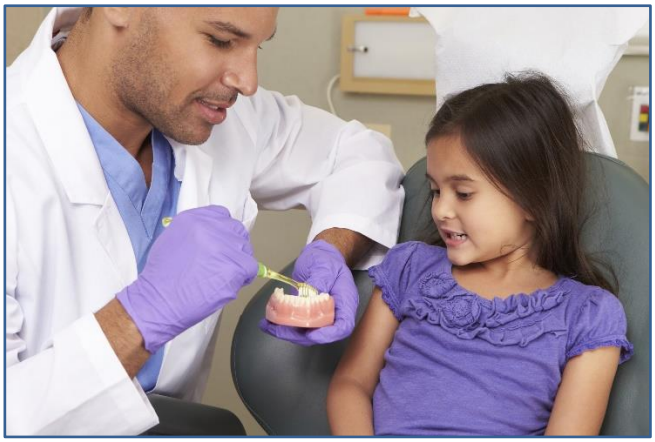

Delaware's Burden of Oral Disease Report

Division of Public Health

Bureau of Oral Health and Dental Services

January 2020

DELAWARE HEALTH AND SOCIAL SERVICES

Division of Public Health

DELAWARE'S BURDEN OF ORAL DISEASE REPORT

January 2020

This report was prepared by
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EXECUTIVE SUMMARY

In 2000, the U.S. Surgeon General's Office published *Oral Health in America: A Report of the Surgeon General*, the first-ever report on Americans' oral health. The report introduced readers to oral health, outlined the status of oral health in the U.S., elucidated the links between oral health and general health, and included recommendations on prevention.

Since its publication, the evidence that poor oral health has broad and costly impact has mounted further. Poor oral health impacts far more than an individual's appearance; it impacts one's ability to eat, communicate, learn, and interact with others. It also impacts general health. Periodontal disease is linked to heart disease, cerebrovascular disease, and diabetes, and may also be linked to dementia, rheumatoid arthritis, and premature birth.

Delaware's Burden of Oral Disease Report, published by the Delaware Department of Health and Social Services, Division of Public Health (DPH), Bureau of Oral Health and Dental Services (BOHDS), is a comprehensive review of available oral health data. This report includes the most recent data available on Delawareans' oral disease burden, the risk behaviors contributing to that burden, and the state's efforts to assure people's oral health. It identifies oral health disparities, which occur among races / ethnicities, differing levels of income and education, and across age groups. It also identifies other factors impacting oral health, such as shortages of dental providers and a lack of dental insurance coverage among Medicaid-eligible adults. It uses measures developed collectively by the Association of State and Territorial Dental Directors (ASTDD), the Council of State and Territorial Epidemiologists (CSTE), and the Centers for Disease Control and Prevention (CDC). Where possible, Delaware's results on these measures are compared with Healthy People 2020 oral health targets.

One purpose of this report is to describe and quantify the burden of oral disease and to highlight areas of particular concern. Another purpose is to compile oral health information residing in many sources and forms into one report that is accessible to all Delawareans. Finally, the report articulates and provides oral health measures and benchmarks for stakeholders to identify priorities, develop interventions, and measure progress toward state and federal objectives.

While BOHDS has published a number of reports and assessments over the years, this is the first comprehensive burden report it has prepared. The report provides a single, comprehensive source of information on the oral health of Delaware's residents, enabling stakeholders to readily access oral health-related information gleaned from multiple sources. Having a "ready reference" to the oral health status of Delaware's residents and to contributing factors allows stakeholders to quickly form a common understanding of Delaware's oral health and move forward with addressing obstacles or removing barriers to continued improvement.

DPH, a nationally accredited health agency, emphasizes population-based services and continually strengthens the state's community-based public health system to meet the needs of Delaware's growing and diverse population. Its vision is healthy people in healthy communities. DPH's four strategic priorities guide its work:

1. Promote healthy lifestyles

2. Improve population health and reduce health care costs
3. Achieve health equity
4. Reduce substance use disorder and overdose deaths.

In addition, DPH has nine Strategic Priorities for Children, four of which relate to oral health:

1. Improve the oral health of children, including children with special health care needs and pregnant women.
2. Reduce youth initiation of tobacco.
3. Improve access to quality care for children (including adequate insurance and medical home and children with special health care needs).
4. Improve the mental health of children (including reduction/coping with bullying).

