Acknowledgements

Special thanks to:
The Minnesota Oral Health Data Advisory Group (MOHSAG):
Sally Bushouse, Ph.D. Director, Minnesota Cancer Surveillance System (MCSS) at Minnesota Department of Health; Erik Zabel, Ph.D, M.P.H. Birth Defect Information System (BDIS) Environmental Impacts Analysis Unit, Minnesota department of Health; Nagi Salem, Ph.D. Director, Behavioral Risk Factor Surveillance System (BRFSS), Minnesota Department of Health; David Rindal, P.E. Senior Engineer, Division of Environmental Health, Water Fluoridation Reporting System (WFRS), Minnesota Department of Health; Jill Myers, Supervisor, Planning and Analysis, Health Workforce Database, Office of Rural Health and Primary Care (ORHPC), Minnesota Department of Health; Judy Punyko, Ph.D., M.S., PRAMS Principal Investigator Pregnancy Risk Assessment Monitoring System (PRAMS), Minnesota Department of Health; Mary Morales, Dental Policy, Minnesota Department of Human Services; Pete Rode, Ph.D. Center for Health Statistics, Minnesota Student Survey (MSS), Minnesota Department of Health.

CDC reviewers
Cassandra Martin
Minnesota Department of Health Oral Health Program staff

Authors
Ayo Adeniyi
Bilquis Khan (your credentials)
Merry Jo Thoele, MPH, RDH
Anyone else?

Funding sources:
CDC Division of Oral Health cooperative agreement funding, DP08-802.
Health Resources and Services Administration grants to states to support oral health workforce activities, T12HP14659,

For more information contact:

Minnesota Department of Health, Oral Health Program.
EXECUTIVE SUMMARY ................................................................................................................................. 4
CHAPTER 1: INTRODUCTION AND BACKGROUND ......................................................................................... 8
  Purpose, Use and Target Audience of Burden Document ............................................................................ 9
CHAPTER 2: STATE DEMOGRAPHICS ............................................................................................................... 10
  Overview of the State .................................................................................................................................. 10
  Overall Population, Growth and Diversity ............................................................................................... 10
  Socio-economic Status ............................................................................................................................... 11
CHAPTER 3: NATIONAL AND STATE OBJECTIVES FOR ORAL HEALTH ...................................................... 12
  United States Surgeon General and the Institute of Medicine Reports ..................................................... 12
  Overview of Health People 2010/2020 ....................................................................................................... 13
CHAPTER 4: THE BURDEN OF ORAL DISEASE ................................................................................................ 14
  Dental Caries Experience in Children ....................................................................................................... 14
  Dental Caries Experience in Adolescent ................................................................................................... 16
  Untreated Tooth Decay (caries) in Children ............................................................................................... 16
  Untreated Tooth Decay (caries) in adults ................................................................................................... 17
  Periodontal disease: Gingivitis and Periodontitis ..................................................................................... 17
  Tooth Loss in adults .................................................................................................................................. 18
  Oral Health Disparity in Adults ................................................................................................................ 19
  Oral Health Disparity in Children ............................................................................................................ 21
  Birth Defects ........................................................................................................................................... 21
  Oral Cavity and Pharyngeal Cancers (OCPC) .......................................................................................... 22
  Disparity .................................................................................................................................................... 26
  Dental Hospital Visits ............................................................................................................................... 27
  Hospital-treated oro-dental conditions ..................................................................................................... 27
  Economic Impact ...................................................................................................................................... 29
  Oral Diseases and Other Health Conditions .......................................................................................... 30
  Oral health and diabetes ............................................................................................................................ 30
  Oral disease in pregnancy .......................................................................................................................... 30
  Oral health and Osteoporosis .................................................................................................................... 31
  Oral health and cardiovascular disease .................................................................................................... 31
CHAPTER 5: PROTECTIVE FACTORS AFFECTING ORAL DISEASE ............................................................... 31
  Community Water Fluoridation ................................................................................................................ 31
  Dental Sealant Programs ........................................................................................................................... 32
  Fluoride Varnish ...................................................................................................................................... 34
CHAPTER 6: RISK FACTORS AFFECTING ORAL DISEASE ............................................................................. 35
  Tobacco Use ............................................................................................................................................. 35
  Beverage Use ........................................................................................................................................... 35
CHAPTER 7: ACCESS TO ORAL HEALTH CARE ............................................................................................. 37
  Dental Professional Shortage Designation ............................................................................................... 37
  Dental Workforce Capacity ....................................................................................................................... 37
  Dentist....................................................................................................................................................... 38
  Pediatric Dentistry .................................................................................................................................... 38
  Dental Hygienist....................................................................................................................................... 38
  Dental Assistants ...................................................................................................................................... 39
  Enhancing Workforce Models and Creating New Providers ................................................................... 39
  Oral Health Financing ............................................................................................................................... 40
CHAPTER 8: CONCLUSION ............................................................................................................................... 42
  Appendix A: Acronyms ............................................................................................................................. 43
  Appendix B: Definition .............................................................................................................................. 45
  Appendix C: Basic Screening Survey (BSS) for Children in Third Grade .............................................. 49
  Appendix E: Maps ..................................................................................................................................... 51
  D1: Rural dental health professional shortage areas in Minnesota .......................................................... 51
  E2: Urban dental health professional shortage area .................................................................................. 52
REFERENCES ............................................................................................................................................... 54
EXECUTIVE SUMMARY

Oral health is integral to overall health. The mouth not only reveals signs of poor nutrition and diseases such as infections, immune disorders, injuries, and certain cancers, but research has shown associations between chronic oral infections and heart and lung diseases, stroke, low-birth-weight, premature births, as well as diabetes. Among the top risk factors for oral disease are high-sugar beverages and foods, which also contribute to obesity, along with tobacco and alcohol. There are several ways in which people suffer from pain and discomfort because of poor oral health: tooth decay; oral and craniofacial diseases; gum disease; cleft lip and palate; oral and facial pain syndromes; traumatic injury; and oral and pharyngeal (mouth and throat) cancers. Tragically, untreated oral disease can also lead to death. Yet many of these conditions and diseases are preventable.

In 2000, Surgeon General David Satcher released *Oral Health in America: A Report of the Surgeon General.* The report found a low awareness of oral health among the public, a significant disparity between racial and socioeconomic groups in regard to oral health, and ensuing overall health issues. Since then several steps have been taken to promote access to oral health care for all, especially the disadvantaged, minority and at risk children.

In April 2009, Institute of Medicine (IOM) through their publication ‘*Advancing Oral Health in America: Publication of the Committee on an Oral Health Initiative*’ recognized that factors such as settings of care, workforce, financing, quality assessment, access, education and stakeholders in private and public sector, influence oral health and entire health care system. To provide a foundation for sustainability and to set measureable goals and objectives for the initiative, benchmarks were set in the form of *Healthy People 2020* indicators.

While Minnesotans in general enjoy a high level of oral health, there is room for improvement, especially among underserved populations who bear the brunt of oral diseases. Significant disparities exist for low-income children and adults, people of color, and the elderly, all of whom disproportionally suffer from oral diseases due to inadequate access to affordable dental care. The vision of optimal oral health for all Minnesotans has been the driving force in strengthening the state’s oral health infrastructure to better respond to the oral health needs of the people.

The ‘burden of disease’ report presents the updated information on oral disease morbidity and mortality (oral and pharyngeal cancer) and identifies risk factors and high risk groups. Furthermore, the report describes preventive strategies such as dental sealants and community water fluoridation, offers insight into dental care access and workforce supply and distribution. Comparisons of state and national data are made along with *Healthy People 2020* objectives for the available data.

Even though dental caries (tooth decay) is nearly 100 percent preventable, it is the most common chronic childhood disease and is five times more common than asthma. According to
Minnesota Basic Screening Survey (BSS) 2010, 55% of third graders experienced dental decay compared to 53% of children 6 to 8 years in the nation (NHANES 1999-2004). The survey also found 18% third graders with untreated cavities compared to 29% in the nation (NHANES 1999-2004). Low-income and children of color bear the greatest burden of oral diseases and conditions when compared to their more affluent and white peers. BSS showed that caries experience and untreated caries rise as income declines: the poorest children (>75% Free and Reduced Lunch) were almost twice as likely to experience tooth decay and almost three times more likely to have their tooth decay go untreated than students in more affluent schools. And, children of color were 12 percent more likely to experience caries and 7 percent more likely to have untreated caries when compared to white children.

Tooth decay and gum disease, which are the most common oral diseases affect both health and productivity in adults. Nationally, 164 million hours of work are lost annually due to dental problems. The poorest Minnesota adults with income $15,000 or less per year, were three times less likely to visit a dentist in the past year than adults making $50,000 or more. Among the elderly, a person without a high school degree was 10 times more likely to have all their teeth extracted than someone with a college degree. Between 2004 and 2010, older Minnesotans who had any permanent teeth extracted declined slightly from 36 to 33 percent as national trends remained stagnant at 44 percent. While these downward trends are encouraging, with no Medicare dental benefits, older adults on fixed incomes are less likely to seek oral health care, compromising their quality of life and health.

To provide health and dental coverage to low-income children and vulnerable adults, federal and state governments sponsor programs such as Early Periodic Screening, Diagnosis, and Treatment (EPSDT) for population under 21 years of age through Centers for Medicare and Medicaid Services (CMS). According to CMS, in 2009, the national dental services expenditure was $102.2 billion with 42 percent of that amount spent on out-of-pocket payments. This gap in dental benefits coverage often discourages low-income adults and families from seeking dental care in the first place, which points to the need for more affordable treatment options.

Despite these resources, dental services continue to be under used by low-income children. In FFY2011, of the 453,502 eligible EPSDT children in Minnesota, the vast majority (59 percent) did not receive dental services. In Minnesota, there was a 6 percent increase in those 21 years and younger eligible for Medicaid from FFY2010 to FFY2011; this number will increase once the Affordable Care Act is fully enacted by 2014.

