lowest participation rate came from third stakeholder group at almost 54%. Each stakeholder provided information on an average of 4.3 programs or policies.

TABLE 32 - INTERVIEW RESPONSE RATES

	Stakeholder Group 1	Stakeholder Group 2	Stakeholder Group 3	Total
# Contracted	13	13	13	**39**
# Respondents	13	11	7	**31**
Response Rate	100%	85%	54%	**79%**

The survey instrument that was used is shown at the end of this section (Figure 26). The primary interview question asked was "What programs or practice policies are in place in your state related to oral health?" This was followed by a brief explanation of what types of programs and policies we were interested in for this project, namely fluoridation, screening, sealants, smoking, or community oral health initiatives of which the stakeholder had some knowledge. Respondents were asked to provide the name of the program and a brief program description. Three additional questions were asked regarding each practice mentioned by stakeholders. The first of these questions was "How long has this practice been in place?" Responses fell into one of four categories: more than 5 years; between 1 and 5 years; less than 1 year; or still being implemented. This question was followed by "How effective would you say this program/policy is?" Responses fell into one of five categories: extremely effective, very effective, effective, somewhat effective, or not effective at all. The last question specific to the practices mentioned was "How many people would you say benefit by this program/policy?" Respondents were asked to categorize responses into one of five categories: 1-100; 101-1,000; 1,001-9,999; or 10,000 or more; otherwise, there is no benefit. Interviews were concluded by requesting recommendations on additional individuals to contact regarding oral health programs and practices. Several recommendations of existing stakeholders were made, but few (n=4) recommendations outside of the contacts we were already making were made. To protect the homogeneity of the stakeholders, these few were not contacted. Comparable stakeholders in other states could not have been determined.

Information on 134 programs and policies related to oral health was obtained from the stakeholder interviews. Each of these cases was coded according to the following themes: water fluoridation, workforce, tobacco initiatives, education and outreach, preventive services, adult services, Medicaid initiatives, and access to care. Categorizing of cases into themes was not necessarily mutually exclusive as some programs and policies were designed to address more than one of these areas. A codebook was created to assist coding of cases into the various themes.

Two methods were used to insure the reliability of the coding. The first method involved a test-retest format in which all cases were coded by a single individual. Two weeks after the initial coding, the same individual re-coded all cases. A comparison of each set of coding was conducted, and a reliability score of approximately 92% was achieved. The second method used to determine the reliability of the coding involved a random sampling of 10% of the cases. A second individual was asked to code these randomly selected cases, and a reliability score of 91% was achieved. Given the two reliability scores, it was determined that the coding was largely consistent.

RESULTS

All programs/policies (n=134) were coded into themes: access to care, adult services, oral health education and outreach, Medicaid initiatives, preventive services, tobacco initiatives, water fluoridation, and dental workforce. Categorizing of cases into themes was not mutually exclusive as some programs and policies were designed to address more than one of these areas. Given the lack of exclusive coding, the percentages presented in Figure 25 do not total to 100%. Nearly three-quarters of programs were associated with improving access to oral health care, more than half were coded as being related to prevention, exactly half were oral health education programs. Far fewer programs (roughly 20% each) dealt with dental workforce, adult dental services and/or Medicaid. Even fewer programs on water fluoridation were found and just 3% of all programs were focused on oral health and tobacco.

FIGURE 25 – PROGRAMS AND POLICIES BY THEME

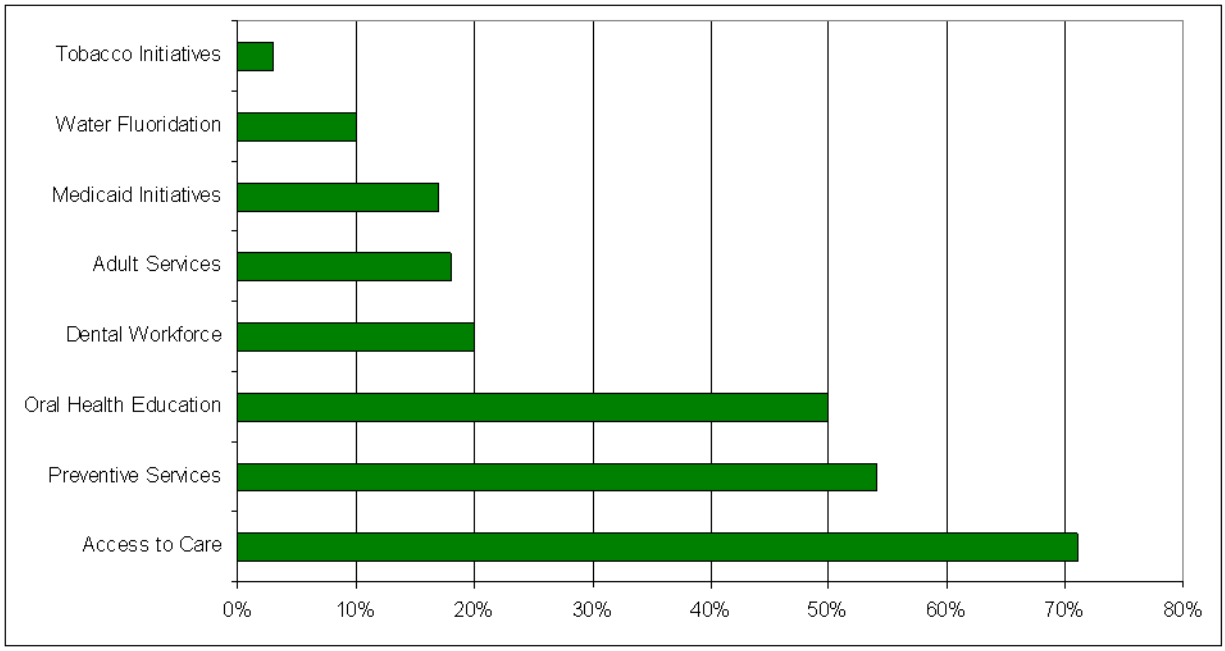


Table 33 shows responses to the question "How long has this practice been in place?" (n=110). About two-thirds of practices (68%) have been in place for more than 5 years, while 19% have been in place between 1 and 5 years. Approximately 7% of the programs/policies have been in place for less than 1 year, and the remaining 5% are still being implemented.

TABLE 33 – RESULTS: "HOW LONG HAS THIS PRACTICE BEEN IN PLACE?"

How long has this practice been in place?	Frequency	Percent
More than 5 years?	75	68
Between 1 and 5 years	21	19
Less than 1 year	8	7
Still being implemented	6	5
Total	**110**	**100**

Table 34 shows responses to the question "How effective would you say this program/policy is?" (n=81). The effectiveness of the programs was predominantly categorized as either extremely effective (37%) or very effective (41%), with the remainder of programs being identified as less effective (23%).

TABLE 34 – RESULTS: "HOW EFFECTIVE WOULD YOU SAY THIS PROGRAM / POLICY IS?

How effective would you say this program is?	Frequency	Percent
Extremely Effective	30	37
Very Effective	33	41
Effective	7	9
Somewhat Effective	11	14
Total	**81**	**100**

Table 35 shows responses to the question "How many people would you say benefit by this program/policy?" (n=96). Nearly three-quarters of programs and policies discussed (71%) were considered to benefit 10,000 or people; most of the remainder (28%) were estimated to benefit fewer than 10,000 people. However, one program was assessed as having provided no benefits to individuals.

TABLE 35 – RESULTS: HOW MANY PEOPLE WOULD YOU SAY BENEFIT BY THIS PROGRAM/POLICY?

How many people benefit by this program?	Frequency	Percent
101-1000	4	4
1001-9999	23	24
10000 or more	68	71
There is no benefit	1	1
Total	**96**	**100**

Access to Care

About 71% of the programs and policies discussed (95 of 134 programs/policies) have the purpose to increase access to care for those in need. Details concerning programs associated with access to oral health care and their associated length of time in place, effectiveness and the number of people benefiting are shown in Table 36. Of these programs and policies in the sample, 68 percent have been in place for more than 5 years. For the remaining practices, 17 percent were implemented between 1 and 5 years ago, 10 percent were implemented in the past year, and 5 percent are still being implemented. The perceived effectiveness of these programs is predominately extremely effective (34%) or very effective (38%). The remaining practices were perceived as effective (9%) or somewhat effective (20%). Overwhelmingly, 10,000 or more people benefit from these practices (69%), while 27 percent of the practices benefit fewer than 10,000 people. Only 3 percent of the practices benefit 1,000 or fewer people, and 2 percent of the practices were reported as having no direct benefit to the population.

Table 36 – Access to Care: Frequency and Percentage

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	52	68
Between 1 and 5 years	13	17
Less than 1 year	8	10
Still being implemented	4	5
How effective would you say this program is?		
Extremely Effective	19	34
Very Effective	21	38
Effective	5	9
Somewhat Effective	11	20
How many people benefit by this program?		
101-1000	2	3
1001-9999	18	26
10000 or more	47	69
There is no benefit	1	1

PREVENTIVE CARE

About 54 percent (72 of 134) of the programs and policies discussed provided preventive services for those in need. Table 37 shows the preventive services programs/policies in regards to length of time in place, perceived effectiveness, and number of people who benefit. Concerning how long the practices have been in place, 57 percent were implemented more than 5 years ago, while 27 percent were implemented between 1 and 5 years ago. Of the remaining practices, 8 percent were implemented less than 1 year ago, and 8 percent are still being implemented. The perceived effectiveness of the practices are mostly considered to be either extremely effective (36%) or very effective (46%). Roughly 7 percent of the practices were perceived as effective and 11 percent were perceived as somewhat effective. About 64 percent of the practices were reported to benefit 10,000 or more people, whereas, the remaining 36 percent benefit fewer than 10,000 people.

TABLE 37 – PREVENTIVE SERVICES: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	34	57
Between 1 and 5 years	16	27
Less than 1 year	5	8
Still being implemented	5	8
How effective would you say this program is?		
Extremely Effective	16	36
Very Effective	20	46
Effective	3	7
Somewhat Effective	5	11
How many people benefit by this program?		
101-1,000	2	4
1,001-9,999	16	32
10,000 or more	32	64
There is no benefit	0	0

ORAL HEALTH EDUCATION

One-half (67) of the programs and policies in the sample sought to educate the population about oral health care. Table 38 shows the oral health education and outreach practices in regards to length of time in place, perceived effectiveness, and number of people who benefit. Slightly more than two-thirds (68%) of these practices have been in place for more than 5 years, while 16% have been in place between 1 and 5 years. Of the remaining cases, 7% have been in place less than 1 year, and 9% are still being implemented. More than 80% of the cases were perceived as extremely effective (43%) or very effective (40%). About 10% of the cases were perceived as effective, and 8% were perceived as somewhat effective. Two-thirds (67%) of the practices in the sample benefit 10,000 or more people, while the remaining one-third (33%) benefit fewer than 10,000 people.

TABLE 38 – ORAL HEALTH EDUCATION: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	38	68
Between 1 and 5 years	9	16
Less than 1 year	4	7
Still being implemented	5	9
How effective would you say this program is?		
Extremely Effective	17	43
Very Effective	16	40
Effective	4	10
Somewhat Effective	3	8
How many people benefit by this program?		
101-1,000	3	7
1,001-9,999	12	26
10,000 or more	31	67
There is no benefit	0	0

DENTAL WORKFORCE

About twenty-seven (20%) of the programs and policies sampled sought to assist the oral health workforce. Table 39 shows the dental workforce practices in regards to length of time in place, perceived effectiveness, and number of people who benefit. Of these, 42% have been in place for more than 5 years, while another 32% were implemented between 1 and 5 years ago. The remaining practices were implemented within the last year or are still being implemented (16% and 11% respectively). The perceived effectiveness of the practices in the sample ranges from 38% as extremely effective to 25% as very effective, 12% as effective to 25% as somewhat effective. Exactly 50% of the practices in the sample benefit 10,000 or more people, while 36% of the practices sampled benefit between 1,001 to 9,999 people. Of the remaining practices in the sample, 7% benefit 1,000 or fewer people, while 7% have no direct benefit to the population as of yet.

TABLE 39 –DENTAL WORKFORCE: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	8	42
Between 1 and 5 years	6	32
Less than 1 year	3	16
Still being implemented	2	11
How effective would you say this program is?		
Extremely Effective	6	38
Very Effective	4	25
Effective	2	13
Somewhat Effective	4	25
How many people benefit by this program?		
101-1,000	1	7
1,001-9,999	5	36
10,000 or more	7	50
There is no benefit	1	7

ADULT SERVICES

Twenty-four (18%) of the programs and policies in the sample sought to provide services to adults in need. Table 40 shows the adult services practices in regards to length of time in place, perceived effectiveness, and number of people who benefit. In terms of how long the practice has been in place, 83% have been in place for more than 5 years, while 11% have been in place between 1 and 5 years and 6% were implemented less than 1 year ago. The perceived effectiveness of the practices ranges from 33% as extremely effective to 42% as very effective, 8% as effective, or 17% as somewhat effective. Approximately 83% of the practices sampled benefit 10,000 or more people, whereas 17% benefit fewer than 10,000 people.