ASTDD designated several oral health measures as "key" to assuring a state has an adequate oral health surveillance plan in place. These measures require that states:

Program-related:

1. Have a written oral health plan
2. Annually submit to ASTDD data on state oral health programs and the environment in which they operate, including workforce and infrastructure indicators
3. Provide publicly available, actionable oral health data to guide public health policy and programs

Population-related:

Capture a variety of oral health status data:

1. Oral health data for a representative sample of third grade children
2. Permanent tooth loss data for adults
3. Oropharyngeal cancer incidence and mortality
4. Percentage of Medicaid- and Children's Health Insurance Program (CHIP)-enrolled children with a dental visit in the past year
5. Percentage of children age 1-17 years who had a dental visit in the preceding year
6. Percentage of adults (age 18 years and older) and adults with diabetes who had a dental visit in the previous year
7. Fluoridation status of public water systems within the state

Delaware fares well in satisfying the requirements of both the program-related and population-related measures. An oral health surveillance plan is in place, BOHDS routinely submits data to ASTDD, and oral health data are available to stakeholders. Data are available for the identified populations and in many cases, for additional populations.

Moreover, for the population measures, Delaware often meets or exceeds the oral health-related objectives identified under Healthy People 2020 (HP2020):

- Delaware's third grade children fared better than HP2020 targets in all three sub-measures:
  - Fifty-four percent had dental sealants on at least one molar tooth (HP2020 target: 28%)

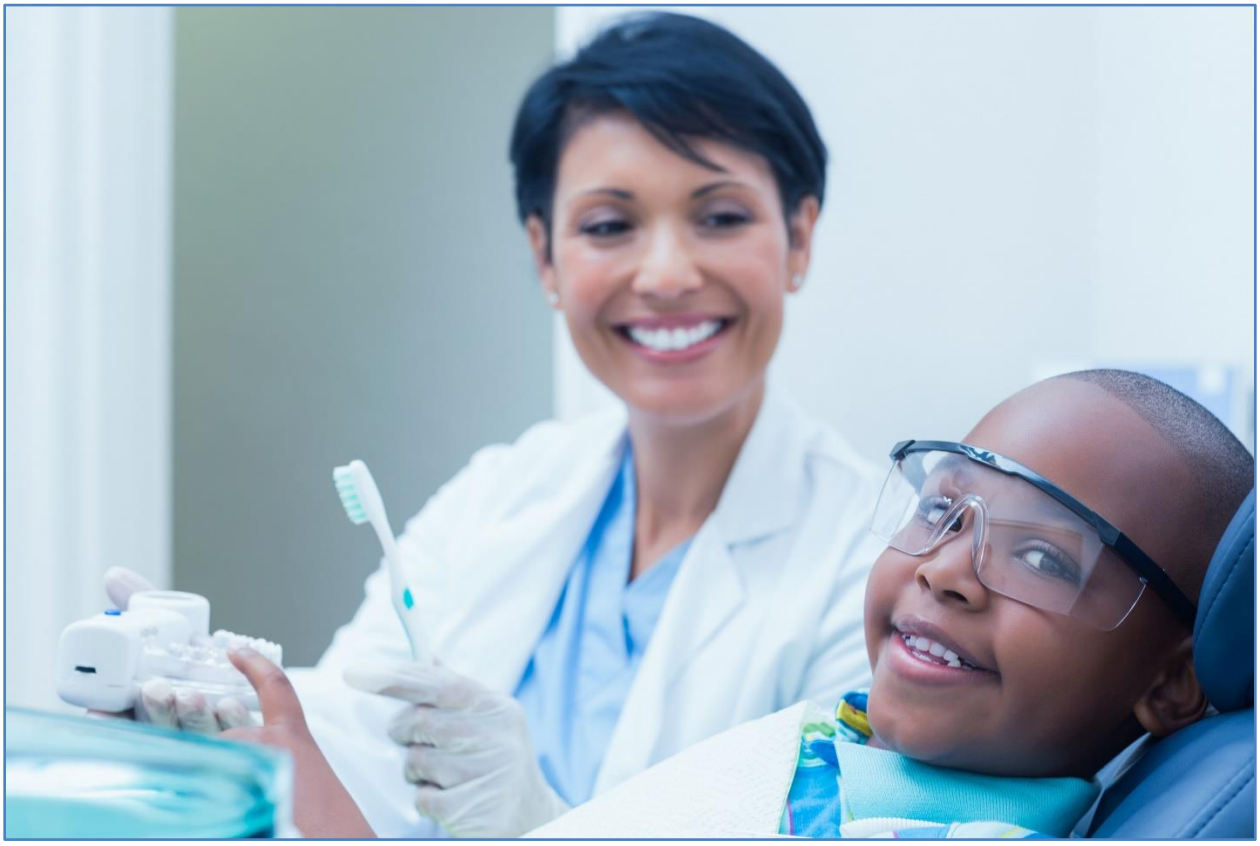
  - Forty-seven percent had decay experience (HP2020 target: 49%)
  - Of those with decay experience, only 16% had untreated dental caries (HPDP 2020 target: 26%).
- Of Delawareans age 45-64 years, 51% have had at least one permanent tooth extracted; just 13% of Delawareans age 65-74 have lost *all* their natural teeth. Both of these are better than the related HP2020 targets of 69% and 22%, respectively.
- Thirty-two percent of oropharyngeal cancers occurring among Delawareans were diagnosed at the earliest stage, lower than the HP2020 target of 36%. Diagnosis of Delaware males at the earliest stage (28% of cases) accounts for Delaware's failure to achieve this HP2020 objective; Delaware females were diagnosed at the earliest stage in 43% of cases.
- Of Delaware's Medicaid- or CHIP-enrolled children, 46% received a dental service in 2016, exceeding the related HP2020 target of 33%.
- Of Delaware's children age 1-17 years, 80% had a dental visit in the previous year; this far exceeds the HP2020 target of 49%.
- Sixty-six percent of all adult Delawareans said in 2016 that they visited the dentist in the past year, as did 56% of Delawareans with diabetes. (There are no HP2020 objectives directly related to these measures.)
- Eight-six percent of Delawareans served by a public water system receive fluoridated water; this exceeds the related HP2020 target of 80%.