The need for more accessible and affordable dental care has led people to seek care in emergency departments and hospitals, resulting in exorbitant health care costs that could be prevented. From 2008 to 2010 in Minnesota, the cost for hospital-treated “non-traumatic” conditions that could have been treated by a dentist rose by 9 percent with the cost totaling an astounding $148 million.
### HIGHLIGHTS
#### Minnesota Oral Health

#### Children
- 55% of 3rd graders experienced dental decay (caries experience) (2010)
- 18% of 3rd graders have untreated cavities (2010)
- Children of color are 12% more likely to experience caries and 7% more likely to have untreated caries as compared to white children (2010)
- Minnesota’s 64% school sealant rate far exceeds the national average of 32% (2010)
- 59% children with Medicaid coverage did not receive any dental services by or under the supervision of a dentist during FFY2011.
- 403 cases out of 361,109 births or 1 in 1,000 births had an orofacial defect such as clefting (2005-2009)

#### Adults and the Elderly
- 79% of adults 18 years and older reported visiting a dentist or dental clinic within the past year (2010)
- The poorest adults (<$15K) were 3 times less likely than their most affluent peers ($50K+) to visit a dentist in the past year (2010)
- Natural teeth extractions fell by 50% for older adults as compared to the national 36% drop in rate (1999-2010)
- An older person without a high school degree was 10 times (nationally and 7 times locally) more likely to have all their teeth extracted than one with a college degree (1999-2010)

#### Cancer of the Oral Cavity and Pharynx
- Minnesota incidence rate is 11.2/100,000 population for oral and pharyngeal cancers compared to 10.9/100,000 nationally (2004-2008)
- Minnesota mortality rate for oral and pharyngeal cancers is 2.0/100,000 population compared to 2.5/100,000 nationally (2004-2008)
- Oral and pharyngeal cancer is highest (23%) among Minnesota’s American Indian men living on or near Indian reservations (2004 and 2008)

#### Community Water Fluoridation
- 78% of Minnesotans receive fluoridated water compared to 64% of people across the nation (2010)
- Almost all Minnesotans have access to fluoridated water through the public water system (2010)

#### Dental Workforce
- 47% of dentists are 55 years or older (2009-2010)
- Of the 3,908 dentists who renewed their Minnesota license, only 26% were practicing in rural areas (2010)
- Just over half (53%) of practicing dentists submitted at least one dental claim for patients on public programs to the Minnesota Department of Human Services (2010)
- In 2009, Minnesota signed into law two new types of “mid-level” dental providers: dental therapist and advanced dental therapist
- Only 7% of dentists and 6% of hygienists work with a “collaborative agreement” (2009-2010)
- Only 23% of dentists are female (2010)
- Only 6% of dentists are people of color (African American, Native American, Asian or multiracial); 2% are Hispanic (2010)

---

In Minnesota, four times more people sought treatment for non-traumatic oral emergencies at hospitals as compared to those seeking treatment for traumatic conditions. From 2007 to 2010, just over a third (37 percent) of patients visiting emergency departments with traumatic
conditions were from rural communities – even though these areas are more sparsely populated – which may be due to the lack of enough dentists in rural locations. Significantly, people who sought treatment from a hospital for non-traumatic oral emergencies were four times more likely to be admitted to the hospital than those seeking treatment for oral trauma conditions. This may be attributable to dental conditions that could have been treated by a dentist early on having evolved into more complicated and costly ailments that needed hospitalization. In turn, when charges like this are not paid by uninsured or under-insured patients, the burden falls to the hospital or health care organization which in turn may pass the cost on to insured patients through higher health care charges.
Chapter 1: Introduction and Background

According to the first *Surgeon General's Report on Oral Health* in 2000, the health of the mouth and surrounding craniofacial (skull and face) structures is central to a person’s overall health and well-being\(^3\),\(^4\). Over the past 50 years, significant improvement in the oral health of Americans is a public health success story. Most of the gains are a result of effective disease prevention and treatment efforts. Community water fluoridation is one of the major successes of the twentieth century and seven out of ten Americans enjoy the benefit of receiving fluoridated water through public water systems.

There are several ways in which oral health can be compromised. Oral and craniofacial diseases and conditions include dental caries (tooth decay), periodontal (gum) diseases, cleft lip and palate, oral and facial pain, traumatic lesions, and oral and pharyngeal (mouth and throat) cancers. In Minnesota, although a large portion of the population enjoys a high level of oral health, there are segments of the population that bear an uneven burden of oral disease. Studies show that access to adequate health care, and dental care in particular, is affected by education level, income, race, and ethnicity.

To address the pressing oral health issues in the state, the Minnesota Department of Health (MDH) received funding from the Centers for Disease Control and Prevention and the Health Services and Resources Administration to develop the Minnesota Oral Health Program (OHP). The program, beginning in 2008, has made tremendous progress by developing the first *State Oral Health Plan*, a blueprint for reducing the prevalence of oral disease. The OHP also conducted the first open-mouth screening (Basic Screening Survey) of Minnesota third grade children, developed communications via the oral health website, enhanced collaborations with programs and departments including the Chronic Disease and Health Promotion Division, Center for Health Promotion, Drinking Water Protection, maternal and child health, tobacco control, Minnesota Obesity Project, the Department of Education, and increased activities with policy and compliance.

In addition, and to promote oral health and improve the dental care delivery system for underserved populations, Minnesota Governor Tim Pawlenty signed a bill into law in 2009 creating new dental professionals (called dental therapists and advanced dental therapists) to be incorporated into the current dental workforce. These new providers will work under direct/indirect supervision of a dentist through a mechanism known as a collaborative management agreement. This initiative has made Minnesota the first state after Alaska to work with this new type of dental workforce to reduce oral health disparities.

Other progress in the state was measured by the Pew Center on the State’s *State of Children Dental Health* report, which gave Minnesota an ‘A’ in 2011 for meeting 6 out of 8 national benchmarks for policy approaches, an upgrade from a ‘C’ given in 2010. The jump in the state’s letter grade is attributable to the following benchmarks:
• share of Medicaid-enrolled children getting dental care (national status 38.1 percent and state’s status 42.1 percent)
• tracking data on children’s dental health (first Basic Screening Survey data submitted)£

Purpose, Use and Target Audience of Burden Document

The Burden of Disease document is written for oral disease prevention/oral health promotion stakeholders committed to recognizing oral health as integral to overall health, improving oral health, enhancing healthy behavior, preventing and reducing the burden of oral disease and reducing disparities related to oral health.

The aims of this document are to raise awareness of the need to monitor oral health burden in Minnesota and to guide efforts to prevent, minimize risk and treat oral diseases and enhance the quality of life of Minnesotans.

Data comparisons on national, state and ‘Health People 2020’ objectives are being made on several indicators depending on the availability of the information.
Chapter 2: State Demographics

Overview of the State

Geographically, Minnesota is located in the north central United States. In the North, it borders Canadian provinces of Manitoba and Ontario, in the west, borders North Dakota and South Dakota, in the south borders Iowa, and in the east Wisconsin and Lake Superior.

Minnesota ranks 12th in the nation in land area. It is the fourth healthiest state after Vermont, New Hampshire and Massachusetts.6 The residents have low rates of premature death, infant mortality, cardiovascular disease, and occupational fatalities, higher life expectancies, and a high rate of health insurance.

Overall Population, Growth and Diversity

The large majority of residents are white (Scandinavian and German descent). Ethnic diversity (African, Asian, and Latin American) has increased in recent years, which is shown in Table 1.

Table 1: Minnesota State Population by Race and Hispanic Ethnicity, 2010

<table>
<thead>
<tr>
<th>Racial groupings</th>
<th>2010 Census</th>
<th>% of population</th>
<th>Change 2000-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>4,524,062</td>
<td>85.3</td>
<td>+ 2.8</td>
</tr>
<tr>
<td>Blacks, African American</td>
<td>274,412</td>
<td>5.2</td>
<td>+ 58.9</td>
</tr>
<tr>
<td>American Indian Alaskan Native</td>
<td>60,916</td>
<td>1.1</td>
<td>+ 10.8</td>
</tr>
<tr>
<td>Asian</td>
<td>214,234</td>
<td>4.0</td>
<td>+ 50.9</td>
</tr>
<tr>
<td>Native Hawaiian/Other Pacific Islander</td>
<td>2,156</td>
<td>0.04</td>
<td>+ 8.9</td>
</tr>
<tr>
<td>Other race</td>
<td>103,000</td>
<td>1.9</td>
<td>+ 56.5</td>
</tr>
<tr>
<td>Two or more races</td>
<td>125,145</td>
<td>2.4</td>
<td>+ 51.2</td>
</tr>
<tr>
<td>Ethnic Origin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino origin (may be of any race)</td>
<td>250,258</td>
<td>4.7</td>
<td>+ 74.5</td>
</tr>
<tr>
<td>Non-Hispanic or Latino</td>
<td>5,053,667</td>
<td>95.3</td>
<td>+ 5.8</td>
</tr>
<tr>
<td>Total</td>
<td>5,303,925</td>
<td></td>
<td>+ 7.8</td>
</tr>
</tbody>
</table>
Socio-economic Status

Public health professionals and policy makers have started to realize that complex, integrated and overlapping social structures and economic systems are responsible for health disparities. In many cases it has been observed and recorded that health outcomes improve as a result of improved socioeconomic status. According to the CDC, socioeconomic gradients in health can be measured through a person’s income, occupation or the highest level of education.\(^8\)

Research has also shown a strong correlation between health outcomes and education. According to 2010 U.S. Census data, 41 percent of Minnesota’s population age 25 years and older attained an associate degree or higher as compared to 36 percent of adults having an associate degree or higher nationally. During the same year, the high school graduation rate in the state (91.3 percent) was higher than the national rate (87.1 percent).[add citation]

According to the census bureau report issued in September 2011, the official poverty rate in the country in 2010 was 15.1 percent (46.2 million people) compared to 4.3% (43.6 million) in 2009. [Missing citation] In Minnesota, 10.8 percent of the population live in poverty (about 544,000 people), which puts Minnesota 13\(^{th}\) in the nation in number of those living below the poverty line ($11,344 for an individual or $22,113 household income for a family of four). National per capita income for 2009 was $50,221 whereas for the state it was $55,621. According to the Bureau of Labor Statistics Current Population Survey, the unemployment rate for Minnesota in November 2011 was 5.9% compared to 8.7% unemployment nationwide\(^9\).
Chapter 3: National and State Objectives for Oral Health

United States Surgeon General and the Institute of Medicine Reports

On May 25, 2000, Surgeon General David Satcher released *Oral Health in America: A Report of the Surgeon General*. Since 2000, this report has framed the science on vital health issues in a way that has helped educate, motivate and mobilize the public to more effectively deal with oral health related issues. The report found a low awareness of oral health among the public, a significant disparity between racial and socioeconomic groups in regard to oral health, and ensuing overall health issues. Based upon these findings, the Surgeon General called for action to promote access to oral health care for all Americans, especially the disadvantaged and minority children found to be at greatest risk for severe medical complications resulting from minimal oral care and treatment.

In 2009, the Health Resources and Services Administration (HRSA) approached the Institute of Medicine (IOM) to provide recommendations for a potential oral health initiative. The committee, organized by IOM recognized that factors such as settings of care, workforce, financing, quality assessment, access, education and stakeholders in private and public sector influence oral health and its care system. The committee used oral health in its most comprehensive sense—as the responsibility of the entire health care system.

The recommendations on an oral health initiative for Health and Human Services (HHS) were published in April 2011 titled *Advancing Oral Health in America: Publication of the Committee on an Oral Health Initiative* with the following organizing principles:

1. Establish high-level accountability.
2. Emphasize disease prevention and oral health promotion.
3. Improve oral health literacy and cultural competence.
4. Reduce oral health disparities.
5. Explore new models for payment and delivery of care.
6. Enhance the role of non-dental health care professionals.
7. Expand oral health research, and improve data collection.
8. Promote collaboration among private and public stakeholders.
9. Measure progress toward short-term and long-term goals and objectives.
10. Advance the goals and objectives of Healthy People 2020.