TABLE 40 – ADULT SERVICES: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	15	83
Between 1 and 5 years	2	11
Less than 1 year	1	6
Still being implemented	0	0
How effective would you say this program is?		
Extremely Effective	4	33
Very Effective	5	42
Effective	1	8
Somewhat Effective	2	17
How many people benefit by this program?		
101-1,000	2	11
1,001-9,999	1	6
10,000 or more	15	83
There is no benefit	0	0

MEDICAID INITIATIVES

Twenty-three (17%) of the programs and policies in the sample had a Medicaid-related purpose. Table 41 shows the Medicaid initiatives in regards to length of time in place, perceived effectiveness, and number of people who benefit. Of the practices samples, 62% have been in place for more than 5 years; 19% have been in place between 1 and 5 years; 14% have been in place less than 1 year; and 5% are still being implemented. In terms of perceived effectiveness, 50% of the practices sampled were perceived as either extremely effective (25%) or very effective (25%). Of the remaining practices, 19% were perceived as effective and 31% were perceived as somewhat effective. This is the only theme where the largest category of perceived effectiveness was somewhat effective; for all other themes the perceived effectiveness was predominately categorized as either extremely effective or very effective. In regards to the number of people who benefit from these programs, 80% of the practices benefit 10,000 or more while 20% benefit fewer than 10,000.

TABLE 41 – MEDICAID INITIATIVES: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	13	62
Between 1 and 5 years	4	19
Less than 1 year	3	14
Still being implemented	1	5
How effective would you say this program is?		
Extremely Effective	4	25
Very Effective	4	25
Effective	3	19
Somewhat Effective	5	31
How many people benefit by this program?		
101-1,000	3	15
1,001-9,999	1	5
10,000 or more	16	80
There is no benefit	0	0

WATER FLUORIDATION

Thirteen (10%) of the programs and policies in the sample focused on community water fluoridation. This practice is currently mandated in 12 of the 50 states and 3 of the 13 Appalachian states – Georgia, Kentucky, and Ohio. Table 42 shows the water fluoridation practices in regards to length of time in place, perceived effectiveness, and number of people who benefit. Community water fluoridation was reported to benefit more than 10,000 people in 100% of the cases and to have been in place for more than 5 years in 100% of the cases. It was perceived as either extremely effective (75%) or very effective (25%).

TABLE 42 – WATER FLUORIDATION: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	11	100
Between 1 and 5 years	0	0
Less than 1 year	0	0
Still being implemented	0	0
How effective would you say this program is?		
Extremely Effective	6	75
Very Effective	2	25
Effective	0	0
Somewhat Effective	0	0
How many people benefit by this program?		
101-1,000	0	0
1,001-9,999	0	0
10,000 or more	11	100
There is no benefit	0	0

TOBACCO INITIATIVES

Only four (3%) of the programs and policies in the sample are related to tobacco and oral cancer initiatives. Table 43 shows the tobacco initiatives in regards to length of time in place, perceived effectiveness, and number of people who benefit. Holding with the trend of the other practices sampled, the majority of these tobacco and oral cancer initiatives have been in place for more than 5 years (75%). The remaining 25% of these practices have been in place between 1 and 5 years. These practices were also perceived as either extremely effective (33%) or very effective (67%). Two-thirds of these practices benefit fewer than 10,000 people, while the remaining one-third benefit 10,000 or more people.

TABLE 43 – TOBACCO INITIATIVES: FREQUENCY AND PERCENTAGE

Question/ Response	Frequency	Percentage
How long has practice been in place?		
More than 5 years?	3	75
Between 1 and 5 years	1	25
Less than 1 year	0	0
Still being implemented	0	0
How effective would you say this program is?		
Extremely Effective	1	33
Very Effective	2	67
Effective	0	0
Somewhat Effective	0	0
How many people benefit by this program?		
101-1,000	1	33
1,001-9,999	1	33
10,000 or more	1	33
There is no benefit	0	0

SUMMARY

PROGRAM EFFECTIVENESS

Although the question regarding program effectiveness is subjective in nature, we grouped and ranked types of programs based on their perceived effectiveness. Programs were first grouped based on name or service provided. The perceived effectiveness of the programs was then examined by group for patterns. Programs perceived to be either extremely effective or very effective were then categorized as most effective, while programs perceived to be either effective or somewhat effective were categorized as least effective. We are not labeling the least effective programs as ineffective, but rather are attempting to rank programs based on type and perceived effectiveness relative to other programs in place that address oral health and oral health issues. Another caveat is that our interview did not ask respondents to expand upon their perceived effectiveness of each program they chose to discuss; therefore we did not draw out what shaped these perceptions. Some assumptions can be made, however.

Overall, for those programs rated based on perceived effectiveness, approximately 78 percent met our criteria for most effective (extremely effective or very effective). Five types of programs seemed to fit into this categorization—community water fluoridation, school-based dental sealant programs, school-based dental screening programs, fluoride varnish programs, and fluoride mouth rinse programs.

Community water fluoridation programs (8 out of 8) were generally perceived to be most effective. This is likely due to the fact that it is an inexpensive method of prevention and reaches a large population. School-based dental sealant programs (11 out of 11) were also generally perceived to be effective. This is most likely due to the nature of sealant programs in that they are a preventive service, potentially alleviating future health care problems such as childhood caries. When targeted to children in the earliest years of their education, dental sealant programs may also introduce a teachable moment by demonstrating the importance of oral health care. Additionally, some school-based dental sealant programs target schools where the students may be considered high-risk (less likely to receive regular dental treatment based on socioeconomic status). School-based dental screenings (7 out of 8) were also generally perceived to be most effective. It is possible that this type of program was perceived as most effective as it seeks to identify problems before they are no longer treatable or before they lead to other health care problems. Fluoride varnish programs (8 out of 10) were also perceived to be effective. These programs target school children, therefore also educating a captive audience on the importance of oral health care. Finally, most fluoride mouth rinse programs (4 out of 5) were generally perceived as effective. These five programs which were perceived as being effective seem to have a commonality in that they reach a large population. Many of these programs have also been in place for several years, so the long-term benefits, such as a decrease in dental caries, may also be more apparent. Therefore, it appears that the programs that reach the most people and that have been in place the longest are *perceived* to be the most effective programs. From these survey data, however, it is not possible to ascertain whether these programs are actually effective or not.

The remaining 22 percent of programs rated lower on their perceived effectiveness. In other words, these programs were perceived by interview participants to be either effective or somewhat effective. One particular type of program seemed to fit into this categorization—public insurance programs. Medicaid and SCHIP (5 out of 5) are programs that were perceived to be less effective. This may be due to inadequate access to dentists who accept Medicaid, as indicated in Section 5. It might also be that these programs are thought to be less effective due to low utilization by those who are eligible.

It may be beneficial to conduct further research exploring specific programs, such as those reviewed here, and their effectiveness.

Discussion of Specific Programs

Access to care seems to be one of the key challenges addressed by these programs and policies. This is not surprising given the distinctive geographic and socioeconomic characteristics of the Region as related to health care (Behringer, et al. 2007). It is also not unexpected given that access to care has been deemed one of the barriers to improving oral health care by the U.S. Surgeon General (DHHS. 2000; Haden, et al. 2003). Additionally, access to care has also been determined to be a leading health indicator (DHHS. 2001). Many of the practices included in the sample seek creative ways to increase access to oral health care. For example, in areas with fewer dentists, allowing primary care physicians to perform basic preventive services is one such mechanism to increase access. At least four of the ARC states—Alabama, North Carolina, South Carolina and Virginia—have such programs in place for young children, who are more likely to visit a primary care physician than a dentist. Furthermore, primary care physicians in some states may be reimbursed by Medicaid for providing these services. The use of mobile clinics may also provide basic access as well as assist patients in finding dental homes. At least one ARC state, North Carolina, considered this to be an effective practice; however, such a program often relies on volunteers and may therefore not be feasible.

Preventive services mentioned in this study primarily focus on children. These services include dental sealants, dental screenings, and fluoride applications, and most, if not all, of these services are offered in some manner in the ARC states. Many of these are administered at schools or by pediatricians in an effort to not only improve oral health, but to educate children about the importance of proper oral hygiene. Dye, et al. (2007) found that dental sealant prevalence among children age 6 to 11 has increased in recent years. Policies regarding dental screenings vary around the nation, yet many states require some sort of dental certificate prior to admittance into school (Booth, et al. 2008). Such a requirement is now found in three states in the Appalachian Region – Georgia, Kentucky, and New York (Booth, et al. 2008).

Oral health education and advocacy is somewhat linked to both access to care and preventive services in this analysis as many of the practices categorized as such also aimed to teach patients about the importance of oral health care. Given that those persons with the greatest need also seem to lack knowledge about its importance (Haden, et al. 2003), it is not unexpected that many practices seek to educate the population about oral health. Furthermore, many oral health diseases, such as dental caries, are perceived as preventable; therefore oral health education should be fundamental to state practices regarding oral health.

Efforts to maximize and continually educate the dental workforce are crucial in areas such as the Appalachian Region given its unique socioeconomic characteristics. Practices that encourage recent dental school graduates to work in rural areas, at least in exchange for tuition, are one such method that addresses the issue of access to care in underserved areas. Haden, et al. (2003) argue that dental schools should support recent graduates in providing at least one year of service in underserved areas in an effort to increase access to care as well as gain knowledge about providing culturally appropriate care. There are other health care workers, such as primary care providers, who, if properly trained, can provide basic dental services geared toward prevention (Selwitz, Ismail and Pitts. 2007). As discussed in Section 7, policies regarding practice restrictions placed on dental hygienists vary by state (BHP 2004). Reducing the restrictions on the level of supervision for dental hygienists has been identified as potentially beneficial for improving access to care in underserved areas (Krause, Mosca and Livingston. 2003). Few of these practices seek to diversify the dental workforce; however, that may be an issue that dental schools are in the best position to address in the recruitment of students.

Practices to improve adult oral health are critical as well. Medicaid coverage for dental services for adults varies by state and is often quite limited (Ellis. et al. 2009). Adults are more likely to have medical insurance that dental insurance (DHHS. 2000). Therefore, some programs and policies have been implemented in ARC states such as Maryland, Mississippi, North Carolina, New York, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia, in order to provide some basic preventive dental services to uninsured adults or insured adults unable to afford costs associated with dental visits. The risk of dental caries continues throughout the lifespan, so it is critical for adults to receive preventive dental care. Adults over the age of 40 who use tobacco are at a greater risk of oral cancer (Selwitz, et al. 2007), so dental utilization is also crucial to oral cancer detection.

Examples of programs and policies that were categorized under Medicaid initiatives included those that seek to increase the number of Medicaid providers, those that rely on Medicaid reimbursement, or others that reduce the amount of paperwork necessary for providers to be reimbursed. Children enrolled in Medicaid are more likely to have dental caries and untreated tooth decay compared to children enrolled in private insurance (GAO. 2008). Savage, et al. (2004) found evidence that children with Medicaid coverage in areas with lower dentist-to-population ratios were less likely to use dental services. Fewer dentists in an area could mean that even fewer dentists participate in Medicaid reimbursement, thus, initiatives to increase the number of Medicaid providers seem warranted. According to a CDC report, an increase in the number of dentists participating in Medicaid occurred in about two-thirds of the states (White, Barker and Lockwood. 2004), perhaps indicating that practices oriented toward this task have been successful.

Given that about one-third of the practices included in the sample relating to Medicaid initiatives have been implemented within the last five years, it is also possible that these practices developed as a response to findings from a year 2000 survey administered by the American Dental Association in which about 75% of dentists did not treat patients insured by Medicaid (Haden, et al. 2003).

Water fluoridation is one relatively inexpensive practice believed to benefit the population (Bailey, et al. 2008; Griffin, Jones and Tomar. 2001; Kohlway. 2008). Not only is community water fluoridation perceived as inexpensive for communities, but it is also perceived as a long term cost-saving mechanism by preventing future expenses related to tooth decay (Kohlway. 2008). However, as of 2006, the CDC reported that only 69% of the population had access to a fluoridated community water system (Bailey, et al. 2008). Given that the rate of water fluoridation varies from state to state, and from county to county in some states, it may be helpful to continue to move forward for those areas that lack community water fluoridation. While water fluoridation has its proponents, it also has its opponents, so education regarding the benefits of water fluoridation may need to be continually addressed in some states (Kohlway. 2008).

Practices related to tobacco initiatives were the only theme not mentioned by at least one stakeholder in each of the 13 states in the Appalachian Region. Given that a significant relationship has been found between tobacco use and dental caries, oral cancer, and other oral diseases (Winn 2001), this is somewhat surprising. However, given that tobacco use is a leading health indicator according to Healthy People 2010 (DHHS. 2001), it is possible that there are programs in place in the Appalachian states, but these programs may not be specific to oral health initiatives. A report generated by the CDC did find evidence that state tobacco cessation programs have been increasing in recent years (White, et al. 2004). Likewise, there is evidence that smoking cessation is successful in tooth removal prevention, particularly as the number of years as a former smoker increase for an individual (Tomar and Asma. 2000; Yanagisawa, et al. 2009).