Despite this good news, there are opportunities for improvement, as not all populations are equally likely to receive preventive oral health care or dental treatment. Disparities exist among people of differing races and ethnicities, of those with differing levels of income and education, across varying ages, and among persons with access and functional needs. Delaware adults with low incomes are particularly vulnerable since Delaware historically has offered no dental benefits for adult Medicaid beneficiaries. (Limited benefits will become available to Delaware's adult Medicaid beneficiaries on April 1, 2020.)

An evaluation of the oral health workforce suggests that Delaware may not have an ample number of dental providers. Both Kent and Sussex Counties are designated dental Health Professional Shortage Areas (HPSAs), as are portions of New Castle County. The U.S. Health Resources and Services Administration (HRSA) estimates that an additional 56 dentists – distributed strategically throughout the state – would be required to eliminate Delaware's dental HPSAs. Surveys of Delaware dentists completed in 2012 and 2016 found that by 2016, 29 fewer dentists had active Delaware licenses and provided dental care to Delawareans. Additionally, Delaware's existing provider population is aging. At the time of the 2016 survey, 45% were age 55 or older and 23% were at least 65 years of age.

Clearly there are challenges ahead as Delaware seeks to improve its population's oral health. Some challenges are more easily met than others. For instance, providing printed oral health literacy information in languages other than English or at varying reading comprehension levels may be more readily accomplished than developing and implementing targeted outreach programs to bring oral health care to those most difficult to reach. Finding adequate resources to do any of the things which need to be done will be a challenge, no matter how modest the enterprise or the goal.

But Delawareans are resourceful people, with a strong history of working collaboratively to achieve difficult goals. Assuring the oral health of all Delawareans is simply one more opportunity for stakeholders to collectively conceive, develop, and implement strategies and actions to produce necessary results.



Background and Introduction

Delaware's Demographics

Delaware is a small but growing state comprised of three counties. New Castle County, the northern and most urbanized county, includes the state's largest city, Wilmington. Kent County, home to the state capital, Dover, is largely rural. Sussex County, the southern and geographically largest county, encompasses a beach resort area to the east and a rural, agricultural area to the west.

The U.S. Census Bureau's 2016 American Community Survey, five-year estimate, places Delaware's population at 934,695, with 59% residing in New Castle County, 18% in Kent County, and 23% in Sussex County. Just over half the state's population is female (52%); 48% is male.

Sussex County's population is the oldest of the three counties; the median age is 47.6 years, compared to 37.6 years in New Castle County and 37.2 years in Kent County. Nearly a third (32%) of Sussex County residents are age 60 or older, and close to one-quarter (24%) are age 65 or older. In comparison, just one-fifth (20%) of New Castle County residents are 60 or older, with only 14% age 65 or older. Among Kent County residents, 21% are age 60 or older and only 16% are age 65 or older (ACS, 2016).

Close to three-quarters (71%) of Delaware's population is white; 23% is black. Asians compose 4% of the remaining 6%. Sixty-seven percent of New Castle County's population is white as is 70% of Kent County's population; 26% of New Castle County's population is black, as is 27% of Kent County's population. Sussex County's racial distribution differs substantially, with 82% of its population being white and 14% being black (ACS, 2015).