To give the initiative a foundation for sustainability and to set measureable goals and objectives for the initiative the committee advised HHS to use well-accepted set of benchmarks developed through strong collaboration of multiple partners in the form of *Healthy People 2020*.

About the same time (fall of 2009), with support from HRSA and the California HealthCare Foundation, the National Research Council (NRC), IOM formed the Committee on oral health access to services to assess the current oral health care system and to focus on the delivery of
oral health care to vulnerable and underserved populations. After reviewing the evidence, overall conclusions of the committee were:

1. Improving access to oral health care is a critical and necessary first step to improving oral health outcomes and reducing disparities.
2. The continued separation of oral health care from overall health care contributes to limited access to oral health care for many Americans.
3. Sources of financing for oral health care for vulnerable and underserved populations are limited and tenuous.
4. Improving access to oral health care will necessarily require multiple solutions that use an array of providers in a variety of settings. [Add citation]

Overview of Health People 2010/2020
Healthy People 2020 (HP2020) is a continuation of Healthy People 2010, a ten year evidence-based strategy to improve the nation’s health through monitoring progress and a set of benchmarks. The process guides health professionals to make informed health decisions, and measure impact of prevention activities by encouraging collaborations across sectors. A consortium of more than 2,000 organizations including public health and prevention experts, federal, state and local government officials and public have been involved in developing these objectives and indicators. The Leading Health Indicators (LHI) are composed of 26 indicators organized under 12 topics including access to health services, clinical preventive services, environmental quality, injury and violence, maternal, infant, and child health, mental health, nutrition, physical activity, and obesity, oral health, reproductive and sexual health, social determinants, substance abuse and tobacco. This is the first time that oral health has been included as one of the 26 leading health indicators. The indicator is: persons aged 2 years and older who have used the oral health care system in the past 12 months (OH-7). There are 17 oral health HP2020 objectives covering children and adolescents, adults, preventive services, oral health interventions, monitoring and surveillance systems and public health infrastructure.
Chapter 4: The Burden of Oral Disease

Generally, the term “Oral” refers to the mouth and associated structures which include not only the teeth and the gums (gingiva) and their supporting connective tissues, ligaments, and bone, but also hard and soft palate, soft mucosal tissue lining of the mouth and throat, tongue, lips, salivary glands, chewing muscles, and upper and lower jaws, which are connected to the skull by the temporomandibular joints. Equally important are the branches of the nervous, immune, and vascular systems that animate, protect, and nourish the oral tissues, as well as provide the connections to the brain and the rest of the body. The genetic development pattern in utero also reveals the relationship of oral tissues to brain development and to the tissues of head and face that surround the mouth.

Hence, when the words oral health are used it means being free of chronic oral-facial pain conditions, oral and pharyngeal (throat) cancers, oral soft tissue lesions, birth defects such as cleft lip and palate, and scores of other diseases and disorders that affect the oral, dental, and craniofacial tissues, collectively called the craniofacial complex. These tissues allow us to speak, smile, smell, touch, taste, chew, swallow, cry out and make facial expressions.

Dental Caries Experience in Children

Dental caries is a disease in which acids produced by the action of bacteria on the teeth lead to loss of minerals from the enamel and dentin. Severe caries can affect children’s quality of life: they experience pain, discomfort, disfigurement, acute and chronic infections, local and systemic infections, disruption in eating and sleeping, higher risk of hospitalization, high treatment costs and loss of school days with the consequently diminished ability to learn. According to a study published in the American Journal of Public Health, dental visits or dental problems account for 117,000 hours of school lost per 100,000 children.\(^{14}\)

If unchecked, caries can result in destruction of tooth structure, inadequate tooth function, unsightly appearance, pain, infection, and ultimately tooth loss. It also affects nutrition, growth and weight gain. According to the CDC, dental caries/tooth decay, though preventable, remains the most common chronic disease of children ages 6 to 19. It is four times more common than asthma among ages 14 to 17 years. Nationally, treating caries costs an estimated $3,513 per 1,000 children and would exceed the total health budget of most low-income countries.\(^{15}\)

Early Childhood Caries (ECC), formerly known as nursing bottle caries or “baby bottle” tooth decay occurs in children age birth to 71 months of age. A study found that children under three years of age with ECC weighed a kilogram less than children in a control group\(^{16}\) because toothache and infection can alter eating and sleeping habits, dietary intake and metabolic processes. Early Childhood Caries is defined as the presence of one or more decayed surfaces (non-cavitated or cavitated lesions), missing teeth (due to caries) or filled tooth surfaces in any primary tooth\(^{17}\).
Typical culprits in the development of ECC include a group of bacteria called streptococcus mutans\textsuperscript{18} (other cariogenic pathogens identified include Scardoviawiggsiae, Veillonellaparvula, Streptococcus cristatus and Actinomycesgerensceriae\textsuperscript{19}), lack of parental education about the oral health needs of the child, inappropriate use of baby bottles and/or sipper cups. Inappropriate use includes bottle feeding with juice or soda, or providing a bottle for overnight use that contains any sugary beverage, including milk. The interaction between these agents can lead to ECC. According to National Health and Nutrition Examination Surveys (NHANES) prevalence of ECC among US children 2 to 4 years was 18.5% (1988-1994) and 23.7% (1999-2004).\textsuperscript{20}

Cariogenic (cavity causing) bacteria such as Streptococcus Mutans can be acquired through vertical transmission from caregiver to child (via saliva pool), or horizontal transmission, either between members of a family or group such as daycare.\textsuperscript{21} Infants whose mothers have high levels of Streptococcus Mutans, a result of untreated caries, are at a greater risk of acquiring the organism earlier than children whose mothers have low levels.\textsuperscript{22} Suppressing maternal reservoirs of Streptococcus Mutans via dental rehabilitation and antimicrobial treatments, especially during the prenatal period\textsuperscript{23,24} has proven effective, just as eliminating saliva-sharing activities (i.e. sharing utensils, orally cleansing a pacifier) may help decrease an infant’s or toddler’s acquisition of cariogenic microbes.

In communities, dental caries prevalence is measured through the ASTDD Basic Screening Survey (BSS) by assessing presence of treated and untreated dental caries. The BSS is a standardized descriptive cross-sectional survey designed to collect information on preschool, school-age, and adult populations on age, gender, race and ethnicity either by observation or self-report. The BSS was developed by the Association of State and Territorial Dental Directors (ASTDD) with technical assistance from CDC.\textsuperscript{25}

In 2010, Minnesota conducted its first ever BSS on students in third grade attending public schools. Presented in the following chart, the survey found that 55% of Minnesota students in third grade had caries experience (history of dental caries) which was slightly higher than the nation (53%) for children 6-8 years. The state had 11% higher prevalence then the target for healthy people 2010 (42%). To meet the target for HP2020 state had to reduce 6% points of caries experience in children.
Dental Caries Experience in Adolescent
According to NHANES data 1999-2004, 56.1% adolescents (age 15 years) nationwide had caries experience. Data also showed higher prevalence in females (60.1%) than males (52.7%). [Add citation]

Untreated Tooth Decay (caries) in Children
Untreated tooth decay is one of the best predictors of future caries activity. The final report for HP2010 showed that this indicator moved away from the target for the children ages 2-4 years and 6-8 years nationally. The data showed that 19% (target for HP2010 was 9%) of children 2-4 years and 29% (target for 2010 was 21%) of children 6-8 years had untreated dental decay.

The 2010 BSS from Minnesota showed 18% of third graders have untreated tooth decay. The state has a lower rate than even the revised target (25.9%) for HP2020 for this indicator. Through continued preventive intervention, the MDH Oral Health Program seeks to maintain or reduce the proportion of young children with untreated tooth decay.
National data for adolescents (15 years) indicate the proportion was 18%, yet higher than the target set for the HP2010 (15%). The new target for the HP2020 is set for 15.3%.

Untreated Tooth Decay (caries) in adults
Generally, people throughout their lives are susceptible to dental caries. Adults, like children and adolescents can experience new decay on the crown and can also develop caries on the root surfaces of teeth. According to NHANES data for 1999-2004 reported for the HP2010 final report, nationwide 27.8% adults, ages 35-44 years and 18% of adults, age 65 years and above had untreated caries.

Periodontal disease: Gingivitis and Periodontitis
Periodontal disease is a bacterial infection, which affect gums and bone supporting the teeth. Gingivitis and periodontitis are included in this category of infection. These infections can cause tooth loss if left untreated.

Gingivitis is the mildest form of periodontal disease often caused by inadequate oral hygiene and is reversible with professional treatment and good oral home care. Untreated gingivitis can advance to periodontitis. With time, plaque can spread and grow below the gum line. Toxins produced by the bacteria cause gums to separate from the teeth and form pockets (spaces between the teeth and gums) which later become infected. This process destroys gum tissue and bone, which results in a loose tooth or tooth removal.

According to CDC, 4 to 12 percent of adults in the US are affected by gum diseases. Cigarette smoking is the cause of half of the cases of severe gum disease and prevalence is three times higher in smokers than non-smokers.
A large body of recent literature recognizes periodontal diseases as the "sixth complication" of diabetes.\textsuperscript{29} According to the expert committee on ‘Diagnosis and Classification of Diabetes Mellitus’, periodontal disease was referred as one of the pathological conditions often found in adults with diabetes.\textsuperscript{30}

**Tooth Loss in adults**

A full dentition is defined as having 28 natural teeth, exclusive of third molars (the wisdom teeth) and teeth removed for orthodontic treatment or as a result of trauma.

Tooth loss decreases individual’s ability to chew and speak and interfere with social functioning. Adequate personal, professional, and population-based preventive practices can save teeth for lifetime for many people. In adults, tooth decay and periodontal (gum) disease are the most common reasons for tooth loss. Tooth loss also occurs due to infection, unintentional injury and head and neck cancer treatment. Furthermore, certain orthodontic and prosthetic services sometimes require teeth removal.

Behavioral Risk Factor Surveillance System (BRFSS) data in the following graph shows declining trends since 2006 for adults ages 65 and above who have had all their natural teeth extracted in the nation and also in the state. The decline is much sharper in Minnesota compared to the nation. In 2010, median percentage for the nation (16.9%) is higher compared to Minnesota (11.2%). [Add citation]

![Graph showing declining trend in tooth loss among adults aged 65+](image)

**Data source: BRFSS 1999-2010**

According to BRFSS 2010 data, over the past 10 years percentage of adults ages 65 and above who have had all their natural teeth extracted has declined from 26.2% to 16.9% (rate of change 35.5%) in the nation whereas the rate of change was much higher in the state (50.2%).
The following graph shows that between years 2004 to 2010, percentage of adults ages 65 and above who have had any permanent teeth extracted had not changed nationally, whereas in the state trend is declining. Between 2004 and 2010, adult extractions declined by 4% in Minnesota.