Due to the nature of the methodology for this section of the study, it is difficult to quantify the effectiveness of these programs from this analysis, particularly for those who are underserved in the Appalachian Region. With the exception of West Virginia (in which all counties are included in the Appalachian Region), this methodology did not uncover to what extent these practices were designed to solely improve the oral health of the residents of the Appalachian Region, although given that many of these practices focus on the underserved, one could infer that the Appalachian Region does benefit. Improvements in the oral health status of the residents of the Appalachian Region may also indicate the effectiveness of these practices.

FIGURE 26 – SURVEY INSTRUMENT

ARC Oral Health Project Interview Protocol

State: _____

Position: _____ State Dental Director
_____ State Dental Association
_____ State Medicaid Dental Division
_____ Other: _____

1. What programs or practice policies are in place in your state?

Examples of programs or practice policies might be related to fluoridation, screening, sealants, smoking, or community oral health initiatives. This should include programs/policies that you are aware of and not be limited to only those with which you are directly involved. [Write title of program and brief description.]

a. _____

b. _____

c. _____

d. _____

e. _____

2. For **each** practice:
   a. How long has this practice been in place?
      i. More than 5 years
      ii. Between 1 and 5 years
      iii. Less than one year
      iv. Still being implemented

b. How effective would you say this program/policy is?
   i. Extremely effective
   ii. Very effective
   iii. Somewhat effective
   iv. Not effective at all

c. How many people would you say benefit by this program/policy?
   i. 1 – 100.
   ii. 101 - 1,000
   iii. 1,001 – 9,999
   iv. 10,000 or more
   v. There is no benefit

3. Are there other people in the state that you think we should interview concerning programs or practices for oral health in [STATE]? [Take name, affiliation, position and telephone number of other parties.]

Name	Affiliation	Position	Phone Number

Appendix G: Dental Workforce Trends in Appalachia

Prepared by Krause, et al., University of Mississippi

Table 44 – Dental Workforce Trends in Appalachian Counties (Sorted by Growth Rate)

Rank	Dental Workforce Trends in Appalachian Counties		Population Count		Population Change		Active Dentists				Active Dentists Private Practitioners				Median Family Income			
1990-2000			1990	2000	Numerical Change	Growth Rate 1990-2000	1991	2006	Numerical Change	Growth Rate 2006-1991	1991	2006	Numerical Change	Growth Rate 1991-2006	1989	1999	Numerical Change	Growth Rate 1989-1999
1	Forsyth	Georgia	44,083	98,407	54,324	1.23%	12	53	41	3.42%	9	52	43	4.78%	$40,718	$74,003	33285	0.82%
2	Paulding	Georgia	41,611	81,678	40,067	0.96%	5	14	9	1.80%	5	14	9	1.80%	$35,667	$56,039	20372	0.57%
3	Gilmer	Georgia	13,368	23,456	10,088	0.75%	5	8	3	0.60%	5	8	3	0.60%	$24,888	$38,863	13975	0.56%
4	Dawson	Georgia	9,429	15,999	6,570	0.70%	5	11	6	1.20%	5	10	5	1.00%	$30,519	$52,320	21801	0.71%
5	Gwinnett	Georgia	352,910	588,448	235,538	0.67%	172	397	225	1.31%	163	383	220	1.35%	$48,000	$66,693	18693	0.39%
6	Pike	Pennsylvania	27,966	46,302	18,336	0.66%	12	20	8	0.67%	12	19	7	0.58%	$34,379	$49,340	14961	0.44%
7	Pickens	Georgia	14,432	22,983	8,551	0.59%	6	9	3	0.50%	5	9	4	0.80%	$27,790	$47,123	19333	0.70%
8	Cherokee	Georgia	90,204	141,903	51,699	0.57%	29	70	41	1.41%	26	67	41	1.58%	$41,762	$66,419	24657	0.59%
9	Barrow	Georgia	29,721	46,144	16,423	0.55%	5	12	7	1.40%	5	12	7	1.40%	$30,922	$49,722	18800	0.61%
10	White	Georgia	13,006	19,944	6,938	0.53%	3	10	7	2.33%	2	10	8	4.00%	$27,830	$40,704	12874	0.46%
11	Hall	Georgia	95,428	139,277	43,849	0.46%	38	73	35	0.92%	35	72	37	1.06%	$34,147	$50,100	15953	0.47%
12	Monroe	Pennsylvania	95,709	138,687	42,978	0.45%	39	58	19	0.49%	38	56	18	0.47%	$36,514	$51,995	15481	0.42%
13	Shelby	Alabama	99,358	143,293	43,935	0.44%	46	100	54	1.17%	37	89	52	1.41%	$42,549	$64,105	21556	0.51%
14	Lumpkin	Georgia	14,573	21,016	6,443	0.44%	4	5	1	0.25%	4	5	1	0.25%	$30,417	$46,368	15951	0.52%
15	Union	Georgia	11,993	17,289	5,296	0.44%	6	9	3	0.50%	5	9	4	0.80%	$24,334	$39,776	15442	0.63%
16	Banks	Georgia	10,308	14,422	4,114	0.40%	1	1	0	0.00%	1	1	0	0.00%	$28,212	$43,136	14924	0.53%
17	Murray	Georgia	26,147	36,506	10,359	0.40%	2	5	3	1.50%	1	5	4	4.00%	$29,708	$42,155	12447	0.42%
18	Sevier	Tennessee	51,043	71,170	20,127	0.39%	19	27	8	0.42%	18	25	7	0.39%	$26,340	$40,474	14134	0.54%
19	Jackson	Georgia	30,005	41,589	11,584	0.39%	4	8	4	1.00%	4	8	4	1.00%	$28,675	$46,211	17536	0.61%
20	Meigs	Tennessee	8,033	11,086	3,053	0.38%	1	2	1	1.00%	1	2	1	1.00%	$22,605	$34,114	11509	0.51%
21	Towns	Georgia	6,754	9,319	2,565	0.38%	2	3	1	0.50%	2	3	1	0.50%	$23,114	$37,295	14181	0.61%
22	Bartow	Georgia	55,911	76,019	20,108	0.36%	14	33	19	1.36%	13	33	20	1.54%	$31,291	$49,198	17907	0.57%
23	Cumberland	Tennessee	34,736	46,802	12,066	0.35%	8	13	5	0.63%	7	12	5	0.71%	$23,498	$35,928	12430	0.53%
24	Jefferson	Tennessee	33,016	44,294	11,278	0.34%	10	16	6	0.60%	10	16	6	0.60%	$26,133	$38,537	12404	0.47%
25	Elmore	Alabama	49,210	65,874	16,664	0.34%	6	18	12	2.00%	6	15	9	1.50%	$30,853	$47,155	16302	0.53%
26	Alleghany	Virginia	13,176	17,215	4,039	0.31%	1	2	1	1.00%	1	2	1	1.00%	$31,145	$45,843	14698	0.47%
27	Union	Tennessee	13,694	17,808	4,114	0.30%	1	1	0	0.00%	1	1	0	0.00%	$22,544	$31,843	9299	0.41%
28	Blount	Alabama	39,248	51,024	11,776	0.30%	2	6	4	2.00%	2	6	4	2.00%	$26,323	$41,573	15250	0.58%
29	Habersham	Georgia	27,621	35,902	8,281	0.30%	10	20	10	1.00%	8	19	11	1.38%	$28,824	$42,235	13411	0.47%
30	Douglas	Georgia	71,120	92,174	21,054	0.30%	21	50	29	1.38%	19	48	29	1.53%	$40,497	$54,082	13585	0.34%
31	St Clair	Alabama	50,009	64,742	14,733	0.29%	10	21	11	1.10%	10	19	9	0.90%	$27,388	$43,152	15764	0.58%
32	Rabun	Georgia	11,648	15,050	3,402	0.29%	7	8	1	0.14%	6	8	2	0.33%	$24,233	$39,992	15759	0.65%

Rank 1990-2000	Dental Workforce Trends in Appalachian Counties		Population Count		Population Change		Active Dentists				Active Dentists Private Practitioners				Median Family Income			
			1990	2000	Numerical Change	Growth Rate 1990-2000	1991	2006	Numerical Change	Growth Rate 2006-1991	1991	2006	Numerical Change	Growth Rate 1991-2006	1989	1999	Numerical Change	Growth Rate 1989-1999
33	Menifee,	Kentucky	5,092	6,556	1,464	0.29%	0	1	1	0.00%	0	1	1		$16,538	$26,325	9787	0.59%
34	Henderson,	North Carolina	69,285	89,173	19,888	0.29%	29	47	18	0.62%	28	44	16	0.57%	$31,331	$44,974	13643	0.44%
35	Sequatchie,	Tennessee	8,863	11,370	2,507	0.28%	2	3	1	0.50%	2	3	1	0.50%	$23,228	$36,435	13207	0.57%
36	Macon,	Tennessee	15,906	20,386	4,480	0.28%	3	4	1	0.33%	3	4	1	0.33%	$22,739	$37,577	14838	0.65%
37	Berkeley,	West Virginia	59,253	75,905	16,652	0.28%	23	39	16	0.70%	22	39	17	0.77%	$32,040	$44,302	12262	0.38%
38	Bledsoe,	Tennessee	9,669	12,367	2,698	0.28%	1	1	0	0.00%	1	1	0	0.00%	$21,941	$34,593	12652	0.58%
39	Garrard,	Kentucky	11,579	14,792	3,213	0.28%	2	4	2	1.00%	2	4	2	1.00%	$26,250	$41,250	15000	0.57%
40	Heard,	Georgia	8,628	11,012	2,384	0.28%	0	1	1	0.00%	0	1	1		$25,066	$39,306	14240	0.57%
41	Monroe,	Tennessee	30,541	38,961	8,420	0.28%	8	10	2	0.25%	8	10	2	0.25%	$22,999	$34,902	11903	0.52%
42	Johnson,	Tennessee	13,766	17,499	3,733	0.27%	3	4	1	0.33%	3	2	-1	-0.33%	$18,024	$28,400	10376	0.58%
43	Polk,	North Carolina	14,416	18,324	3,908	0.27%	7	9	2	0.29%	7	9	2	0.29%	$31,864	$45,096	13232	0.42%
44	Macon,	North Carolina	23,499	29,811	6,312	0.27%	8	13	5	0.63%	7	10	3	0.43%	$25,655	$37,381	11726	0.46%
45	Gordon,	Georgia	35,072	44,104	9,032	0.26%	5	12	7	1.40%	4	12	8	2.00%	$31,331	$43,184	11853	0.38%
46	Bibb,	Alabama	16,576	20,826	4,250	0.26%	2	6	4	2.00%	2	6	4	2.00%	$23,714	$37,230	13516	0.57%
47	Catoosa,	Georgia	42,464	53,282	10,818	0.25%	6	15	9	1.50%	6	15	9	1.50%	$29,657	$45,710	16053	0.54%
48	Smith,	Tennessee	14,143	17,712	3,569	0.25%	1	2	1	1.00%	1	2	1	1.00%	$27,393	$41,645	14252	0.52%
49	Loudon,	Tennessee	31,255	39,086	7,831	0.25%	12	17	5	0.42%	11	16	5	0.45%	$28,712	$46,517	17805	0.62%
50	Davie,	North Carolina	27,859	34,835	6,976	0.25%	8	10	2	0.25%	7	10	3	0.43%	$34,719	$47,699	12980	0.37%
51	Noble,	Ohio	11,336	14,058	2,722	0.24%	0	2	2	0.00%	0	2	2		$25,625	$38,939	13314	0.52%
52	Fannin,	Georgia	15,992	19,798	3,806	0.24%	4	7	3	0.75%	4	7	3	0.75%	$22,619	$35,258	12639	0.56%
53	Jackson,	North Carolina	26,846	33,121	6,275	0.23%	11	16	5	0.45%	9	14	5	0.56%	$25,826	$40,876	15050	0.58%
54	Madison,	Kentucky	57,508	70,872	13,364	0.23%	18	27	9	0.50%	18	27	9	0.50%	$27,052	$41,383	14331	0.53%
55	Morgan,	West Virginia	12,128	14,943	2,815	0.23%	3	6	3	1.00%	3	5	2	0.67%	$28,252	$40,690	12438	0.44%
56	Blount,	Tennessee	85,969	105,823	19,854	0.23%	32	56	24	0.75%	28	51	23	0.82%	$30,277	$45,038	14761	0.49%
57	Lewis,	Tennessee	9,247	11,367	2,120	0.23%	1	2	1	1.00%	1	2	1	1.00%	$20,901	$35,972	15071	0.72%
58	Cherokee,	Alabama	19,543	23,988	4,445	0.23%	0	3	3	0.00%	0	3	3		$24,932	$36,920	11988	0.48%
59	Clay,	North Carolina	7,155	8,775	1,620	0.23%	2	3	1	0.50%	1	3	2	2.00%	$22,750	$38,264	15514	0.68%
60	Cannon,	Tennessee	10,467	12,826	2,359	0.23%	1	5	4	4.00%	1	5	4	4.00%	$27,481	$38,424	10943	0.40%
61	Hampshire,	West Virginia	16,498	20,203	3,705	0.22%	3	6	3	1.00%	3	6	3	1.00%	$24,164	$37,616	13452	0.56%
62	Madison,	Georgia	21,050	25,730	4,680	0.22%	1	3	2	2.00%	1	2	1	1.00%	$30,065	$42,189	12124	0.40%
63	Carroll,	Georgia	71,422	87,268	15,846	0.22%	20	31	11	0.55%	19	30	11	0.58%	$30,096	$44,642	14546	0.48%
64	Botetourt,	Virginia	24,992	30,496	5,504	0.22%	11	14	3	0.27%	10	13	3	0.30%	$37,116	$55,125	18009	0.49%
65	Alexander,	North Carolina	27,544	33,603	6,059	0.22%	1	4	3	3.00%	1	4	3	3.00%	$30,275	$45,691	15416	0.51%
66	Chilton,	Alabama	32,458	39,593	7,135	0.22%	8	8	0	0.00%	8	8	0	0.00%	$26,203	$39,505	13302	0.51%
67	Franklin,	Georgia	16,650	20,285	3,635	0.22%	4	4	0	0.00%	3	4	1	0.33%	$27,517	$38,463	10946	0.40%