Most Delawareans (91%) are not Hispanic or Latino; 9% are reportedly Hispanic or Latino. This distribution is largely the same within each county, though in Kent County, 7% of its residents are Hispanic or Latino (ACS, 2016).

When reviewing poverty status in the past 12 months, just over one-quarter (28%) of Delaware's overall population had an income below 200% of the federal poverty level (FPL). Thirty-three percent of Kent County residents and 31% of Sussex County residents fell within that range. Twenty-five percent of New Castle County's population had an income below 200% FPL (ACS, 2015).

Wilmington has an estimated population of 71,502. Just over half of the city's population (53%) is female; 47% is male. Wilmington's residents are slightly younger than those of New Castle County as a whole: the median age is 35.3 years, and 13% of residents are age 65 or older. The racial distribution of Wilmington's population differs significantly from that of the state as a whole. Slightly more than one-third (36%) of Wilmington's population is white and 58% is black. The great majority (88%) of Wilmington residents are not Hispanic or Latino; 12% are Hispanic or Latino. A much larger proportion of Wilmington residents (49%) had incomes below 200% of the FPL (ACS, 2015).

The U.S. Health Resources and Services Administration (HRSA) has designated large portions of

Delaware as Health Professional Shortage Areas (HPSAs) and/or as having medically underserved areas or populations (MUA/P). HPSAs may be designated for primary care, mental health, or dental care. Dental care HPSAs in Delaware include: all of Kent County (low income); all of Sussex County (low income); and portions of New Castle County (low income – Wilmington / New Castle County sub-county). Two of Delaware's federally qualified health centers (FQHCs), Westside Health Services and LaRed Health Center, are designated as facility FQHCs. MUA/Ps include all of Kent and Sussex Counties and portions of New Castle County (HRSA, 2018).

Delaware's Oral Health

Given Delaware's recognized dental care shortage areas, an important next step is to assess the impact of that shortage on Delawareans. One purpose of this report is to describe and quantify the burden of oral disease in Delaware, highlighting areas of particular concern. A second purpose is to compile oral health information from many sources and forms into one report that can be easily accessed by all Delawareans. Finally, the report articulates to stakeholders the oral health measures and benchmarks for measuring progress over time.

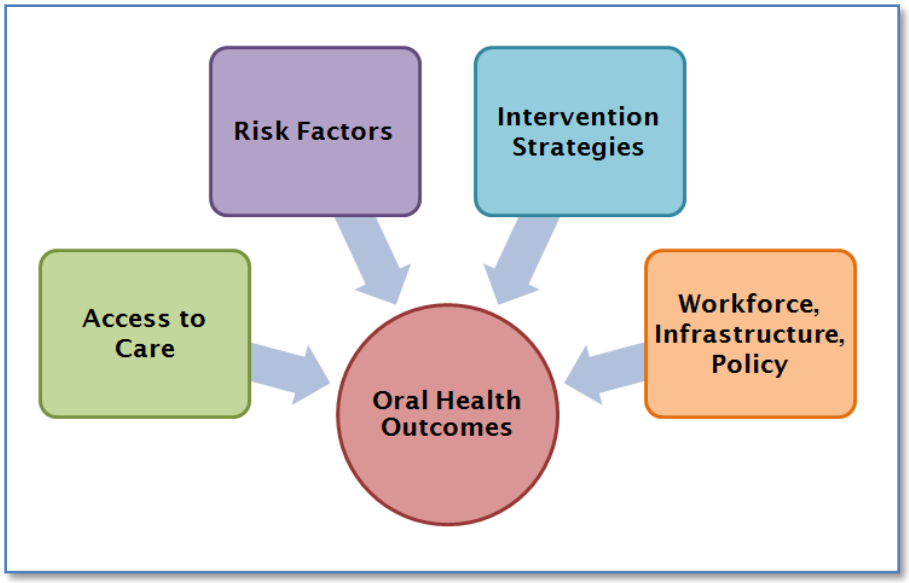
Delaware routinely collects oral health-related information available through a number of standard sources recognized by ASTDD and the CSTE. These include the Behavior Risk Factor Surveillance System (BRFSS); the Youth Risk Behavior Survey (YRBS); the National Survey of Children's Health (NSCH); and annual reporting data submitted to the U.S. Centers for Medicare and Medicaid Services (CMS), the U.S. Health Resources and Services Administration (HRSA), and the U.S. Office of Head Start. In addition, Delaware conducts periodic, targeted data collection. Examples include a survey of the oral health of Delaware's third-grade children (most recently conducted in 2012-13), a 2016 survey of dentists in Delaware, and program data compiled from the Delaware Smile Check program.