**Figure 5: Adults Aged 65+ that have had any permanent Teeth Extracted**

**Data source: BRFSS 1999-2010**

Oral Health Disparity in Adults

Health disparities are differences that socially disadvantaged populations experience in the burden of disease and opportunities to achieve optimal health. Multiple factors contribute to create health disparities such as race or ethnicity, gender, education or income, disability, geographic location (rural/urban), inadequate access to health care or individual and behavioral factors. Health disparities are directly related to the historical and current inequitable distribution of social, economic, environmental and health system resources. Oral health is no exception when it comes to health disparities. Certain ethnic groups, people with lower socioeconomic status and education level, populations living in rural areas bear the burden of oral diseases more than others.

BRFSS data for 1999 to 2010 on oral health reflects the phenomenon of disparity through the following graphs. These graphs depict that greater proportion of Minnesota adults and their counterparts nationwide with lower socioeconomic status (measured by personal income and level of education) have poorer dental indicators. These graphs also show that Minnesota proportions for these indicators are slightly better than the national indictors. However, there is still an estimated 73,714 number of people age 65 and older in Minnesota who experience tooth loss, and the related discomfort such as loss of function of the ability to chew food. And other discomforts related to improper mastication.
This graph shows that proportion of adults 65+ who have had all their natural teeth extracted is higher in people with educational level less than high school and very low in people with a college degree.

**Figure 6: Adults Aged 65+ who have had all their Natural Teeth Extracted by Educational Level**

Data source: BRFSS 1999-2010

The following graph shows an inverse relationship between the income levels and adults aged 18+ who did not visit a dentist or dental clinic in the past year. As income increases, the percentage of adults 18+ who did not visit a dentist or a dental clinic in the past years decreases.

**Figure 7: Adults Aged 18+ Who did not Visit a Dentist or a Dental Clinic in the Past Year by Income**

Data source: BRFSS 1999-2010
**Oral Health Disparity in Children**

In general, lower-income communities bear a disproportionate burden of oral diseases and conditions. Using schools’ Free or Reduced Lunch (FRL) eligibility status as a proxy for community socio-economic status the 2010 BSS data indicated the presence of a positive correlation between oral health indicators and FRL eligibility status among third grade students. Schools with higher proportions of students on or qualified for FRL program performed worse on all indicators measured on the BSS.

In general, schools with 25 percent or fewer students on or qualified for FRL program have better oral health status than their peers in schools with 75 percent or more students.

Despite progress in reducing dental caries in the United States, sharp disparities exist across income levels. Generally, the caries seen in individuals of all ages from poor families is more likely to be untreated than caries in those living above the poverty level.

![Figure 8: Caries and Untreated Caries Experience in Students in 3rd Grade by Free and Reduced Lunch Eligibility](image)

Data source: Minnesota BSS 2010 on third graders

Figure 8 shows that caries experience was higher in schools with 75% or more children eligible for free and reduced lunch as compared to schools with <25% of their children eligible for free and reduced lunch program. This illustrates the role of poverty in poor oral health.

Ethnicity is another risk factor for compromised oral health as shown in the following graphs. Non-white non-Hispanic children are more likely to experience caries and untreated caries as compared to white non-Hispanics and Hispanic children in third grade.
**Birth Defects**

The most common Oral Birth Defects (OBD) are cleft lip and cleft palate; facial and oral malformations occur within the first six to eight weeks of pregnancy\(^32\). Cleft lip and palate is the fourth most common birth defect in the US with about one OBD per 700 births. It’s commonly prevalent in Asian, Latino or Native Americans. Cleft lips with and without cleft palates affect boys twice than girls whereas cleft palate without a cleft lip affect girls twice than the boys.

In June 2005, MDH started active surveillance of Birth Defects. As of 2010, the program has access to the records of about 50% of all births in Minnesota, which includes all the birthing hospitals in Hennepin, Ramsey, Washington and Olmsted counties.\(^33\) According to birth defect program 2009 annual report, published in September 2010, there were 403 cases of Orofacial recorded for the births (total 361,109 births) between 2005 and 2009\(^34\).

Oral clefts can occur on one or both sides of the mouth as lip and palate develop separately, it is possible to have a cleft lip without a cleft palate, a cleft palate without a cleft lip, or both together. The defects range from a small notch in the lip to a groove that runs into the roof of the mouth and nose. Surgery often is performed to close the lip and palate and most children do well after treatment. A child with oral cleft is usually assessed immediately after birth to devise a treatment plan. Treatments and rehabilitation begins within the first few months of life. As the process involves multiple specialists and procedures, the average treatment costs for treating cleft lip or cleft palate per patient over their lifetime has been estimated by NIH about $250,000\(^35\).

In most cases, the cause of oral cleft is unknown. Most scientists believe they are due to a combination of genetic and environmental factors.\(^36\) There appears to be a greater chance of oral cleft if a sibling, parent, or relative has had the problem. Use of medications such as anti-seizure/anticonvulsant (topirimate), acne medications containing accutane and methotrexate used for treating cancer, arthritis, and psoriasis; during pregnancy could be another Potential cause. Exposure to viruses or chemicals or other medical conditions during pregnancy have also been thought as contributing factors in the oral birth defect.

Cleft palate usually makes breastfeeding difficult because babies can’t suck properly. Kids born with cleft palate may also have frequent ear infections which can eventually cause hearing loss. Speaking clearly is another challenge for kids with this type of anomaly.

**Oral Cavity and Pharyngeal Cancers (OCPC)**

Oral cavity and cancers of the pharynx (OCPC) represent about 2.4% of all cancer sites combined. These cancers are found on lip (excluding skin of the lip), tongue, salivary glands, gum, mouth, pharynx, oropharynx, and hypo pharynx. According to the American Cancer Society (ACS) estimates for the US population, in the year 2012, 40,250 (Males: 28,540, Females: 11,710) new cases will be diagnosed and 7,850 (Males: 5,440, Females: 2,410) people will die of this type of cancers\(^37\).
Over the five-year period from 2004 to 2008, each year in Minnesota, an average of 603 cases of OCPC was diagnosed (2.4% of all new cancer cases) and 111 people died (1.2% of all the cancer related mortality) from this cancer.

**Incidence, Mortality and Lifetime Risk by Age and Gender**

The average annual incidence and mortality rates for OCPC from 2004 to 2008 were 11.2 and 2.0 per 100,000 respectively in Minnesota. The incidence rate was significantly lower in females (7.1 per 100,000 females) than males (15.9 per 100,000 males) for the above reporting period. Average mortality rate for the state (2.0 per 100,000) was lower than the average for the nation (2.5 per 100,000).

Table 3a below shows that in Minnesota, median age at diagnosis for males is 61 year and for females is 65 years. Table also depicts higher lifetime risk of diagnosis and death for males as compared to females.

**Table 2**

**Median Age at Diagnosis/Death and Lifetime Risk of Diagnosis/Death**

*Oral Cavity and Pharynx Cancer 2006-2008*

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age at diagnosis (in years)</td>
<td>61.0</td>
<td>64.0</td>
</tr>
<tr>
<td>Median age at death (in years)</td>
<td>66.0</td>
<td>73.0</td>
</tr>
<tr>
<td>Lifetime risk of diagnosis</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Life time risk for death</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Data Source: MCSS*

In the following graph, incidence rate for OCPC, in both genders increases with age. More than two-thirds of the new cases are identified after the age of 74 years. Incidence rates are twice in males compared to females.
Data Source: MCSS

Morality rates for OCPC increase sharply after age 64 years in both genders. Similar to incidence rates females have lower rates of mortality by OCPC.
Table 3b shows that five-year relative survival is highest for localized tumors (82.4%), whereas metastasized tumors have the lowest relative survival (33.2%). Most of the OCPC in Minnesota are diagnosed at the regional stage. Little over one-third of the cases are diagnosed at the localized stage.

**Table 3**  
Cases Distribution and Five-Year Relative Survival by Extent of Disease at Diagnosis  
Oral Cavity and Pharynx Cancer 2006-2008

<table>
<thead>
<tr>
<th>Stage at Diagnosis</th>
<th>Cases (%)</th>
<th>Five-year Relative Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Localized (confined to primary site)</td>
<td>36.6</td>
<td>82.4</td>
</tr>
<tr>
<td>Regional (spread to regional lymph nodes)</td>
<td>39.0</td>
<td>55.5</td>
</tr>
<tr>
<td>Distant (cancer has metastasized)</td>
<td>12.0</td>
<td>33.2</td>
</tr>
<tr>
<td>Unstaged (Unknown)</td>
<td>7.7</td>
<td>50.4</td>
</tr>
</tbody>
</table>

**Trends**

In the state, from 1988 to 2008 incidence rate for OCPC for women has been stable. Among males, the rate declined significantly from 1988 to 2006 (figure 13). A slight increase was notices in 2007. State’s incidence rates were consistent with national rates.
Mortality rates for the state decreased significantly among males from 1988 to 2008. They were consistently lower than the national statistics. For females the rates were consistent and were closer to the national figures.

**Figure 12: Mortality Rates for Oral Cavity and Pharynx Cancer by Gender - US and Minnesota Populations 1988-2008**

*Data Source: MCSS*

**Disparity**

The average annual incidence rates among American Indians living in CHSDA counties (Contract Health Service Delivery Area) were 17% higher than among American Indians living in the geographic areas covered by SEER (Surveillance Epidemiology and End Results). Table 4 shows that average annual incidence rates of OCPC for males were highest among CHSDA followed by blacks. In females American Indian females had highest incidence rate. Interestingly mortality rates were higher in Asian/pacific Islander populations.

**Table 4: Oral Cavity and Pharyngeal Cancers Average Annual Rates by Race and Ethnicity in Minnesota**

<table>
<thead>
<tr>
<th>Race</th>
<th>Average Annual Incidence Rate</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>15.7</td>
<td>6.8</td>
</tr>
<tr>
<td>Hispanic all races</td>
<td>5.9</td>
<td>7.4</td>
</tr>
<tr>
<td>Black</td>
<td>20.8</td>
<td>7.9</td>
</tr>
<tr>
<td>Asian/Pacific Islanders</td>
<td>14.6</td>
<td>7.6</td>
</tr>
<tr>
<td>American Indians</td>
<td>19.4</td>
<td>12.0</td>
</tr>
<tr>
<td>CHSDA*</td>
<td>23.4</td>
<td>~</td>
</tr>
</tbody>
</table>
Risk Factors

Use of tobacco and heavy consumption of alcohol are widely considered major risk factors for OCPC. 38 Recently, human papillomavirus (HPV) exposure and infection have been documented as a strong risk factor for certain types of OCPC, particularly in men. A case-control study published in 2007 showed that independent of tobacco and alcohol use, HPV exposure and infection increase the risk of oropharyngeal squamous cell cancer. Most cases of OCPC are preventable. Reduction in exposure to tobacco and alcohol is the single most effective measure to lower the risk of developing this type of cancer.