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68	Laurel	,	Kentucky	43,438	52,715	9,277	0.21%	7	17	10	1.43%	7	17	10	1.43%	$20,977	$31,318	10341	0.49%
69	DeKalb	,	Tennessee	14,360	17,423	3,063	0.21%	2	4	2	1.00%	2	4	2	1.00%	$22,956	$36,920	13964	0.61%
70	Limestone	,	Alabama	54,135	65,676	11,541	0.21%	9	17	8	0.89%	8	15	7	0.88%	$31,739	$45,146	13407	0.42%
71	Putnam	,	Tennessee	51,373	62,315	10,942	0.21%	21	28	7	0.33%	20	25	5	0.25%	$27,015	$39,553	12538	0.46%
72	Brown	,	Ohio	34,966	42,285	7,319	0.21%	4	7	3	0.75%	4	7	3	0.75%	$28,840	$43,040	14200	0.49%
73	Grainger	,	Tennessee	17,095	20,659	3,564	0.21%	1	3	2	2.00%	1	3	2	2.00%	$21,697	$33,347	11650	0.54%
74	Cherokee	,	North Carolina	20,170	24,298	4,128	0.20%	10	11	1	0.10%	10	10	0	0.00%	$22,788	$33,768	10980	0.48%
75	Putnam	,	West Virginia	42,835	51,589	8,754	0.20%	15	28	13	0.87%	14	27	13	0.93%	$31,448	$48,674	17226	0.55%
76	Hawkins	,	Tennessee	44,565	53,563	8,998	0.20%	6	9	3	0.50%	6	9	3	0.50%	$26,402	$37,557	11155	0.42%
77	Pontotoc	,	Mississippi	22,237	26,726	4,489	0.20%	5	6	1	0.20%	4	5	1	0.25%	$24,599	$39,845	15246	0.62%
78	Stokes	,	North Carolina	37,223	44,711	7,488	0.20%	4	6	2	0.50%	4	5	1	0.25%	$31,831	$44,615	12784	0.40%
79	Morgan	,	Kentucky	11,648	13,948	2,300	0.20%	3	4	1	0.33%	3	4	1	0.33%	$16,031	$26,135	10104	0.63%
80	Wayne	,	Pennsylvania	39,944	47,722	7,778	0.19%	11	20	9	0.82%	11	18	7	0.64%	$28,395	$40,589	12194	0.43%
81	Bradley	,	Tennessee	73,712	87,965	14,253	0.19%	25	39	14	0.56%	25	36	11	0.44%	$30,372	$41,779	11407	0.38%
82	Yadkin	,	North Carolina	30,488	36,348	5,860	0.19%	4	7	3	0.75%	4	6	2	0.50%	$30,626	$43,758	13132	0.43%
83	Coffee	,	Tennessee	40,339	48,014	7,675	0.19%	22	31	9	0.41%	21	30	9	0.43%	$28,778	$40,228	11450	0.40%
84	Greenville	,	South Carolina	320,167	379,616	59,449	0.19%	134	238	104	0.78%	129	228	99	0.77%	$34,560	$50,332	15772	0.46%
85	Holmes	,	Ohio	32,849	38,943	6,094	0.19%	5	11	6	1.20%	5	11	6	1.20%	$27,531	$40,230	12699	0.46%
86	Clermont	,	Ohio	150,187	177,977	27,790	0.19%	42	64	22	0.52%	40	60	20	0.50%	$36,511	$57,032	20521	0.56%
87	Jackson	,	Tennessee	9,297	10,984	1,687	0.18%	3	3	0	0.00%	2	3	1	0.50%	$21,834	$32,088	10254	0.47%
88	McDowell	,	North Carolina	35,681	42,151	6,470	0.18%	6	10	4	0.67%	6	9	3	0.50%	$27,018	$37,789	10771	0.40%
89	Cherokee	,	South Carolina	44,506	52,537	8,031	0.18%	4	9	5	1.25%	4	9	5	1.25%	$28,925	$39,393	10468	0.36%
90	Buncombe	,	North Carolina	174,821	206,330	31,509	0.18%	79	137	58	0.73%	66	124	58	0.88%	$30,889	$45,011	14122	0.46%
91	Pickens	,	South Carolina	93,894	110,757	16,863	0.18%	24	49	25	1.04%	21	47	26	1.24%	$32,492	$44,507	12015	0.37%
92	DeKalb	,	Alabama	54,651	64,452	9,801	0.18%	11	17	6	0.55%	11	17	6	0.55%	$24,836	$35,801	10965	0.44%
93	Burke	,	North Carolina	75,744	89,148	13,404	0.18%	19	28	9	0.47%	16	25	9	0.56%	$30,647	$42,114	11467	0.37%
94	Polk	,	Tennessee	13,643	16,050	2,407	0.18%	1	2	1	1.00%	1	2	1	1.00%	$23,934	$36,370	12436	0.52%
95	Monroe	,	West Virginia	12,406	14,583	2,177	0.18%	1	2	1	1.00%	1	2	1	1.00%	$21,530	$35,299	13769	0.64%
96	Jefferson	,	West Virginia	35,926	42,190	6,264	0.17%	12	20	8	0.67%	11	19	8	0.73%	$34,887	$51,351	16464	0.47%
97	Hart	,	Kentucky	14,890	17,445	2,555	0.17%	3	4	1	0.33%	3	4	1	0.33%	$19,587	$31,746	12159	0.62%
98	Haralson	,	Georgia	21,966	25,690	3,724	0.17%	5	6	1	0.20%	5	6	1	0.20%	$27,027	$38,373	11346	0.42%
99	Hart	,	Georgia	19,712	22,997	3,285	0.17%	3	5	2	0.67%	3	4	1	0.33%	$27,561	$39,600	12039	0.44%
100	Rhea	,	Tennessee	24,344	28,400	4,056	0.17%	5	11	6	1.20%	5	11	6	1.20%	$23,789	$35,580	11791	0.50%
101	Lincoln	,	Kentucky	20,045	23,361	3,316	0.17%	3	5	2	0.67%	3	5	2	0.67%	$21,239	$32,284	11045	0.52%
102	Craig	,	Virginia	4,372	5,091	719	0.16%	1	1	0	0.00%	1	1	0	0.00%	$28,530	$41,750	13220	0.46%

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103	Washington	,	Tennessee	92,315	107,198	14,883	0.16%	40	63	23	0.58%	35	55	20	0.57%	$29,701	$41,162	11461	0.39%
104	Marshall	,	Alabama	70,832	82,231	11,399	0.16%	18	28	10	0.56%	18	27	9	0.50%	$26,135	$38,788	12653	0.48%
105	Warren	,	Tennessee	32,992	38,276	5,284	0.16%	5	12	7	1.40%	5	11	6	1.20%	$25,900	$37,835	11935	0.46%
106	Madison	,	North Carolina	16,953	19,635	2,682	0.16%	2	2	0	0.00%	2	2	0	0.00%	$23,963	$37,383	13420	0.56%
107	Madison	,	Alabama	238,912	276,700	37,788	0.16%	105	161	56	0.53%	95	153	58	0.61%	$39,264	$54,360	15096	0.38%
108	McMinn	,	Tennessee	42,383	49,015	6,632	0.16%	14	19	5	0.36%	13	17	4	0.31%	$26,207	$38,992	12785	0.49%
109	Floyd	,	Virginia	12,005	13,874	1,869	0.16%	3	3	0	0.00%	3	3	0	0.00%	$27,439	$38,128	10689	0.39%
110	Watauga	,	North Carolina	36,952	42,695	5,743	0.16%	17	24	7	0.41%	16	23	7	0.44%	$27,752	$45,508	17756	0.64%
111	Lee	,	Mississippi	65,581	75,755	10,174	0.16%	30	48	18	0.60%	25	45	20	0.80%	$29,299	$43,149	13850	0.47%
112	Avery	,	North Carolina	14,867	17,167	2,300	0.15%	4	7	3	0.75%	4	6	2	0.50%	$24,154	$37,454	13300	0.55%
113	Surry	,	North Carolina	61,704	71,219	9,515	0.15%	16	23	7	0.44%	16	22	6	0.38%	$27,750	$38,902	11152	0.40%
114	Hardy	,	West Virginia	10,977	12,669	1,692	0.15%	3	4	1	0.33%	2	3	1	0.50%	$25,843	$37,003	11160	0.43%
115	Vinton	,	Ohio	11,098	12,806	1,708	0.15%	1	1	0	0.00%	1	1	0	0.00%	$21,963	$34,371	12408	0.56%
116	Montgomery	,	Kentucky	19,561	22,554	2,993	0.15%	7	9	2	0.29%	7	9	2	0.29%	$24,542	$36,939	12397	0.51%
117	Yancey	,	North Carolina	15,419	17,774	2,355	0.15%	2	3	1	0.50%	2	3	1	0.50%	$22,659	$35,879	13220	0.58%
118	Whitfield	,	Georgia	72,462	83,525	11,063	0.15%	21	31	10	0.48%	19	30	11	0.58%	$32,423	$44,652	12229	0.38%
119	Dade	,	Georgia	13,147	15,154	2,007	0.15%	1	2	1	1.00%	1	2	1	1.00%	$24,051	$39,481	15430	0.64%
120	Marshall	,	Mississippi	30,361	34,993	4,632	0.15%	2	3	1	0.50%	2	3	1	0.50%	$21,554	$33,125	11571	0.54%
121	Cocke	,	Tennessee	29,141	33,565	4,424	0.15%	3	4	1	0.33%	3	4	1	0.33%	$20,644	$30,418	9774	0.47%
122	Oconee	,	South Carolina	57,494	66,215	8,721	0.15%	10	20	10	1.00%	10	20	10	1.00%	$30,858	$43,047	12189	0.40%
123	Hamblen	,	Tennessee	50,480	58,128	7,648	0.15%	26	31	5	0.19%	25	30	5	0.20%	$27,325	$39,138	11813	0.43%
124	Forsyth	,	North Carolina	265,878	306,067	40,189	0.15%	122	197	75	0.61%	90	182	92	1.02%	$37,923	$52,032	14109	0.37%
125	Haywood	,	North Carolina	46,942	54,033	7,091	0.15%	16	24	8	0.50%	15	23	8	0.53%	$26,820	$40,438	13618	0.51%
126	Swain	,	North Carolina	11,268	12,968	1,700	0.15%	1	2	1	1.00%	1	2	1	1.00%	$19,533	$33,786	14253	0.73%
127	Scott	,	Tennessee	18,358	21,127	2,769	0.15%	3	5	2	0.67%	3	4	1	0.33%	$18,637	$28,595	9958	0.53%
128	Union	,	Pennsylvania	36,176	41,624	5,448	0.15%	15	27	12	0.80%	14	23	9	0.64%	$31,776	$47,538	15762	0.50%
129	White	,	Tennessee	20,090	23,102	3,012	0.15%	8	11	3	0.38%	7	9	2	0.29%	$24,147	$34,854	10707	0.44%
130	Transylvania	,	North Carolina	25,520	29,334	3,814	0.15%	6	10	4	0.67%	6	10	4	0.67%	$30,613	$45,579	14966	0.49%
131	Union	,	Mississippi	22,085	25,362	3,277	0.15%	5	7	2	0.40%	5	7	2	0.40%	$26,010	$39,666	13656	0.53%
132	Cullman	,	Alabama	67,613	77,483	9,870	0.15%	15	22	7	0.47%	15	22	7	0.47%	$25,856	$39,341	13485	0.52%
133	Butler	,	Pennsylvania	152,013	174,083	22,070	0.15%	64	104	40	0.63%	60	97	37	0.62%	$34,647	$51,215	16568	0.48%
134	Chattooga	,	Georgia	22,242	25,470	3,228	0.15%	5	7	2	0.40%	5	7	2	0.40%	$24,851	$36,230	11379	0.46%
135	Highland	,	Ohio	35,728	40,875	5,147	0.14%	10	13	3	0.30%	10	12	2	0.20%	$26,224	$41,091	14867	0.57%
136	Bath	,	Kentucky	9,692	11,085	1,393	0.14%	1	1	0	0.00%	1	1	0	0.00%	$20,026	$31,758	11732	0.59%
137	Panola	,	Mississippi	29,996	34,274	4,278	0.14%	5	9	4	0.80%	5	9	4	0.80%	$21,119	$32,675	11556	0.55%