Dental Hospital Visits

Access to dental care whether limited to shortages of oral health care providers or providers not accepting uninsured or under insured populations have made hospital emergency rooms as dental destination for the patients in pain and suffering. This recent phenomenon of increased utilization of ED for preventive and less severe oral health problems has serious financial implication to the overall health care system. Often the care being offered in ED may result in additional visits and corrective procedure as the ED staff is not generally trained in dealing with oral health problems.

Since the summer of 2010, few publications and reports have identified various aspect which are significantly important in reviewing the financial burden of these inappropriate admission to ED39404142.

- Urgent care dental visits to ED were more pronounced among uninsured population
- In 2007, over 10,000 visits to ED related to oral health occurred in one year period, costing nearly $5 million to the public programs
- Barriers to dental care including lack of insurance, dental provider not accepting Medicaid, lack of transportation, dental health literacy, cultural and societal habits were implicated in the realm of ED admissions.

Hospital-treated oro-dental conditions

For oral conditions, hospital discharge data based on primary diagnosis using ICD-9 (International Classification of Disease) can be divided into two categories – oral trauma and non-trauma. Hospital treated oral trauma includes broken tooth, open wound of internal structures of mouth etc. Whereas, non-trauma conditions include disorder of tooth development and eruption, abscess, periodontal diseases, gingivitis, dentofacial anomalies, malocclusion and other diseases of the internal structure of mouth.

Following tables shows that more males come with traumatic conditions to ER whereas more females visit ER with non-traumatic oral conditions. More patients with non-traumatic condition are admitted in the hospital as compared to traumatic. Slightly lower than half of the
patients, visiting ER with traumatic condition were from rural areas. This could be attributable to lower number of dental office available for rural population. Therefore, they seek refuge in hospitals for non-traumatic oral conditions.

Table 5: Profile of Hospital Treated Patients with Traumatic and Non-traumatic Oral Conditions - 2000 - 2010

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of cases</td>
<td>32,553</td>
<td>136,982</td>
</tr>
<tr>
<td>Male</td>
<td>18,816</td>
<td>65,340</td>
</tr>
<tr>
<td>Female</td>
<td>13,737</td>
<td>71,642</td>
</tr>
<tr>
<td>Urban Residents</td>
<td>20,443</td>
<td>74,655</td>
</tr>
<tr>
<td>Patients treated in Emergency Department</td>
<td>32,293</td>
<td>131,914</td>
</tr>
<tr>
<td>Patients hospitalized</td>
<td>260</td>
<td>5,068</td>
</tr>
</tbody>
</table>

Data source: Statewide hospital discharge and emergency department uniform billing data from the Minnesota Hospital Association, 2000-2010

The following graph shows that hospitalization rates for oro-dental conditions vary by age. Age specific rates for oral trauma are highest in children ages one to four followed by adults ages 20 to 29 years. Males and females show the same pattern.

Figure 13: Hospital-treated Oral Trauma by Age Minnesota 2000-2010, Rate/100,000 cases

Data source: Statewide hospital discharge and emergency department uniform billing data from the Minnesota Hospital Association, 2000-2010
The graphs shows rate of hospital treated oral non-trauma cases by age. The most affected age group was 20 to 29 years of age. Age specific rates were higher in females then males in the same age categories.

Data source: Statewide hospital discharge and emergency department uniform billing data from the Minnesota Hospital Association, 2000-2010

Economic Impact

According to the World Health Organization, in some countries, oral diseases are the fourth most expensive diseases to treat\(^4\). According to CMS in 2009, dental services expenditure in the country was $102.2 billion\(^4\). Forty two percent of the amount was out-of-pocket payment. The following table shows hospital charges which has increased since 2008 for trauma and non-traumatic conditions. If these charges are not being paid by the patient then they become the liability to the public service. The observed change is much higher in non-traumatic cases compared to traumatic which could be attributable to the under insured and uninsured population utilizing hospital service for their regular dental needs.

Table 6: Hospital Charges for Hospital-treated Trauma and Non-Traumatic Oral Condition

<table>
<thead>
<tr>
<th></th>
<th>Charges for Hospital-Treated Oral Trauma</th>
<th>Charges for Hospital-treated Oral Non-traumatic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009-2010</td>
</tr>
<tr>
<td>Mean</td>
<td>$453.16</td>
<td>$483</td>
</tr>
<tr>
<td>Median</td>
<td>$187</td>
<td>$208</td>
</tr>
<tr>
<td>Total</td>
<td>$11,720,194</td>
<td>$12,755,259</td>
</tr>
</tbody>
</table>

Data source: Statewide hospital discharge and emergency department uniform billing data from the Minnesota Hospital Association, 2000-2010
Oral Diseases and Other Health Conditions
In recent years, rising chronic disease morbidity and mortality have emerged as threats to the well-being of populations. Research has demonstrated interrelationship between the chronic diseases and oral health. Studies have shown a strong association between periodontal (gum) disease and diabetes, cardiovascular diseases, stroke, respiratory infections, osteoporosis, HIV and adverse pregnancy outcomes.

Oral health and diabetes
As people with diabetes are more susceptible to contracting infections, they are more likely to have periodontal disease than people without diabetes. Periodontal disease is often considered the sixth complication of diabetes. People with uncontrolled diabetes are at even higher risk.

A study found that poorly controlled type 2 diabetic patients are more likely to develop periodontal disease than well-controlled diabetic patients. Research also suggests that the relationship goes both ways as periodontal disease may make it more difficult for diabetic patients to control their blood sugar.

Severe periodontal disease can cause a rise in blood sugar contributing to body functioning with a high blood sugar. This increases risk for diabetic complications. Therefore, diabetic patients should be treated for periodontal disease to avoid complications.

Children with diabetes often develop gum diseases earlier in life than those without diabetes. Clinical studies have also shown that diabetic children show more plaque and gingival inflammation than non-diabetic children.

Oral disease in pregnancy
According to the Pregnancy Risk Assessment Monitoring System (PRAMS), only 22 to 34 percent of women in the US consult a dentist during pregnancy. Studies have found that maternal oral health has significant implications for birth outcomes and baby’s oral health. Periodontitis has been associated with poor pregnancy outcomes. A systematic review of studies conducted in 12 countries and three US states between 1996 and 2006 found that 24 studies demonstrated a positive relationship between periodontitis and preterm birth, low birth weight, or both. Only 14 studies reported no relationship between periodontitis and poor pregnancy outcomes. However, another large U.S.-based Randomized Control Trial (RCT) did not find an association between periodontitis and preterm birth and low birth weight. Racial, socio-economic and delayed treatment for periodontal diseases, are hypothesized by authors as a possible explanation for conflicting findings.

Literature is available on the association between maternal oral health and child’s caries experience but no conclusive evidence has been found. More studies and research is needed to ascertain the relationship between periodontal diseases and pregnancy outcomes. In oral health programs, more focus should be on improving pre-pregnancy oral health condition of women.
Oral health and Osteoporosis
Although more research is needed to assess the association between osteoporosis and tooth loss and periodontal disease, researchers cite that osteoporosis may be a risk factor for oral bone loss. Research findings suggest early detection of changes in bone density may be observed by dental health professionals with the use of high quality intra-oral dental radiographs. Some of the indicators such as loose teeth, severe gum disease, dentures that don’t fit well and difficulty eating or speaking could be early sign of bone loss.

Oral health and cardiovascular disease
Although poor oral health may not be the primary cause of heart disease there are a few recent studies showing that poor oral health combined with other risk factors may contribute to heart disease. On the other hand there are also a few studies refuting the possible link between periodontal disease and cardiovascular disease.

Chapter 5: Protective Factors Affecting Oral Disease

Community Water Fluoridation
Community water fluoridation has recognized by CDC as one of the ten great public health achievements of 20th century. It is one of the most cost-effective and equitable means to provide protection from tooth decay. Economic analysis of studies conducted by CDC found that communities with more than 20,000 people where community water fluoridation costs 50 cents per person, every dollar invested yields approximately $38 savings in dental treatment cost. Another study found that the states where more than half of the communities have fluoridated water, have 26% fewer decayed tooth surfaces per year in children 12 years old as compared to the states with less than one-quarter of the communities fluoridated.

Figure 15 depicts that in 2010, 73.9% of the US population on public water system was receiving fluoridated water whereas, 98.8% Minnesotans on public water system were receiving fluoridated water. This ranks Minnesota 4th in the nation after Kentucky, Maryland and Illinois for percentage of state population on public water systems receiving fluoridated water. Health People 2020 target for the nation has been set to 79.6%. Minnesota is far ahead of the set target, and to maintain its status, significant amount of work needs to be done while striving to achieve optimal oral health for its populations.
According to the CDC Water Fluoridation Reporting System (WFRS), as of April 2012, in all the 87 counties of Minnesota, more than 75% of the county population, which was connected to public water supply, had their drinking water fluoridated.

Approximately 25% (one million) of Minnesotans rely on private, household wells as their source of fresh water in their homes which may not have optimal levels of fluoride to prevent tooth decay in children\(^59\).

**Dental Sealant Programs**
The likelihood of developing pit and fissure decay begins early in life. Dental sealants (pit and fissure sealants) are effective in preventing decay and stopping the progression of early caries. Dental sealant is applied to the chewing surfaces of back teeth (molars) to prevent decay from occurring in the pits and fissures. Dental Sealants are cost effective when given to children and adults who are at the highest risk of developing caries. They may last as long as five years. School-based sealant program have been shown to reduce oral health disparities\(^60\). Colorado estimated a $1.2 million in saving in a year if statewide sealant programs were implemented\(^61\).
In 2011, after analyzing Basic Screening Survey findings, MDH established a coordinated school-based sealant program in five regional sites through its Health Resources and Services Administration funding. MDH is also collaborating with the Minnesota Department of Human Services (DHS) to achieve the Centers for Medicare and Medicaid Services (CMS) goal of increasing the rate of children who have received dental sealants by ten percentage points. Other partners participating in these efforts include 3M, Delta Dental, Smiles Across America, and the School Nurse Organization of Minnesota (SNOM). The goal of the program is to improve community-based prevention services by strengthening the infrastructure and expanding the capacity of school-based pit-and-fissure sealant delivery programs in Minnesota. The school-based sealant program targets second grade students in high-risk schools (schools with a >50 percent rate of students eligible for the Free or Reduced Lunch Program).

In 2009, less than 25 percent of high-risk schools had sealant programs. As shown in the following table, today more than 29 percent of high-risk schools have MDH-sponsored or coordinated dental sealant programs.