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				1990	2000	Numerical Change	Growth Rate 1990-2000	1991	2006	Numerical Change	Growth Rate 2006-1991	1991	2006	Numerical Change	Growth Rate 1991-2006	1989	1999	Numerical Change	Growth Rate 1989-1999
138	Claiborne	,	Tennessee	26,137	29,862	3,725	0.14%	5	7	2	0.40%	5	7	2	0.40%	$19,993	$31,234	11241	0.56%
139	Pike	,	Ohio	24,249	27,695	3,446	0.14%	6	10	4	0.67%	6	10	4	0.67%	$22,567	$35,934	13367	0.59%
140	Morgan	,	Tennessee	17,300	19,757	2,457	0.14%	3	3	0	0.00%	3	3	0	0.00%	$22,163	$31,901	9738	0.44%
141	Anderson	,	South Carolina	145,196	165,740	20,544	0.14%	40	65	25	0.63%	39	63	24	0.62%	$31,228	$44,229	13001	0.42%
142	Overton	,	Tennessee	17,636	20,118	2,482	0.14%	4	5	1	0.25%	4	5	1	0.25%	$21,586	$32,156	10570	0.49%
143	Wayne	,	Kentucky	17,468	19,923	2,455	0.14%	3	6	3	1.00%	3	6	3	1.00%	$15,967	$24,869	8902	0.56%
144	Knox	,	Tennessee	335,749	382,032	46,283	0.14%	164	246	82	0.50%	153	230	77	0.50%	$32,614	$49,182	16568	0.51%
145	Itawamba	,	Mississippi	20,017	22,770	2,753	0.14%	4	5	1	0.25%	4	5	1	0.25%	$24,489	$36,793	12304	0.50%
146	Van Buren	,	Tennessee	4,846	5,508	662	0.14%	0	0	0	0.00%	0	0	0		$23,242	$34,949	11707	0.50%
147	Campbell	,	Tennessee	35,079	39,854	4,775	0.14%	7	7	0	0.00%	6	7	1	0.17%	$20,151	$30,197	10046	0.50%
148	Pulaski	,	Kentucky	49,489	56,217	6,728	0.14%	18	40	22	1.22%	17	37	20	1.18%	$21,792	$32,350	10558	0.48%
149	Rockbridge	,	Virginia	18,350	20,808	2,458	0.13%	3	3	0	0.00%	3	3	0	0.00%	$28,545	$41,324	12779	0.45%
150	Fentress	,	Tennessee	14,669	16,625	1,956	0.13%	2	2	0	0.00%	2	2	0	0.00%	$16,405	$28,856	12451	0.76%
151	Powell	,	Kentucky	11,686	13,237	1,551	0.13%	2	4	2	1.00%	2	4	2	1.00%	$19,540	$30,483	10943	0.56%
152	Montgomery	,	Virginia	73,913	83,629	9,716	0.13%	19	31	12	0.63%	15	30	15	1.00%	$32,128	$47,239	15111	0.47%
153	Wirt	,	West Virginia	5,192	5,873	681	0.13%	1	2	1	1.00%	1	2	1	1.00%	$21,193	$33,872	12679	0.60%
154	Braxton	,	West Virginia	12,998	14,702	1,704	0.13%	2	4	2	1.00%	2	4	2	1.00%	$20,365	$29,133	8768	0.43%
155	Lawrence	,	Tennessee	35,303	39,926	4,623	0.13%	10	11	1	0.10%	10	11	1	0.10%	$25,197	$35,326	10129	0.40%
156	Franklin	,	Tennessee	34,725	39,270	4,545	0.13%	6	11	5	0.83%	5	11	6	1.20%	$27,731	$42,279	14548	0.52%
157	Clay	,	Kentucky	21,746	24,556	2,810	0.13%	5	6	1	0.20%	5	5	0	0.00%	$14,721	$18,925	4204	0.29%
158	Jackson	,	Kentucky	11,955	13,495	1,540	0.13%	1	3	2	2.00%	1	2	1	1.00%	$14,767	$23,638	8871	0.60%
159	Jackson	,	Alabama	47,796	53,926	6,130	0.13%	12	15	3	0.25%	12	15	3	0.25%	$25,772	$38,082	12310	0.48%
160	Polk	,	Georgia	33,815	38,127	4,312	0.13%	6	11	5	0.83%	6	11	5	0.83%	$27,896	$37,847	9951	0.36%
161	Winston	,	Alabama	22,053	24,843	2,790	0.13%	2	4	2	1.00%	1	4	3	3.00%	$22,023	$32,628	10605	0.48%
162	Greene	,	Tennessee	55,853	62,909	7,056	0.13%	18	24	6	0.33%	16	24	8	0.50%	$25,600	$36,889	11289	0.44%
163	Randolph	,	Alabama	19,881	22,380	2,499	0.13%	4	5	1	0.25%	4	5	1	0.25%	$23,994	$34,684	10690	0.45%
164	Edmonson	,	Kentucky	10,357	11,644	1,287	0.12%	1	1	0	0.00%	1	1	0	0.00%	$17,295	$31,843	14548	0.84%
165	Clark	,	Kentucky	29,496	33,144	3,648	0.12%	13	22	9	0.69%	12	20	8	0.67%	$29,089	$45,647	16558	0.57%
166	Adair	,	Kentucky	15,360	17,244	1,884	0.12%	3	5	2	0.67%	3	5	2	0.67%	$20,163	$29,779	9616	0.48%
167	Franklin	,	Alabama	27,814	31,223	3,409	0.12%	9	10	1	0.11%	9	10	1	0.11%	$22,755	$34,274	11519	0.51%
168	Fleming	,	Kentucky	12,292	13,792	1,500	0.12%	3	3	0	0.00%	3	3	0	0.00%	$22,564	$33,300	10736	0.48%
169	Rockcastle	,	Kentucky	14,803	16,582	1,779	0.12%	1	2	1	1.00%	1	2	1	1.00%	$18,144	$30,278	12134	0.67%
170	Metcalfe	,	Kentucky	8,963	10,037	1,074	0.12%	1	2	1	1.00%	1	2	1	1.00%	$18,543	$29,178	10635	0.57%
171	Spartanburg	,	South Carolina	226,800	253,791	26,991	0.12%	71	114	43	0.61%	65	108	43	0.66%	$31,857	$45,349	13492	0.42%
172	Oktibbeha	,	Mississippi	38,375	42,902	4,527	0.12%	9	15	6	0.67%	9	15	6	0.67%	$27,336	$36,914	9578	0.35%

Rank 1990-2000	Dental Workforce Trends in Appalachian Counties		Population Count		Population Change		Active Dentists				Active Dentists Private Practitioners				Median Family Income			
			1990	2000	Numerical Change	Growth Rate 1990-2000	1991	2006	Numerical Change	Growth Rate 2006-1991	1991	2006	Numerical Change	Growth Rate 1991-2006	1989	1999	Numerical Change	Growth Rate 1989-1999
173	Marion	Tennessee	24,860	27,776	2,916	0.12%	1	4	3	3.00%	1	3	2	2.00%	$24,178	$36,351	12173	0.50%
174	Floyd	Georgia	81,251	90,565	9,314	0.11%	23	35	12	0.52%	21	33	12	0.57%	$30,998	$42,302	11304	0.36%
175	Washington	Virginia	45,887	51,103	5,216	0.11%	21	31	10	0.48%	17	27	10	0.59%	$25,843	$40,162	14319	0.55%
176	Alleghany	North Carolina	9,590	10,677	1,087	0.11%	1	1	0	0.00%	1	1	0	0.00%	$22,431	$38,473	16042	0.72%
177	Lawrence	Kentucky	13,998	15,569	1,571	0.11%	3	4	1	0.33%	3	4	1	0.33%	$18,123	$26,113	7990	0.44%
178	Graham	North Carolina	7,196	7,993	797	0.11%	0	0	0	0.00%	0	0	0		$19,654	$32,750	13096	0.67%
179	Patrick	Virginia	17,473	19,407	1,934	0.11%	2	4	2	1.00%	2	4	2	1.00%	$26,879	$36,232	9353	0.35%
180	Green	Kentucky	10,371	11,518	1,147	0.11%	2	4	2	1.00%	2	4	2	1.00%	$23,079	$31,852	8773	0.38%
181	Morgan	Alabama	100,043	111,064	11,021	0.11%	33	52	19	0.58%	31	52	21	0.68%	$32,912	$45,827	12915	0.39%
182	Cleburne	Alabama	12,730	14,123	1,393	0.11%	0	0	0	0.00%	0	0	0		$25,900	$35,579	9679	0.37%
183	Hale	Alabama	15,498	17,185	1,687	0.11%	0	3	3	0.00%	0	3	3		$18,272	$31,875	13603	0.74%
184	Russell	Kentucky	14,716	16,315	1,599	0.11%	4	8	4	1.00%	4	8	4	1.00%	$20,991	$27,803	6812	0.32%
185	Juniata	Pennsylvania	20,625	22,821	2,196	0.11%	2	3	1	0.50%	2	3	1	0.50%	$28,781	$39,757	10976	0.38%
186	Hocking	Ohio	25,533	28,241	2,708	0.11%	5	5	0	0.00%	5	5	0	0.00%	$26,715	$40,888	14173	0.53%
187	Rutherford	North Carolina	56,918	62,899	5,981	0.11%	12	17	5	0.42%	11	16	5	0.45%	$28,429	$37,787	9358	0.33%
188	Wilkes	North Carolina	59,393	65,632	6,239	0.11%	9	18	9	1.00%	9	15	6	0.67%	$26,476	$40,607	14131	0.53%
189	Carter	Kentucky	24,340	26,889	2,549	0.10%	2	7	5	2.50%	2	6	4	2.00%	$20,826	$31,278	10452	0.50%
190	Lawrence	Alabama	31,513	34,803	3,290	0.10%	1	1	0	0.00%	1	1	0	0.00%	$25,478	$38,565	13087	0.51%
191	Lauderdale	Alabama	79,661	87,966	8,305	0.10%	25	45	20	0.80%	24	45	21	0.88%	$29,589	$41,437	11848	0.40%
192	Coosa	Alabama	11,063	12,202	1,139	0.10%	0	1	1	0.00%	0	1	1		$23,472	$36,082	12610	0.54%
193	Clay	Tennessee	7,238	7,976	738	0.10%	2	2	0	0.00%	2	2	0	0.00%	$21,228	$29,784	8556	0.40%
194	Carter	Tennessee	51,505	56,742	5,237	0.10%	11	15	4	0.36%	11	14	3	0.27%	$22,520	$33,825	11305	0.50%
195	Grayson	Virginia	16,278	17,917	1,639	0.10%	3	4	1	0.33%	3	4	1	0.33%	$22,526	$35,076	12550	0.56%
196	Carroll	Virginia	26,594	29,245	2,651	0.10%	6	9	3	0.50%	6	9	3	0.50%	$24,885	$36,755	11870	0.48%
197	Roane	Tennessee	47,227	51,910	4,683	0.10%	12	19	7	0.58%	12	18	6	0.50%	$28,262	$41,399	13137	0.46%
198	Ashe	North Carolina	22,209	24,384	2,175	0.10%	4	5	1	0.25%	3	5	2	0.67%	$22,695	$36,052	13357	0.59%
199	Prentiss	Mississippi	23,278	25,556	2,278	0.10%	2	7	5	2.50%	2	7	5	2.50%	$21,976	$35,125	13149	0.60%
200	Centre	Pennsylvania	123,786	135,758	11,972	0.10%	45	79	34	0.76%	38	76	38	1.00%	$34,313	$50,557	16244	0.47%
201	Tuscaloosa	Alabama	150,522	164,875	14,353	0.10%	47	76	29	0.62%	40	70	30	0.75%	$30,135	$45,485	15350	0.51%
202	Caldwell	North Carolina	70,709	77,415	6,706	0.09%	12	20	8	0.67%	11	19	8	0.73%	$30,117	$41,665	11548	0.38%
203	McCreary	Kentucky	15,603	17,080	1,477	0.09%	2	3	1	0.50%	2	3	1	0.50%	$12,223	$22,261	10038	0.82%
204	Stephens	Georgia	23,257	25,435	2,178	0.09%	6	7	1	0.17%	6	7	1	0.17%	$27,768	$35,660	7892	0.28%
205	Alcorn	Mississippi	31,722	34,558	2,836	0.09%	15	22	7	0.47%	14	22	8	0.57%	$23,785	$36,899	13114	0.55%
206	Pickett	Tennessee	4,548	4,945	397	0.09%	0	0	0	0.00%	0	0	0		$18,379	$31,355	12976	0.71%
207	Carroll	Ohio	26,521	28,836	2,315	0.09%	6	7	1	0.17%	6	7	1	0.17%	$29,341	$41,114	11773	0.40%