Table 7:

<table>
<thead>
<tr>
<th>2010-2011 School Year: Elementary Schools</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Elementary Schools</td>
<td>946</td>
<td></td>
</tr>
<tr>
<td>Total Number of High-Risk schools</td>
<td>392</td>
<td>41.4</td>
</tr>
<tr>
<td>Total Number of High-Risk with a School-based Dental Sealant Program</td>
<td>115</td>
<td>29.3</td>
</tr>
</tbody>
</table>

*Source: Minnesota Department of Education and Minnesota Department of Health, 2011.*
Data collected by the state program show that one-third (34%) of the eligible children in second grade participated in the program. On average, three dental sealants per child were applied on participating second graders molar teeth. According to CMS 416 report for the Fiscal Year 2011 only 15% (n=90,300) of eligible children ages 6 to 9 years received a sealant on a permanent molar tooth.

Fluoride Varnish
Several emerging dental preventive strategies are in the scientific literature. Fluoride varnish is one of those. Fluoride varnish is a high concentration of fluoride in a resin base, intended for professional use as a cavity liner and de-sensitizing agent. Recently varnish has been widely used in children to help to prevent early childhood caries. It can also help arrest the caries process when applied early. Fluoride varnish has been found to reduce decay on tooth surfaces by 50% to 70%. Fluoride varnish has been found to be cost effective when dental service and non-hospital treatment costs can be 1.5 to 2 times higher. A study found improved clinical outcomes by 1.52 cavity-free months at a cost of $7.18 for each cavity-free month gained per child and $203 for each averted treatment.
Chapter 6: Risk Factors Affecting Oral Disease

Tobacco Use
Tobacco is a known risk factor in oral cavity and pharyngeal cancers. Oral health, Cancer and HIV. Smoking and alcohol use are strongly associated with oral cancers, which are relatively common and have a poor prognosis compared with other types of cancer.

Smokers are four times more likely to develop gum diseases compared to non-smokers. According to the American Academy of Periodontology, tobacco use may be one of the most significant risk factors in the development and progression of periodontal disease.

Smoking rates have been on the decline statewide among adults and teenage students, according to the Behavioral Risk Factor Surveillance System (BRFSS) and the Minnesota Student Survey (MSS). Smoking rates among 12th graders, both nationwide and in Minnesota, started to decline after its peak in 1998. In 2010, less than one in five high school seniors nationwide (19.5%) and in Minnesota (19.2%) reported smoking cigarettes in the past 30 days. Over the years, smoking rates have been higher among Minnesota students than their national counterparts. However, the downward trend since 1998 is more pronounced in Minnesota (1998: 41.9%, 2010: 19.2%) than in the country (1997:36.4%, 2009: 19.5%).

Figure 17: Adult Current Smokers - US Minnesota Comparison

Data Source: BRFSS 2000-2010

Beverage Consumption

There is a positive causal relationship between sugar sweetened beverage consumption and dental caries in children. There are 40.5 grams of sugar in a 12 oz. can of Coke (equivalent to 10 teaspoons of sugar) and has high level of acidity which is associated with increased dental caries in children and youth.
The most popular teen beverage after water as of spring 2010 was milk followed by water in 2007, about 49 percent of 6th to 12th grade students drink one to two glasses of milk per day, approximately 300 - 600 mg of calcium. For children and youth ages 9 to 18 years recommended daily intake of calcium is 1300 mg. It is scientifically proven that intake of milk is good for bone including teeth.

Alcohol use shows an overall declining pattern among 12th graders, both nationwide and in Minnesota. In 1992 nationwide, more than three quarters of high school seniors reported using alcohol during the past year, compared to about two-thirds in 2010. In 1992, alcohol use by students in the state was higher than the national level. In 1995, the levels fall below the national level and remained that way ever since as shown in the following graph.

**Figure 18: Percentage of Alcohol Consumption in Students in 12th Grade**

Data source: Minnesota Student Survey, 1992-2010
Chapter 7: Access to Oral Health Care

Dental Professional Shortage Designation

Health Professional Shortage Area (HPSA) is a designation given by the Department of Health and Human Services (DHHS) to identify shortages of primary medical, dental or mental health providers within a geographic area, population group or a facility. For further background information refer appendix D.

As of September 2012, there were 112 dental HPSAs in the state. More than half (66 out of 112) are low-income population designations. Based on the dentist Full Time Equivalent (FTE) data serving Medicaid and/or low-income populations in these areas, DHHS estimates that 166,200 people have access to dental services and 362,569 experience barriers. Majority of HPSA are located in rural parts of the state. There are 13 HPSAs designated in Hennepin County (four population and nine facilities) and five in Ramsey County (two population and three facilities). In five other metropolitan counties (Anoka, Washington, Carver, Dakota and Scott), there are two correctional facilities and one Native American tribal population designations.

Dental Workforce Capacity

Office of Rural Health and primary Care (ORHPC) collects dental workforce data through licensing process. Table 8 presents comparison of state and national dental provider data.

Table 8: Ratio of Dental Provider Types per 100,000 Population

<table>
<thead>
<tr>
<th>Dental Professionals</th>
<th>*Minnesota: Number per 100,000 population</th>
<th>**National: Number per 100,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentists (practicing)</td>
<td>3,244 (61 dentists per 100,000)</td>
<td>195,628 (63 dentists per 100,000)</td>
</tr>
<tr>
<td>Collaborative Agreement Dentists</td>
<td>274 (5 dentist per 100,000)</td>
<td>~</td>
</tr>
<tr>
<td>Pediatric Dental Specialists</td>
<td>77 (6 dentists per 100,000 children &lt;18 years)</td>
<td>6,181 (8 dentists per 100,000 children &lt;18 years)</td>
</tr>
<tr>
<td>Advanced Dental Therapists</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Dental Therapists</td>
<td>16 (3 per 1,000,000)</td>
<td>~</td>
</tr>
<tr>
<td>Hygienists (practicing)</td>
<td>3,594 (68 per 100,000)</td>
<td>152,000 (49 per 100,000)</td>
</tr>
<tr>
<td>Collaborative Agreement Hygienists</td>
<td>276 (5 per 100,000)</td>
<td>~</td>
</tr>
<tr>
<td>Dental Assistants (practicing)</td>
<td>6,288 (119 per 100,000 pop)</td>
<td>297,200 (96 per 100,000)</td>
</tr>
</tbody>
</table>

*Total Minnesota population: 5,303,925; children under 18 years (24%): 1,267,638

**U.S. Population: 308,745,538; children under 18 years (24%): 73,172,69
**Dentist**
Comparison in table 8 shows that the Minnesota has lower ratio of dentists per 100,000 population compared to the nation. This difference may increase in future as ORHPC licensee survey shows 47 percent dentists were 55 years or older and rural dentists (median age 57 years) were older than urban dentists (median age 53 years). Most of the dentists (57%) planned to practice in Minnesota for more than ten years whereas only seven percent worked small rural areas. Dentists who planned to stop their practice, 21% planned to stop in the next five years. Solo practice is the most common type of practice especially in rural areas (44%) followed by small group practice (37%). One-third (74%) of the dentists were practicing in urban areas.

**Pediatric Dentistry**
Pediatric dental services are available in fewer than 20 of Minnesota’s 87 counties. Many of these dentists practice at more than one location. Most pediatric practices are clustered in and around the 7-county Minneapolis/St. Paul metropolitan area with very few, if any, located in rural Minnesota. In Greater Minnesota, pediatric dentists are most likely to be located in the larger cities such as Duluth, Rochester, St. Cloud, and Mankato.

**Dental Hygienist**
Dental hygienists are licensed professionals who specialize in preventive dental care and oral hygiene. Minnesota law allows health care organizations or nonprofit organizations that serve uninsured or publicly insured patients, to employ dental hygienists to perform following functions in some settings without direct supervision of a dentist. To do so, the hygienist must have a collaborative agreement with a supervising dentist. Statute 150A. 10, Subd.1a called ‘collaborative agreement’ gives limited authorization to dental hygienists. Oral health promotion and disease prevention education

- Removal of deposits and stains from teeth surfaces
- Application of topical preventive or prophylactic agents
- Polishing and smoothing of restorations
- Removal of marginal overhangs
- Preliminary charting
- Radiographs
- Scaling and root planning.
- The hygienist may also administer local anesthetics or nitrous oxide if specifically delegated by the dentist in the collaborative agreement

In the process of preparation for licensure as a hygienist, 69% received associate degree while 30% had bachelor or higher degree. Based on license information, half of the hygienists were 45 years or older (53 percent). Data from the survey showed that 80% of the hygienist workforce was serving the 75% of the population living in metropolitan areas (Minneapolis-St. Paul, St. Cloud, Rochester, Duluth-Superior, Fargo, Grand Forks and La Crosse). Only seven percent hygienists were serving 12% of the population in the rural areas. When hygienists were asked about collaborative agreement, 20% were even did not know whether they were practicing under a collaborative agreement of not.
Table 9: Profile Dental Workforce
Minnesota Board of Dentistry License Renewal Data and
Survey of Office of Rural Health and Primary Care
2008-2009

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
</tr>
<tr>
<td>Renewed licenses</td>
<td>3,908</td>
<td>4,608</td>
<td>7,146</td>
</tr>
<tr>
<td>Actively practicing in Minnesota</td>
<td>3,244</td>
<td>83</td>
<td>72</td>
</tr>
<tr>
<td>Responded to the ORHPC survey</td>
<td>2,926</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>77</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>23</td>
<td>98</td>
</tr>
<tr>
<td>Median Age</td>
<td>Urban</td>
<td>53 years</td>
<td>34 year</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>57 years</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>White</td>
<td>94</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>Non-white</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Area of practice</td>
<td>Urban</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>% of dental hygienist actively participating under collaborative agreement</td>
<td>7</td>
<td>6</td>
<td>~</td>
</tr>
</tbody>
</table>

**Dental Assistants**

Dental assistants are unlicensed dental practitioners who work under supervision of a licensed dentist. Dental assistants may or may not be registered. This means that their licensing is voluntary. Dental assistants may perform only duties delegated to unlicensed assistants by the Board of Dentistry. Dental assistant registration requires completion of a program approved by the American Dental Association’s Commission on Dental Accreditation (CODA), or another program approved by the Board of Dentistry. CODA standards require the equivalent of a one-year post-secondary program; students may or may not earn an academic degree. Thirteen Minnesota community and technical colleges offer dental assistant programs approved by the MBD.

**Enhancing Workforce Models and Creating New Providers**

In 2009, Minnesota’s governor signed a bill into law creating a new “midlevel” dental provider type. Under the bill two new types of practitioner are now recognized – a Dental Therapist (DT) and an Advanced Dental Therapist (ADT). This mid-level dental practitioner will work under the
supervision of a licensed dentist. These practitioners are trained to provide evaluative, preventive, restorative, and minor surgical dental care within the scope of their practice defined in the statue. The purpose of this provider type is to extend dental care to underserved communities. They will be practicing that serve low-income and underserved; dental shortage areas Dental therapists will be the dental equivalent of a physician's assistant. They'll provide more services than dental hygienists, but won't be able to do everything what a dentist can do.

The purpose of creating this new workforce is to address access issue such as limited availability of dental providers, dental providers not accepting populations on public program, uninsured patients and people living in rural areas.

The University of Minnesota (UM) offers a Bachelor of Science in Dental Therapy Program after completing one year of prerequisite college coursework and a Master of Dental Therapy for students who have completed a Bachelor of Science or Bachelor of Arts degree. Whereas, Metropolitan State University offers Bachelor of Science in Dental Hygiene (BSDH) to those who have associate degree in dental hygiene from accredited institutions. Completion of a baccalaureate degree provides students with new and different opportunities to become an oral healthcare professional and broaden employment prospects in either traditional and/or non-traditional work settings including local, state, and federal health programs; research and development; sales; education; school-based programs; and marketing. This program also prepares students who are interested in pursuing university's master's degree program -Master of Science in Advanced Dental Therapy degree (MSADT).

The Minnesota state legislature will receive a report from the Minnesota Board of Dentistry in January 2014 regarding the impact of the new dental therapists on the delivery and access to services. The first class of dental therapy students graduated in December 2011.

**Oral Health Financing**

The Medicare and Medicaid are both government sponsored and taxpayer funded programs established in 1965. Medicare is designed to help with long-term care for the elderly ages 65 and older, while Medicaid jointly administered and funded by Federal and State governments covers medical, dental, and long-term healthcare costs for people with limited income. It is often a program of last resort for those without access to other resources.

For Medicaid eligible individuals, ages 21 years and under, dental services are required to be provided according to a state established periodicity schedule such as Early and Periodic Screening, Diagnostic and Treatment (EPSDT) requirement. For EPSDT recipients services are not limited to emergency services but also include at a minimum, relief of pain and infections, restoration of teeth and maintenance of dental health.

In 2008, in a review of 16 states where dental utilization rates were 30% or less, CMS identified the following key barriers in children receiving adequate dental care.

- Limited availability of dental providers
- Low reimbursement rates
- Administrative burdens for providers
- Lack of clear information for beneficiaries about dental benefits
- Missed dental appointments
- Transportation
- Cultural and language competency
- Need for consumer education about the benefits of dental care

Medicaid and CHIP cover comprehensive dental benefits for children, but 30% of children with private health insurance are uninsured for dental care. In 2010, more than 80% of low-income children with health insurance – whether Medicaid or private insurance – had a dental visit within the past 12 months, compared to half of low-income, uninsured children.\textsuperscript{74}

According to CMS data for 2009, 16.8% population in the state was enrolled as Medicaid recipient which is nine percent increase from 2008 enrollees (15.4% of total population). The state’s sharing of cost to Medicaid declined in 2009 (39%) compared to 2008 (49.6%).\textsuperscript{75}

| Table 10: Minnesota Indicators for Medicaid Recipients Birth through under the Age of 21 Years |
|---------------------------------------------------------------|------------|------------|------------|------------|
|                                                                 | FFY2010    | FFY2011    | FFY2010    | FFY2011    |
|                                                               | Number     | Percent    | Number     | Percent    |
| Total individuals eligible for EPSDT for 90 continuous days* | 436,388    | 453,502    |
| Total eligible receiving any dental services [any service by or under the supervision of a dentist] | 181,137    | 42         | 183,929    | 41         |
| Total who did not receive dental services                     | 255,251    | 58         | 269,573    | 59         |
| Total eligible receiving a least one preventive dental services [by or under the supervision of a dentist] | 162,986    | 33         | 164,432    | 36         |
| Total eligible receiving dental treatment services [by or under the supervision of a dentist] | 81,942     | 19         | 79,335     | 17         |
| Total eligible (only children 6-9 years ) receiving a sealant on a permanent molar tooth | 14,273     | 17         | 13,590     | 15         |

Above table shows that the number of individuals eligible for EPSDT have increase by six percent points. In 2010, percentage of eligible receiving any dental services increased, whereas total eligible receiving preventive dental service and dental treatment services showed a slight increase. This table shows that vast majority of population under 21 years of age is still not receiving dental services.
Chapter 8: Conclusion

This is the first burden of oral disease document for the state of Minnesota, presenting insight into the oral health profile for the state with baseline estimates and data trends based on the data availability. The data presents existing disparities and identify service gaps.

Caries experience of Minnesota children remains high and there exists remarkable disproportionate burden of oral disease among minority populations and/or lower income families. This is compounded by a lopsided distribution of dental workforce in the state, with more dentists practicing in the urban region at the detriment of populations in the remote hinterlands.

The absence of data on service coverage and disease estimates in pockets of population is brought to the fore by this report. Data is missing on dental caries experience or untreated caries among ages 2-4, 6-8, adolescent, and in the adult population, particularly among the institutionalized elderly. Other areas where limited statewide data are available include pharyngeal and other oral cancers, burden of disease among migrant and native populations, sealant coverage in school age children, oral birth defects, and oral health of pregnant women.

However, despite these limitations, good preventive strategies and dental treatment services exist in the state, particularly in the form of water fluoridation and dental services for the non-minority populations and along the urban corridors, where notably more dental professionals practice.

This burden of disease report presents the most current information on the oral health status in Minnesota. It intended as a guide for oral health-related policy development and preventive strategies in the state.
# Appendix A: Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS</td>
<td>American Cancer Society</td>
</tr>
<tr>
<td>ADT</td>
<td>Advance Dental Therapist</td>
</tr>
<tr>
<td>ASTDD</td>
<td>Association of State and Territorial Dental Directors</td>
</tr>
<tr>
<td>BDIS</td>
<td>Birth Defect Information System</td>
</tr>
<tr>
<td>BRFSS</td>
<td>Behavioral Risk Factor Surveillance System</td>
</tr>
<tr>
<td>BSDH</td>
<td>Bachelor of Science in Dental Hygiene</td>
</tr>
<tr>
<td>BSS</td>
<td>Basic Screening Survey</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control and Prevention</td>
</tr>
<tr>
<td>CHSDA</td>
<td>Contract Health Service Delivery Area</td>
</tr>
<tr>
<td>CMS</td>
<td>Center for Medicaid and Medicare Services</td>
</tr>
<tr>
<td>CODA</td>
<td>Commission of Dental Accreditation</td>
</tr>
<tr>
<td>DHHS</td>
<td>Department of Human Services</td>
</tr>
<tr>
<td>DHS</td>
<td>Department of Health and Human Services</td>
</tr>
<tr>
<td>DT</td>
<td>Dental Therapist</td>
</tr>
<tr>
<td>ECC</td>
<td>Early Childhood Caries</td>
</tr>
<tr>
<td>ED</td>
<td>Emergency Department</td>
</tr>
<tr>
<td>EPSDT</td>
<td>Early Periodic Screening, Diagnosis and Treatment</td>
</tr>
<tr>
<td>ER</td>
<td>Emergency Room</td>
</tr>
<tr>
<td>FRL</td>
<td>Free or reduced lunch program</td>
</tr>
<tr>
<td>HHS</td>
<td>Health and Human Services</td>
</tr>
<tr>
<td>HIV</td>
<td>Human immunodeficiency virus</td>
</tr>
<tr>
<td>HP</td>
<td>Health People</td>
</tr>
<tr>
<td>HPSA</td>
<td>Health Professional Shortage Areas</td>
</tr>
<tr>
<td>HPV</td>
<td>Human Papilloma Virus</td>
</tr>
<tr>
<td>HRSA</td>
<td>Health and Human Services Administration</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine</td>
</tr>
<tr>
<td>LHI</td>
<td>Leading Health Indicator</td>
</tr>
<tr>
<td>MBD</td>
<td>Minnesota Board of Dentistry</td>
</tr>
<tr>
<td>MCSS</td>
<td>Minnesota Cancer Surveillance System</td>
</tr>
<tr>
<td>MDH</td>
<td>Minnesota Department of Health</td>
</tr>
<tr>
<td>MOHSAG</td>
<td>Minnesota Oral Health Data Advisory Group</td>
</tr>
<tr>
<td>MSS</td>
<td>Minnesota Student Survey</td>
</tr>
<tr>
<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>NIH</td>
<td>National Institute of Medicine</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council</td>
</tr>
<tr>
<td>OBD</td>
<td>Oral Birth Defects</td>
</tr>
<tr>
<td>OCPA</td>
<td>Oral Cavity and Pharyngeal Cancer</td>
</tr>
<tr>
<td>OH</td>
<td>Oral Health</td>
</tr>
<tr>
<td>OHP</td>
<td>Oral Health Program</td>
</tr>
<tr>
<td>ORHPC</td>
<td>Office of Rural Health and Primary Care</td>
</tr>
<tr>
<td>PRAMS</td>
<td>Pregnancy Risk Assessment Monitoring System</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomized control Trial</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>SEER</td>
<td>Surveillance, Epidemiology, and End Results</td>
</tr>
<tr>
<td>SNOM</td>
<td>School Nurse Organization of Minnesota</td>
</tr>
<tr>
<td>UM</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>WFRS</td>
<td>Water Fluoridation Reporting System</td>
</tr>
<tr>
<td>YRBS</td>
<td>Youth Risk Behavior Surveillance System</td>
</tr>
</tbody>
</table>
Appendix B: Definition

**Annual Percent Change (APC)** is one way to characterize trends in cancer rates over time. This means that the cancer rates are assumed to change at a constant percentage of the rate of the previous year. For example, if the APC is 1%, and the rate is 50.000 per 100,000 in 1990, the rate is $50.000 	imes 1.01 = 50.500$ in 1991 and $50.5 	imes 1.01 = 51.005$ in 1992.

http://surveillance.cancer.gov/joinpoint/aapc.html

**Association of State and Territorial Dental Directors (ASTDD):** The ASTDD membership consists of the chief dental public health officers (state dental directors) of the state health departments or equivalent agencies and the U. S. territories.

**Birth Defect Information System (BDIS):** The Birth Defect Information System is operated by the MDH birth program. It began active surveillance on June 1, 2005. To date, the BD Program has gained access to records in a total of 15 locations. These facilities represent all birthing hospitals in Hennepin and Ramsey counties, with an estimated capture of approximately 50% of all births in Minnesota. As funding becomes available, the BD Program plans to expand abstraction to all hospital Neonatal Intensive Care Units (NICUs) and birthing hospitals statewide.

**Basic Screening Survey (3rd grade BSS):** A standardized set of surveys designed to collect information about the observed oral health of participants; self-reported or observed information on age, gender, race and Hispanic ethnicity; and self-reported information on access to care for preschool, school-age and adult populations. In the observed oral health survey, gross dental or oral lesions are recorded by dentists, dental hygienists, or other appropriate health-care workers in accordance with state law. The examiner records presence of untreated cavities and urgency of need for treatment for all age groups. In addition, for preschool and school-age children, caries experience (treated and untreated decay) also is recorded. School-age children also are examined for presence of sealants on permanent molars.