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208	Casey	Kentucky	14,211	15,447	1,236	0.09%	0	1	1	0.00%	0	1	1		$18,176	$27,044	8868	0.49%
209	Mitchell	North Carolina	14,433	15,687	1,254	0.09%	5	8	3	0.60%	5	8	3	0.60%	$24,063	$36,367	12304	0.51%
210	Wolfe	Kentucky	6,503	7,065	562	0.09%	1	1	0	0.00%	1	1	0	0.00%	$12,469	$23,333	10864	0.87%
211	Rowan	Kentucky	20,353	22,094	1,741	0.09%	7	12	5	0.71%	6	12	6	1.00%	$19,432	$34,338	14906	0.77%
212	Yalobusha	Mississippi	12,033	13,051	1,018	0.08%	1	2	1	1.00%	1	2	1	1.00%	$20,948	$31,801	10853	0.52%
213	Monongalia	West Virginia	75,509	81,866	6,357	0.08%	61	115	54	0.89%	25	66	41	1.64%	$30,426	$43,628	13202	0.43%
214	Talladega	Alabama	74,107	80,321	6,214	0.08%	11	16	5	0.45%	10	16	6	0.60%	$25,225	$38,004	12779	0.51%
215	Wythe	Virginia	25,466	27,599	2,133	0.08%	6	8	2	0.33%	4	6	2	0.50%	$24,620	$40,188	15568	0.63%
216	Tishomingo	Mississippi	17,683	19,163	1,480	0.08%	3	4	1	0.33%	3	4	1	0.33%	$21,749	$34,378	12629	0.58%
217	Grant	West Virginia	10,428	11,299	871	0.08%	4	6	2	0.50%	4	6	2	0.50%	$25,327	$33,813	8486	0.34%
218	Elbert	Georgia	18,949	20,511	1,562	0.08%	3	6	3	1.00%	3	6	3	1.00%	$24,070	$34,276	10206	0.42%
219	Lewis	Kentucky	13,029	14,092	1,063	0.08%	2	3	1	0.50%	2	3	1	0.50%	$19,591	$26,109	6518	0.33%
220	Potter	Pennsylvania	16,717	18,080	1,363	0.08%	5	7	2	0.40%	4	7	3	0.75%	$25,448	$38,066	12618	0.50%
221	Tuscarawas	Ohio	84,090	90,914	6,824	0.08%	23	30	7	0.30%	23	30	7	0.30%	$29,303	$41,677	12374	0.42%
222	Perry	Ohio	31,557	34,078	2,521	0.08%	6	10	4	0.67%	5	8	3	0.60%	$24,985	$40,294	15309	0.61%
223	Jackson	Ohio	30,230	32,641	2,411	0.08%	4	8	4	1.00%	4	7	3	0.75%	$22,611	$36,022	13411	0.59%
224	Jackson	West Virginia	25,938	28,000	2,062	0.08%	8	10	2	0.25%	8	10	2	0.25%	$25,121	$38,021	12900	0.51%
225	Hamilton	Tennessee	285,536	307,896	22,360	0.08%	141	216	75	0.53%	132	206	74	0.56%	$32,185	$48,037	15852	0.49%
226	Adams	Ohio	25,371	27,330	1,959	0.08%	5	8	3	0.60%	5	7	2	0.40%	$21,226	$34,714	13488	0.64%
227	Whitley	Kentucky	33,326	35,865	2,539	0.08%	13	21	8	0.62%	12	21	9	0.75%	$18,021	$27,871	9850	0.55%
228	Choctaw	Mississippi	9,071	9,758	687	0.08%	1	3	2	2.00%	1	3	2	2.00%	$21,067	$31,095	10028	0.48%
229	Clay	Alabama	13,252	14,254	1,002	0.08%	2	2	0	0.00%	2	2	0	0.00%	$24,145	$34,033	9888	0.41%
230	Chickasaw	Mississippi	18,085	19,440	1,355	0.07%	3	4	1	0.33%	3	4	1	0.33%	$22,331	$33,819	11488	0.51%
231	Sullivan	Pennsylvania	6,104	6,556	452	0.07%	1	1	0	0.00%	1	0	-1	-1.0%	$25,316	$37,196	11880	0.47%
232	Grundy	Tennessee	13,362	14,332	970	0.07%	0	1	1	0.00%	0	1	1		$19,555	$27,691	8136	0.42%
233	Knox	Kentucky	29,676	31,795	2,119	0.07%	3	8	5	1.67%	3	8	5	1.67%	$15,412	$23,136	7724	0.50%
234	Tallapoosa	Alabama	38,826	41,475	2,649	0.07%	9	11	2	0.22%	9	10	1	0.11%	$27,247	$38,148	10901	0.40%
235	Clearfield	Pennsylvania	78,097	83,382	5,285	0.07%	16	28	12	0.75%	16	27	11	0.69%	$26,192	$38,004	11812	0.45%
236	Unicoi	Tennessee	16,549	17,667	1,118	0.07%	4	6	2	0.50%	3	4	1	0.33%	$26,283	$36,871	10588	0.40%
237	Robertson	Kentucky	2,124	2,266	142	0.07%	0	0	0	0.00%	0	0	0		$23,788	$35,521	11733	0.49%
238	Tippah	Mississippi	19,523	20,826	1,303	0.07%	4	6	2	0.50%	4	5	1	0.25%	$22,500	$34,547	12047	0.54%
239	Lee	Kentucky	7,422	7,916	494	0.07%	0	1	1	0.00%	0	1	1		$14,618	$24,918	10300	0.70%
240	Sullivan	Tennessee	143,596	153,048	9,452	0.07%	71	108	37	0.52%	65	105	40	0.62%	$30,167	$41,025	10858	0.36%
241	Colbert	Alabama	51,666	54,984	3,318	0.06%	14	20	6	0.43%	12	20	8	0.67%	$27,862	$39,294	11432	0.41%
242	Taylor	West Virginia	15,144	16,089	945	0.06%	2	4	2	1.00%	2	3	1	0.50%	$22,357	$32,222	9865	0.44%

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243	Perry	,	Pennsylvania	41,172	43,602	2,430	0.06%	7	9	2	0.29%	7	9	2	0.29%	$32,776	$47,997	15221	0.46%
244	Doddridge	,	West Virginia	6,994	7,403	409	0.06%	0	0	0	0.00%	0	0	0		$19,830	$30,502	10672	0.54%
245	Ross	,	Ohio	69,330	73,345	4,015	0.06%	23	33	10	0.43%	21	31	10	0.48%	$28,634	$43,241	14607	0.51%
246	Russell	,	Virginia	28,667	30,308	1,641	0.06%	2	3	1	0.50%	2	3	1	0.50%	$21,777	$31,491	9714	0.45%
247	Bland	,	Virginia	6,514	6,871	357	0.05%	3	5	2	0.67%	3	5	2	0.67%	$28,750	$35,765	7015	0.24%
248	Clinton	,	Kentucky	9,135	9,634	499	0.05%	2	2	0	0.00%	2	2	0	0.00%	$14,627	$25,919	11292	0.77%
249	Cumberland	,	Kentucky	6,784	7,147	363	0.05%	2	2	0	0.00%	2	2	0	0.00%	$16,084	$28,701	12617	0.78%
250	Bath	,	Virginia	4,799	5,048	249	0.05%	1	1	0	0.00%	1	0	-1	-1.0%	$29,282	$41,276	11994	0.41%
251	Morgan	,	Ohio	14,194	14,897	703	0.05%	2	2	0	0.00%	2	2	0	0.00%	$25,847	$34,973	9126	0.35%
252	Crawford	,	Pennsylvania	86,169	90,366	4,197	0.05%	29	37	8	0.28%	27	34	7	0.26%	$27,828	$40,755	12927	0.46%
253	Estill	,	Kentucky	14,614	15,307	693	0.05%	3	3	0	0.00%	3	3	0	0.00%	$19,223	$27,284	8061	0.42%
254	Walker	,	Georgia	58,340	61,053	2,713	0.05%	8	11	3	0.38%	8	9	1	0.13%	$28,250	$39,034	10784	0.38%
255	Marion	,	Alabama	29,830	31,214	1,384	0.05%	4	6	2	0.50%	4	6	2	0.50%	$22,394	$34,359	11965	0.53%
256	Susquehanna	,	Pennsylvania	40,380	42,238	1,858	0.05%	7	9	2	0.29%	6	8	2	0.33%	$29,025	$39,564	10539	0.36%
257	Elliott	,	Kentucky	6,455	6,748	293	0.05%	2	4	2	1.00%	2	3	1	0.50%	$17,134	$27,125	9991	0.58%
258	Guernsey	,	Ohio	39,024	40,792	1,768	0.05%	10	17	7	0.70%	10	16	6	0.60%	$25,225	$35,660	10435	0.41%
259	Anderson	,	Tennessee	68,250	71,330	3,080	0.05%	39	49	10	0.26%	36	47	11	0.31%	$31,690	$42,584	10894	0.34%
260	Walker	,	Alabama	67,670	70,713	3,043	0.04%	14	24	10	0.71%	14	24	10	0.71%	$25,322	$35,221	9899	0.39%
261	Athens	,	Ohio	59,549	62,223	2,674	0.04%	16	22	6	0.38%	16	20	4	0.25%	$25,702	$39,785	14083	0.55%
262	Bedford	,	Pennsylvania	47,919	49,984	2,065	0.04%	15	21	6	0.40%	13	20	7	0.54%	$25,355	$37,741	12386	0.49%
263	Clay	,	Mississippi	21,120	21,979	859	0.04%	4	4	0	0.00%	4	4	0	0.00%	$22,229	$35,461	13232	0.60%
264	Monroe	,	Mississippi	36,582	38,014	1,432	0.04%	8	10	2	0.25%	6	9	3	0.50%	$24,469	$36,749	12280	0.50%
265	Lowndes	,	Mississippi	59,308	61,586	2,278	0.04%	15	28	13	0.87%	14	28	14	1.00%	$27,932	$38,248	10316	0.37%
266	Winston	,	Mississippi	19,433	20,160	727	0.04%	3	6	3	1.00%	3	6	3	1.00%	$23,149	$33,602	10453	0.45%
267	Etowah	,	Alabama	99,840	103,459	3,619	0.04%	36	47	11	0.31%	31	45	14	0.45%	$27,071	$38,697	11626	0.43%
268	Columbiana	,	Ohio	108,276	112,075	3,799	0.04%	20	28	8	0.40%	18	26	8	0.44%	$27,666	$40,486	12820	0.46%
269	Clay	,	West Virginia	9,983	10,330	347	0.03%	1	2	1	1.00%	1	2	1	1.00%	$16,130	$27,137	11007	0.68%
270	Coshocton	,	Ohio	35,427	36,655	1,228	0.03%	5	8	3	0.60%	5	8	3	0.60%	$28,606	$41,676	13070	0.46%
271	Carbon	,	Pennsylvania	56,846	58,802	1,956	0.03%	23	29	6	0.26%	21	28	7	0.33%	$30,225	$42,118	11893	0.39%
272	Lincoln	,	West Virginia	21,382	22,108	726	0.03%	3	4	1	0.33%	3	4	1	0.33%	$16,868	$28,297	11429	0.68%
273	Huntingdon	,	Pennsylvania	44,164	45,586	1,422	0.03%	10	14	4	0.40%	10	13	3	0.30%	$27,807	$40,388	12581	0.45%
274	Raleigh	,	West Virginia	76,819	79,220	2,401	0.03%	16	38	22	1.38%	13	37	24	1.85%	$24,391	$35,315	10924	0.45%
275	Monroe	,	Kentucky	11,401	11,756	355	0.03%	3	6	3	1.00%	3	6	3	1.00%	$19,602	$27,112	7510	0.38%
276	Mason	,	West Virginia	25,178	25,957	779	0.03%	4	5	1	0.25%	4	4	0	0.00%	$24,125	$32,953	8828	0.37%
277	Muskingum	,	Ohio	82,068	84,585	2,517	0.03%	33	44	11	0.33%	30	44	14	0.47%	$29,480	$41,938	12458	0.42%

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278	Fulton	,	Pennsylvania	13,837	14,261	424	0.03%	2	3	1	0.50%	2	3	1	0.50%	$26,866	$40,341	13475	0.50%
279	Wayne	,	West Virginia	41,636	42,903	1,267	0.03%	8	9	1	0.13%	6	8	2	0.33%	$23,525	$32,458	8933	0.38%
280	Schuyler	,	New York	18,662	19,224	562	0.03%	3	6	3	1.00%	3	5	2	0.67%	$29,512	$41,441	11929	0.40%
281	Forest	,	Pennsylvania	4,802	4,946	144	0.03%	0	0	0	0.00%	0	0	0		$23,010	$34,257	11247	0.49%
282	Fayette	,	Alabama	17,962	18,495	533	0.03%	2	3	1	0.50%	2	3	1	0.50%	$26,002	$35,291	9289	0.36%
283	Bradford	,	Pennsylvania	60,967	62,761	1,794	0.03%	18	24	6	0.33%	16	23	7	0.44%	$27,914	$40,664	12750	0.46%
284	Ashtabula	,	Ohio	99,821	102,728	2,907	0.03%	22	36	14	0.64%	22	36	14	0.64%	$28,610	$42,449	13839	0.48%
285	Greene	,	Pennsylvania	39,550	40,672	1,122	0.03%	9	13	4	0.44%	8	10	2	0.25%	$25,284	$37,435	12151	0.48%
286	Montour	,	Pennsylvania	17,735	18,236	501	0.03%	6	7	1	0.17%	4	5	1	0.25%	$33,130	$45,224	12094	0.37%
287	Tompkins	,	New York	94,097	96,501	2,404	0.03%	37	56	19	0.51%	35	54	19	0.54%	$37,874	$53,041	15167	0.40%
288	Breathitt	,	Kentucky	15,703	16,100	397	0.03%	1	5	4	4.00%	1	5	4	4.00%	$14,908	$23,721	8813	0.59%
289	Galax city	,	Virginia	6,670	6,837	167	0.03%	4	5	1	0.25%	3	4	1	0.33%		$36,832	36832	
290	Snyder	,	Pennsylvania	36,680	37,546	866	0.02%	15	22	7	0.47%	14	20	6	0.43%	$30,302	$41,682	11380	0.38%
291	Upshur	,	West Virginia	22,867	23,404	537	0.02%	5	6	1	0.20%	5	6	1	0.20%	$22,267	$32,399	10132	0.46%
292	Somerset	,	Pennsylvania	78,218	80,023	1,805	0.02%	21	27	6	0.29%	19	27	8	0.42%	$25,549	$36,822	11273	0.44%
293	Fayette	,	Pennsylvania	145,351	148,644	3,293	0.02%	45	75	30	0.67%	44	71	27	0.61%	$23,578	$34,881	11303	0.48%
294	Smyth	,	Virginia	32,370	33,081	711	0.02%	10	14	4	0.40%	10	14	4	0.40%	$25,027	$36,392	11365	0.45%
295	Roane	,	West Virginia	15,120	15,446	326	0.02%	3	4	1	0.33%	3	3	0	0.00%	$17,898	$29,280	11382	0.64%
296	Clinton	,	Pennsylvania	37,182	37,914	732	0.02%	9	15	6	0.67%	9	14	5	0.56%	$26,575	$38,177	11602	0.44%
297	Magoffin	,	Kentucky	13,077	13,332	255	0.02%	2	5	3	1.50%	2	5	3	1.50%	$13,955	$24,031	10076	0.72%
298	Otsego	,	New York	60,517	61,676	1,159	0.02%	19	26	7	0.37%	16	21	5	0.31%	$30,466	$41,110	10644	0.35%
299	Erie	,	Pennsylvania	275,572	280,843	5,271	0.02%	133	176	43	0.32%	129	164	35	0.27%	$32,145	$44,829	12684	0.39%
300	Pulaski	,	Virginia	34,496	35,127	631	0.02%	8	9	1	0.13%	8	9	1	0.13%	$28,057	$42,251	14194	0.51%
301	Giles	,	Virginia	16,366	16,657	291	0.02%	5	5	0	0.00%	5	5	0	0.00%	$29,416	$42,089	12673	0.43%
302	Pendleton	,	West Virginia	8,054	8,196	142	0.02%	3	4	1	0.33%	3	4	1	0.33%	$22,500	$34,860	12360	0.55%
303	Delaware	,	New York	47,225	48,055	830	0.02%	10	15	5	0.50%	9	15	6	0.67%	$28,554	$39,695	11141	0.39%
304	Henry	,	Virginia	56,942	57,930	988	0.02%	13	15	2	0.15%	13	15	2	0.15%	$29,730	$38,649	8919	0.30%
305	Randolph	,	West Virginia	27,803	28,262	459	0.02%	6	12	6	1.00%	6	10	4	0.67%	$21,522	$32,632	11110	0.52%
306	Jefferson	,	Alabama	651,525	662,047	10,522	0.02%	289	561	272	0.94%	236	460	224	0.95%	$31,609	$45,951	14342	0.45%
307	Washington	,	Ohio	62,254	63,251	997	0.02%	12	22	10	0.83%	12	22	10	0.83%	$29,863	$41,605	11742	0.39%
308	Columbia	,	Pennsylvania	63,202	64,151	949	0.02%	20	29	9	0.45%	20	28	8	0.40%	$29,355	$41,398	12043	0.41%
309	Mineral	,	West Virginia	26,697	27,078	381	0.01%	7	10	3	0.43%	7	9	2	0.29%	$26,895	$37,866	10971	0.41%
310	Wise	,	Virginia	39,573	40,123	550	0.01%	5	7	2	0.40%	5	6	1	0.20%	$23,007	$32,898	9891	0.43%
311	Pocahontas	,	West Virginia	9,008	9,131	123	0.01%	2	2	0	0.00%	2	2	0	0.00%	$20,595	$32,511	11916	0.58%
312	Nicholas	,	Kentucky	6,725	6,813	88	0.01%	0	0	0	0.00%	0	0	0		$22,729	$35,491	12762	0.56%

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313	Wood	West Virginia	86,915	87,986	1,071	0.01%	25	44	19	0.76%	22	43	21	0.95%	$30,582	$40,436	9854	0.32%
314	Pickens	Alabama	20,699	20,949	250	0.01%	1	2	1	1.00%	1	2	1	1.00%	$22,474	$32,937	10463	0.47%
315	Lamar	Alabama	15,715	15,904	189	0.01%	1	3	2	2.00%	1	3	2	2.00%	$25,506	$33,050	7544	0.30%
316	Lycoming	Pennsylvania	118,710	120,044	1,334	0.01%	34	46	12	0.35%	34	43	9	0.26%	$30,461	$41,040	10579	0.35%
317	Calhoun	Mississippi	14,908	15,069	161	0.01%	2	2	0	0.00%	2	2	0	0.00%	$23,067	$34,407	11340	0.49%
318	Ritchie	West Virginia	10,233	10,343	110	0.01%	3	3	0	0.00%	3	3	0	0.00%	$20,584	$34,809	14225	0.69%
319	Cameron	Pennsylvania	5,913	5,974	61	0.01%	1	2	1	1.00%	1	2	1	1.00%	$24,006	$39,479	15473	0.64%
320	Preston	West Virginia	29,037	29,334	297	0.01%	3	6	3	1.00%	2	5	3	1.50%	$23,222	$32,904	9682	0.42%
321	Kemper	Mississippi	10,356	10,453	97	0.01%	1	1	0	0.00%	1	1	0	0.00%	$18,183	$30,248	12065	0.66%
322	Scott	Virginia	23,204	23,403	199	0.01%	1	2	1	1.00%	0	2	2		$22,497	$33,163	10666	0.47%
323	Johnson	Kentucky	23,248	23,445	197	0.01%	4	7	3	0.75%	3	7	4	1.33%	$19,114	$29,142	10028	0.52%
324	Lawrence	Ohio	61,834	62,319	485	0.01%	10	18	8	0.80%	9	17	8	0.89%	$23,603	$35,308	11705	0.50%
325	Webster	Mississippi	10,222	10,294	72	0.01%	3	3	0	0.00%	3	3	0	0.00%	$22,654	$34,969	12315	0.54%
326	Hancock	Tennessee	6,739	6,786	47	0.01%	0	1	1	0.00%	0	0	0		$14,745	$25,372	10627	0.72%
327	Elk	Pennsylvania	34,878	35,112	234	0.01%	8	12	4	0.50%	8	12	4	0.50%	$30,176	$46,402	16226	0.54%
328	Mifflin	Pennsylvania	46,197	46,486	289	0.01%	11	13	2	0.18%	11	11	0	0.00%	$27,502	$38,486	10984	0.40%
329	Tioga	Pennsylvania	41,126	41,373	247	0.01%	12	15	3	0.25%	11	15	4	0.36%	$26,564	$37,907	11343	0.43%
330	Martin	Kentucky	12,526	12,578	52	0.00%	1	2	1	1.00%	1	2	1	1.00%	$18,143	$21,574	3431	0.19%
331	Greenup	Kentucky	36,742	36,891	149	0.00%	12	14	2	0.17%	11	14	3	0.27%	$29,054	$38,928	9874	0.34%
332	Gallia	Ohio	30,954	31,069	115	0.00%	11	12	1	0.09%	11	11	0	0.00%	$25,077	$35,938	10861	0.43%
333	Meigs	Ohio	22,987	23,072	85	0.00%	3	3	0	0.00%	3	3	0	0.00%	$21,884	$33,071	11187	0.51%
334	Clarion	Pennsylvania	41,699	41,765	66	0.00%	6	13	7	1.17%	6	13	7	1.17%	$26,488	$37,964	11476	0.43%
335	Wyoming	Pennsylvania	28,076	28,080	4	0.00%	6	11	5	0.83%	5	9	4	0.80%	$31,441	$42,824	11383	0.36%
336	Cabell	West Virginia	96,827	96,784	-43	0.00%	40	56	16	0.40%	38	53	15	0.39%	$28,090	$37,691	9601	0.34%
337	Westmoreland	Pennsylvania	370,321	369,993	-328	0.00%	172	231	59	0.34%	164	226	62	0.38%	$31,360	$45,996	14636	0.47%
338	Benton	Mississippi	8,046	8,026	-20	0.00%	0	0	0	0.00%	0	0	0		$18,737	$29,907	11170	0.60%
339	Jefferson	Pennsylvania	46,083	45,932	-151	0.00%	20	23	3	0.15%	19	23	4	0.21%	$26,208	$37,364	11156	0.43%
340	Cattaraugus	New York	84,234	83,955	-279	0.00%	25	33	8	0.32%	24	30	6	0.25%	$28,178	$39,318	11140	0.40%
341	Steuben	New York	99,088	98,726	-362	0.00%	29	34	5	0.17%	25	32	7	0.28%	$30,213	$41,940	11727	0.39%
342	Pleasants	West Virginia	7,546	7,514	-32	0.00%	2	4	2	1.00%	2	4	2	1.00%	$26,110	$37,795	11685	0.45%
343	Indiana	Pennsylvania	89,994	89,605	-389	0.00%	32	39	7	0.22%	31	38	7	0.23%	$27,893	$38,386	10493	0.38%
344	Noxubee	Mississippi	12,604	12,548	-56	0.00%	2	3	1	0.50%	2	3	1	0.50%	$17,121	$27,312	10191	0.60%
345	Radford city	Virginia	15,940	15,859	-81	-0.01%	9	10	1	0.11%	7	10	3	0.43%		$46,332	46332	
346	Mercer	Pennsylvania	121,003	120,293	-710	-0.01%	41	55	14	0.34%	39	53	14	0.36%	$29,347	$41,776	12429	0.42%
347	Greenbrier	West Virginia	34,693	34,453	-240	-0.01%	14	18	4	0.29%	13	17	4	0.31%	$23,819	$33,292	9473	0.40%