**Behavioral Risk Factor Surveillance System (BRFSS):** A state-based, ongoing data collection program designed to measure behavioral risk factors in the adult, non-institutionalized population 18 or older. States select a random sample of adults for a telephone interview. This selection process results in a representative sample for each state so that statistical inferences can be made from the information collected.

**Caries Experience:** A clinical diagnosis of dental caries, presence of fillings in at least one primary or permanent tooth, or evidence of a missing tooth due to caries.

**Contract Health Services Delivery Area (CHSDA):** Contract health services are provided at the expense of the Indian Health Service from public or private medical or hospital facilities other than those of the Service. (e.g. dentists, physicians, hospitals, ambulances). As defined by the Indian Health Services. By regulation, CHSDA shall consist of a county which includes all or part
of a reservation, and any county or counties which have a common boundary with the reservation.

**Dental Visit (Source: BRFSS):** Visited a dentist or a dental clinic for any reason within the past year.

**Dental Workforce Survey:** The Minnesota Office of Rural Health & Primary Care maintains dentistry profiles. Profiles are mailed to dentists annually, and dentists are asked to return the survey with updated profile information.

**Free or reduced lunch program (FRL):** The National School Lunch Program (NSLP) is a federally assisted meal program operating in public and nonprofit private schools and residential child care institutions. It provides nutritionally balanced, low-cost or free lunches to children each school day. The program was established under the National School Lunch Act, signed by President Harry Truman in 1946.

**Fluoride:** A mineral that helps strengthen tooth enamel making teeth less susceptible to decay. Fluoride is ingested through food or water, is available in most toothpaste, or can be applied as a gel, varnish or liquid to the surface of teeth by a health professional.

**Health Insurance Portability and Accountability Act (HIPAA):** A federal law passed in 1996 to promote standardization and efficiency in the health-care industry and to enforce privacy and security of protected health information.

**Hospital-treated oro-dental conditions** were identified from Minnesota Hospital Association (a trade association representing Minnesota’s hospitals and health systems) using the ICD-9-CM diagnostic codes 520-529 (Diseases of the oral cavity, salivary glands, and jaws) and 873.60 –.69 and 873.70 –.79 (open wound of mouth and gum broken tooth. Oral and pharyngeal cancers and surgical corrections of birth defects are excluded.

**Health Professional Shortage Areas (HPSA)**
Health Professional Shortage Areas (HPSA) are designated by HRSA as having shortages of primary medical care, dental or mental health providers and may be geographic (a county or service area), demographic (low income population) or institutional (comprehensive health center, federally qualified health center or other public facility). Medically Underserved Areas/Populations are areas or populations designated by HRSA as having: too few primary care providers, high infant mortality, high poverty and/or high elderly population.

**Minnesota Student Survey (MSS)** is conducted every three years among three populations of students in Minnesota public schools: students in regular public schools, including charter schools and tribal schools (grades 6, 9, and 12 only), students in alternative schools and Area Learning Centers (all grades), and students in juvenile correctional facilities (all grades). The survey asks questions about activities, experiences, and behaviors. Topics covered include tobacco, alcohol and drug use, school climate, physical activity, violence and safety,
connections with school and family, health, and other topics. Questions about sexual activity are asked only of high school students. The survey is administered jointly by the Minnesota Departments of Education, Health, Human Services, and Public Safety.  

**Missing Teeth (Source: BRFSS):** Permanent teeth that have been removed or lost because of tooth decay or gum disease, but not due to other reasons, such as injury or orthodontics.

**National Health and Nutrition Examination Survey (NHANES):** is a program of studies designed to assess the health and nutritional status of adults and children in the United States. The survey is unique in that it combines interviews and physical examinations.

**Oropharyngeal Cancer (Source: MCSS): ICD-10, C00-C14 codes:** Cancers of the oral cavity and pharynx include cancers of the lip, tongue, floor of mouth, gingival, soft and hard palate, salivary gland, tonsil, nasopharynx, hypopharynx, oropharynx, and pharynx.

**Pregnancy Risk Assessment Monitoring System (PRAMS):** A surveillance project of CDC and state health departments. PRAMS collects state-specific, population-based data about maternal attitudes and experiences before, during and shortly after pregnancy.

**Presence of Dental Sealants:** A clinical confirmation of dental sealants applied to one or more permanent molars.

**Preventive Visit (Source: BRFSS):** Adult preventive visits are determined by whether the person’s teeth were cleaned by a dentist or dental hygienist within the past year.

**Sealants:** A thin resin that is usually applied to the biting surfaces on molar teeth to prevent decay.

**Surveillance, Epidemiology, and End Results (SEER):** Program of the National Cancer Institute provides information on cancer incidence, prevalence and survival and mortality from specific geographic areas representing 28% of US population.

**Untreated Decay:** A clinical diagnosis of dental decay in at least one tooth that has not been restored.

**Water Fluoridation:** An adequately fluoridated community water supply is formerly defined as having a level of fluoridation of 0.7 – 1.2 ppm. This can be naturally or artificially supplied. A recently proposed recommendation of 0.7 milligrams of fluoride per liter of water replaces the current recommended range of 0.7 to 1.2 milligrams. This updated recommendation is based on recent Environmental Protection Agency (EPA) and Human Health Services scientific assessments to balance the benefits of preventing tooth decay while limiting any unwanted health effects. These scientific assessments will also guide EPA in making a determination of whether to lower the maximum amount of fluoride allowed in drinking water, which is set to prevent adverse health effects.
**Water Fluoridation Reporting System (WFRS):** provides state oral health program staff a tool to monitor quality of water fluoridation program in their state. State oral health program staff use the data provided by this system to recognize excellent work in water fluoridation and to identify opportunities for continuous improvement in the water fluoridation program.

**Youth Risk Behavior Surveillance System (YRBS):** CDC developed this survey in 1990 to monitor priority health risk behaviors that contribute markedly to the leading causes of death, disability and social problems among youth and adults in the United States. Minnesota does not participate in the survey.
Appendix C: Basic Screening Survey (BSS) for Children in Third Grade

The basic screening survey (BSS) is a standardized cross sectional survey developed by the Association of State and Territorial Dental Directors to assess and monitor oral health status of a population. The survey checks for the presence of dental caries, fillings and significant infection that requires immediate care.

The first statewide BSS was conducted in 2010 on third grade students at 40 randomly selected public schools with classroom size of ten or more students. A total of 1,766 third grade students were observed for the presence of sealant (on at least one molar) and treated and untreated tooth decay (caries experience).

The BSS questionnaire was pre-tested in three pilot schools. Data was collected from the representative sample of schools between February and May 2010 by trained contract staff, MDH staff, and 31 volunteer hygienists. Active consent was obtained from parents or guardians of students prior to screening.

For detailed analysis please refer to the following table.

[http://www.health.state.mn.us/oralhealth/pdfs/BSS2010Table.pdf](http://www.health.state.mn.us/oralhealth/pdfs/BSS2010Table.pdf)
Appendix D: Background on Health Professional Shortage Areas (HPSA)

The designation methodology uses a provider-to-population ratio based on the available primary care provider FTE (full-time equivalent) serving the specified area, population or facility as well as the availability of health care resources in contiguous areas. For instance, a dental HPSA for a geographic area requires a ratio of dentist FTE-to-population ratio of 1:5000 or greater in addition to lack of contiguous services available to the area.

A population HPSA, based on a specific population subset within a geographic area, uses only dentist FTE serving the specified population subset. For example, the ratio for a low-income population designation would be based on the dentist FTE serving Medicaid and/or low-income patients to the population with income status at or below 200 percent of the Federal Poverty Level. The ratio threshold for a population HPSA is 1:4000 or greater. Additionally, the methodology requires that the percentage of the population with incomes at or below 200 percent of the Federal Poverty Level be at 30% or higher and that contiguous services are unavailable. An exception to this methodology is that Native American and Alaskan Native Tribal populations have been afforded automatic population HPSA designations by Congress.

Facility HPSA designations are available to independent facilities serving a designation HPSA population, correctional facilities, state mental health hospitals, Rural Health Clinics (if a discount fee schedule is provided), Comprehensive Health Centers and Federally Qualified Health Center Look-Alikes. Rural Health Clinics, Comprehensive Health Centers and the Federally Qualified Health Center Look-Alikes were given automatic HPSA designations by Congress. The other facility designations are based on a methodology prescribed by federal regulation.
Appendix E: Maps

D1: Rural dental health professional shortage areas in Minnesota

Health Professional Shortage Areas
Dental Designations

Data Source:
Minnesota Department of Health
Office of Rural Health and Primary Care
State DHFS A June 2011, md

[Map of Minnesota showing dental shortage areas]
E2: Urban dental health professional shortage area

Minneapolis & St Paul
Dental Health Professional Shortage Area Designations

NOTE: All areas are low income designations & each color represents a different shortage area.

Data Source: MN Department of Health, Office of Rural Health & Primary Care
September 2010.
Revised ICD-9 codes for Oral Health

Diagnostic codes
520 - 529

V Codes
52.3 - Dental prosthetic device
53.4 - Orthodontic device, fitting
58.5 - Orthodontic, general
72.2 - Dental examination
41.6 - Problems with swallowing and mastication
10.01 - Tongue neoplasm
10.02 - Other and unspecified oral cavity & pharynx

Procedure Codes
23 - 27
REFERENCES


25 National Center for Chronic Disease Prevention and Health Promotion
http://www.cdc.gov/nohss/DSMain.htm


The Pew center on the states, A Costly Dental Destination-Hospital Care Means States Pay Dearly, February 2012.


https://apps.health.state.mn.us/mndata/drinkingwater


http://www.cdphe.state.co.us/pp/oralhealth/impact.pdf


Minnesota department of Health, Minnesota Student Survey. Accessed online June 24, 2011: http://education.state.mn.us/mde/Learning_Support/Safe_and_Healthy_Learners/Minnesota_Student_Survey/index.html


Minnesota Student Survey, 2007. Accessed online June 2011: 

Health Professional Shortage Area (HPSA) Fact Sheet. Office of Rural Health and Primary Care, Minnesota Department of Health, 2012. Accessed online September 2012: 
http://www.health.state.mn.us/divs/orhpc/shortage/fact.pdf


Metro State University Dental Hygiene (BSDH) Baccalaureate Completion Program Accessed online Sept 2012: 
http://www.metrostate.edu/msweb/explore/catalog/undergrad/index.cfm?lvl=U&section=1&page_name=dental_hygiene_bsdh.html


Indian Health Services (IHS), Contract Health Service (CHS). Accessed online June 2011: 
http://www.ihs.gov/nonmedicalprograms/chs/index.cfm?module=chs_requirements_chsda