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348	Chenango	New York	51,768	51,401	-367	-0.01%	10	15	5	0.50%	9	14	5	0.56%	$30,388	$39,711	9323	0.31%
349	Cortland	New York	48,963	48,599	-364	-0.01%	8	18	10	1.25%	8	17	9	1.13%	$32,517	$42,204	9687	0.30%
350	Fayette	West Virginia	47,952	47,579	-373	-0.01%	10	16	6	0.60%	10	15	5	0.50%	$20,848	$30,243	9395	0.45%
351	Chambers	Alabama	36,876	36,583	-293	-0.01%	5	8	3	0.60%	5	8	3	0.60%	$26,331	$36,598	10267	0.39%
352	Nicholas	West Virginia	26,775	26,562	-213	-0.01%	5	9	4	0.80%	5	9	4	0.80%	$21,390	$32,074	10684	0.50%
353	Washington	Pennsylvania	204,584	202,897	-1,687	-0.01%	78	119	41	0.53%	73	114	41	0.56%	$31,239	$47,287	16048	0.51%
354	Schoharie	New York	31,859	31,582	-277	-0.01%	4	7	3	0.75%	4	7	3	0.75%	$30,215	$43,118	12903	0.43%
355	Buena Vista city	Virginia	6,406	6,349	-57	-0.01%	1	3	2	2.00%	1	3	2	2.00%		$39,449	39449	
356	Barbour	West Virginia	15,699	15,557	-142	-0.01%	4	4	0	0.00%	4	4	0	0.00%	$19,106	$29,722	10616	0.56%
357	Harrison	West Virginia	69,371	68,652	-719	-0.01%	27	43	16	0.59%	25	39	14	0.56%	$25,245	$36,870	11625	0.46%
358	Tioga	New York	52,337	51,784	-553	-0.01%	5	8	3	0.60%	5	8	3	0.60%	$36,023	$46,509	10486	0.29%
359	Blair	Pennsylvania	130,542	129,144	-1,398	-0.01%	51	69	18	0.35%	48	66	18	0.38%	$28,367	$40,160	11793	0.42%
360	Allegany	New York	50,470	49,927	-543	-0.01%	7	11	4	0.57%	7	10	3	0.43%	$28,056	$38,580	10524	0.38%
361	Marion	West Virginia	57,249	56,598	-651	-0.01%	18	23	5	0.28%	17	22	5	0.29%	$25,963	$37,182	11219	0.43%
362	Trumbull	Ohio	227,813	225,116	-2,697	-0.01%	69	105	36	0.52%	69	104	35	0.51%	$33,313	$46,203	12890	0.39%
363	Belmont	Ohio	71,074	70,226	-848	-0.01%	23	29	6	0.26%	22	29	7	0.32%	$25,945	$37,538	11593	0.45%
364	Boone	West Virginia	25,870	25,535	-335	-0.01%	5	9	4	0.80%	5	9	4	0.80%	$21,221	$31,999	10778	0.51%
365	Lexington city	Virginia	6,959	6,867	-92	-0.01%	5	7	2	0.40%	5	7	2	0.40%		$58,529	58529	
366	Scioto	Ohio	80,327	79,195	-1,132	-0.01%	18	27	9	0.50%	16	26	10	0.63%	$21,848	$34,691	12843	0.59%
367	Harrison	Ohio	16,085	15,856	-229	-0.01%	1	2	1	1.00%	1	2	1	1.00%	$24,432	$36,646	12214	0.50%
368	Knott	Kentucky	17,906	17,649	-257	-0.01%	3	4	1	0.33%	3	4	1	0.33%	$15,998	$24,930	8932	0.56%
369	Schuylkill	Pennsylvania	152,585	150,336	-2,249	-0.01%	40	59	19	0.48%	38	54	16	0.42%	$29,041	$41,279	12238	0.42%
370	Armstrong	Pennsylvania	73,478	72,392	-1,086	-0.01%	23	27	4	0.17%	21	27	6	0.29%	$27,024	$38,271	11247	0.42%
371	Chautauqua	New York	141,895	139,750	-2,145	-0.02%	37	61	24	0.65%	34	58	24	0.71%	$29,926	$41,054	11128	0.37%
372	Montgomery	Mississippi	12,388	12,189	-199	-0.02%	2	3	1	0.50%	2	3	1	0.50%	$20,148	$31,602	11454	0.57%
373	Lawrence	Pennsylvania	96,246	94,643	-1,603	-0.02%	36	52	16	0.44%	34	51	17	0.50%	$27,490	$41,463	13973	0.51%
374	Lewis	West Virginia	17,223	16,919	-304	-0.02%	3	5	2	0.67%	3	5	2	0.67%	$22,273	$32,431	10158	0.46%
375	Monroe	Ohio	15,497	15,180	-317	-0.02%	2	2	0	0.00%	2	2	0	0.00%	$24,162	$36,297	12135	0.50%
376	Tyler	West Virginia	9,796	9,592	-204	-0.02%	1	2	1	1.00%	1	2	1	1.00%	$25,462	$35,320	9858	0.39%
377	Northumberland	Pennsylvania	96,771	94,556	-2,215	-0.02%	27	33	6	0.22%	27	32	5	0.19%	$27,669	$39,551	11882	0.43%
378	Beaver	Pennsylvania	186,093	181,412	-4,681	-0.03%	62	85	23	0.37%	59	82	23	0.39%	$29,455	$45,495	16040	0.54%
379	McKean	Pennsylvania	47,131	45,936	-1,195	-0.03%	15	18	3	0.20%	15	16	1	0.07%	$28,567	$40,924	12357	0.43%
380	Lackawanna	Pennsylvania	219,039	213,295	-5,744	-0.03%	106	161	55	0.52%	103	154	51	0.50%	$31,474	$44,949	13475	0.43%
381	Floyd	Kentucky	43,586	42,441	-1,145	-0.03%	15	24	9	0.60%	15	23	8	0.53%	$18,270	$25,717	7447	0.41%
382	Warren	Pennsylvania	45,050	43,863	-1,187	-0.03%	11	17	6	0.55%	11	17	6	0.55%	$31,092	$42,658	11566	0.37%

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383	Luzerne	Pennsylvania	328,149	319,250	-8,899	-0.03%	149	206	57	0.38%	134	195	61	0.46%	$30,349	$43,335	12986	0.43%
384	Boyd	Kentucky	51,150	49,752	-1,398	-0.03%	27	38	11	0.41%	25	34	9	0.36%	$30,241	$41,125	10884	0.36%
385	Mahoning	Ohio	264,806	257,555	-7,251	-0.03%	106	149	43	0.41%	100	142	42	0.42%	$29,657	$44,185	14528	0.49%
386	Perry	Kentucky	30,283	29,390	-893	-0.03%	5	16	11	2.20%	5	15	10	2.00%	$19,119	$26,718	7599	0.40%
387	Tazewell	Virginia	45,960	44,598	-1,362	-0.03%	14	18	4	0.29%	11	18	7	0.64%	$23,535	$33,732	10197	0.43%
388	Venango	Pennsylvania	59,381	57,565	-1,816	-0.03%	20	23	3	0.15%	20	23	3	0.15%	$27,161	$39,405	12244	0.45%
389	Mercer	West Virginia	64,980	62,980	-2,000	-0.03%	18	26	8	0.44%	18	25	7	0.39%	$24,020	$33,524	9504	0.40%
390	Calhoun	Alabama	116,034	112,249	-3,785	-0.03%	39	50	11	0.28%	34	48	14	0.41%	$28,340	$39,908	11568	0.41%
391	Macon	Alabama	24,928	24,105	-823	-0.03%	3	3	0	0.00%	3	3	0	0.00%	$20,096	$28,511	8415	0.42%
392	Owsley	Kentucky	5,036	4,858	-178	-0.04%	1	1	0	0.00%	1	1	0	0.00%	$11,110	$18,034	6924	0.62%
393	Kanawha	West Virginia	207,619	200,073	-7,546	-0.04%	86	132	46	0.53%	80	126	46	0.58%	$30,030	$42,568	12538	0.42%
394	Lee	Virginia	24,496	23,589	-907	-0.04%	3	5	2	0.67%	3	4	1	0.33%	$17,783	$28,525	10742	0.60%
395	Highland	Virginia	2,635	2,536	-99	-0.04%	0	0	0	0.00%	0	0	0		$25,714	$37,530	11816	0.46%
396	Calhoun	West Virginia	7,885	7,582	-303	-0.04%	1	1	0	0.00%	0	0	0		$17,671	$26,701	9030	0.51%
397	Allegheny	Pennsylvania	1,336,449	1,281,666	-54,783	-0.04%	774	1178	404	0.52%	696	1076	380	0.55%	$35,338	$49,815	14477	0.41%
398	Chemung	New York	95,195	91,070	-4,125	-0.04%	28	44	16	0.57%	25	40	15	0.60%	$32,014	$43,994	11980	0.37%
399	Bell	Kentucky	31,506	30,060	-1,446	-0.05%	9	11	2	0.22%	9	11	2	0.22%	$15,840	$23,818	7978	0.50%
400	Martinsville city	Virginia	16,162	15,416	-746	-0.05%	10	15	5	0.50%	10	15	5	0.50%		$35,321	35321	
401	Marshall	West Virginia	37,356	35,519	-1,837	-0.05%	7	10	3	0.43%	7	9	2	0.29%	$26,974	$39,053	12079	0.45%
402	Tucker	West Virginia	7,728	7,321	-407	-0.05%	1	4	3	3.00%	1	4	3	3.00%	$22,825	$32,574	9749	0.43%
403	Pike	Kentucky	72,583	68,736	-3,847	-0.05%	23	41	18	0.78%	21	39	18	0.86%	$20,656	$29,302	8646	0.42%
404	Broome	New York	212,160	200,536	-11,624	-0.05%	75	119	44	0.59%	72	112	40	0.56%	$35,824	$45,422	9598	0.27%
405	Brooke	West Virginia	26,992	25,447	-1,545	-0.06%	6	9	3	0.50%	6	9	3	0.50%	$31,407	$39,948	8541	0.27%
406	Bristol city	Virginia	18,426	17,367	-1,059	-0.06%	3	6	3	1.00%	3	6	3	1.00%		$34,266	34266	
407	Letcher	Kentucky	27,000	25,277	-1,723	-0.06%	3	7	4	1.33%	3	5	2	0.67%	$18,229	$24,869	6640	0.36%
408	Cambria	Pennsylvania	163,029	152,598	-10,431	-0.06%	53	76	23	0.43%	50	71	21	0.42%	$26,455	$37,797	11342	0.43%
409	Gilmer	West Virginia	7,669	7,160	-509	-0.07%	1	1	0	0.00%	1	1	0	0.00%	$16,994	$28,685	11691	0.69%
410	Ohio	West Virginia	50,871	47,427	-3,444	-0.07%	30	41	11	0.37%	30	38	8	0.27%	$30,037	$41,261	11224	0.37%
411	Dickenson	Virginia	17,620	16,395	-1,225	-0.07%	1	3	2	2.00%	1	2	1	1.00%	$19,498	$27,986	8488	0.44%
412	Hancock	West Virginia	35,233	32,667	-2,566	-0.07%	11	18	7	0.64%	10	17	7	0.70%	$30,576	$40,719	10143	0.33%
413	Jefferson	Ohio	80,298	73,894	-6,404	-0.08%	22	30	8	0.36%	21	28	7	0.33%	$27,839	$38,807	10968	0.39%
414	Norton city	Virginia	4,247	3,904	-343	-0.08%	1	2	1	1.00%	0	2	2			$30,889	30889	
415	Wetzel	West Virginia	19,258	17,693	-1,565	-0.08%	6	7	1	0.17%	6	7	1	0.17%	$28,122	$36,793	8671	0.31%
416	Summers	West Virginia	14,204	12,999	-1,205	-0.08%	1	2	1	1.00%	1	2	1	1.00%	$20,076	$27,251	7175	0.36%
417	Leslie	Kentucky	13,642	12,401	-1,241	-0.09%	2	2	0	0.00%	2	2	0	0.00%	$16,419	$22,225	5806	0.35%

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418	Harlan	,	Kentucky	36,574	33,202	-3,372	-0.09%	4	8	4	1.00%	4	7	3	0.75%	$18,158	$23,536	5378	0.30%
419	Webster	,	West Virginia	10,729	9,719	-1,010	-0.09%	1	1	0	0.00%	1	1	0	0.00%	$15,489	$25,049	9560	0.62%
420	Covington city	,	Virginia	6,991	6,303	-688	-0.10%	3	4	1	0.33%	3	4	1	0.33%		$36,640	36640	
421	Wyoming	,	West Virginia	28,990	25,708	-3,282	-0.11%	4	6	2	0.50%	4	6	2	0.50%	$20,730	$29,709	8979	0.43%
422	Logan	,	West Virginia	43,032	37,710	-5,322	-0.12%	2	4	2	1.00%	2	3	1	0.50%	$21,100	$29,072	7972	0.38%
423	Buchanan	,	Virginia	31,333	26,978	-4,355	-0.14%	3	4	1	0.33%	3	4	1	0.33%	$22,464	$27,328	4864	0.22%
424	Mingo	,	West Virginia	33,739	28,253	-5,486	-0.16%	3	4	1	0.33%	3	4	1	0.33%	$19,643	$26,581	6938	0.35%
425	McDowell	,	West Virginia	35,233	27,329	-7,904	-0.22%	2	3	1	0.50%	2	2	0	0.00%	$15,756	$20,496	4740	0.30%
	Allegany	,	Maryland	0	74,930	74,930		29	43	14	0.48%	25	42	17	0.68%	$27,069	$39,886	12817	0.47%
	Garrett	,	Maryland	0	29,846	29,846		9	11	2	0.22%	8	11	3	0.38%	$26,365	$37,811	11446	0.43%
	Washington	,	Maryland	0	131,923	131,923		39	64	25	0.64%	36	63	27	0.75%	$34,614	$48,962	14348	0.41%