The Burden of Oral Disease

In the United States, the two most common oral diseases are dental caries (tooth decay) and periodontal (gum) disease. Other less common oral diseases include cancers of the oral cavity and pharynx, orofacial clefts (cleft lip and cleft palate), malocclusion, and oral-facial pain. All of these can severely affect general health and quality of life. Poor oral health impacts the ability to eat, communicate, and learn, and affects how we look and interact with others (Phipps, 2013).

Several factors influence oral diseases or conditions, also known as "oral health outcomes" (Figure 1). These factors include access to dental care, individual risk factors, availability of interventions, adequacy of the oral health workforce, financing issues, public health infrastructure, and public policies (Phipps, 2013).

Figure 1: Factors Impacting Oral Health Outcomes



Source: State-based Oral Health Surveillance Systems, Conceptual Framework and Operational Definition. Phipps et al. 2013

A brief overview of the major oral health outcomes, including common risk factors and intervention strategies, illustrates the relationship between oral health and general health and underscores the importance of improving oral health.

Dental Caries

In 2010, the U.S. Surgeon General Dental noted that dental caries is the most common chronic childhood disease (Benjamin, 2010). In 2011-2012, approximately 37% of U.S. children age 2-8 years had experienced dental caries in primary teeth, while 21% of children age 6-11 and 58% of adolescents age 12-19 had experienced dental caries in permanent teeth (Dye, NCHS brief 191, 2015). The impact of dental caries accumulates over time; of those 20-64 years of age, 91% had treated or untreated caries experience (Dye, NCHS brief 197, 2015). The prevalence of dental caries experience is generally higher in low-income and minority populations, representing a significant health disparity (Phipps, 2013).

There are effective preventive intervention strategies for dental caries. The prevalence and severity of caries can be reduced through community water fluoridation, personal or professional topical fluoride applications, and using toothpaste with fluoride.

The CDC has recognized community water fluoridation as one of the 10 great public health achievements of the 20th century, yet not everyone has access to fluoridated water (CDC, 1999). Approximately 88% of Delaware's population is served by a community water system; of the people served by these systems, 86% receive fluoridated water (My Water's Fluoridation, 2018).

Another important component of caries prevention, early detection and treatment, is regular dental care such as routine dental visits and screening. HP2020 objectives include increasing the proportion of children, adolescents, and adults who have used the oral health care system in the past year, with an

aim to increase that proportion from a 2007 baseline of 44.5% to 49.0% by 2020. Another objective specifically targets increasing the proportion of low-income children and adolescents who have received preventive dental services during the past year from 30.2% in 2007 to 33.2% by 2020.

Delaware monitors indicators developed by CSTE that correspond to these objectives. One relies on figures drawn from the NSCH. The 2016 NSCH found that 80% of Delaware's children age 1-17 years had seen a dental or other oral health care provider for preventive dental care within the preceding 12 months. However, the percentage varied markedly across age groups. Fifty-five percent of children age 1-5 years had seen a dentist in the prior year, compared to 92% of children age 6-11 years and 90% of adolescents age 12-17 years.

A 2016 survey revealed that just 55% of 1- to 5-year-old children in Delaware saw an oral health professional for preventive dental care in the past 12 months.

A second source of data on dental visits among young Delawareans is the YRBS, administered every two years to a representative sample of Delaware's middle school and high school students. The 2015 YRBS revealed that 73% of students in grades 9-12 had seen a dentist within the previous 12 months; the middle school version of the survey did not include an oral health-related question that year. The 2017 survey included an oral health-related question in both the middle school and high school versions of the survey, but results for that question are not available for Delaware.

Another measure focusing on children and adolescents focuses on those eligible to participate in the Early Periodic Screening, Detection and Treatment (EPSDT) program. Summary reports for that program, submitted annually to the Centers for Medicare and Medicaid Services (CMS) revealed that in Fiscal Year 2017, 42% of Delaware's children who were age 1-20 years and eligible for EPSDT services received a dental service (e.g., a screening or treatment).

A measure of adult Delawareans' oral health visits is drawn from the results of the BRFSS, an annual survey of a representative sample of Delaware's population age 18 years or older. Delaware's 2016 BRFSS revealed that two-thirds (66%) of Delawareans overall had visited a dentist or dental clinic within the past year. Sixty-eight percent of females had done so, slightly more likely than 64% of males. Younger Delawareans age 18-24 were the most likely (74%) to have had a dental visit in the previous year; those age 25-34 years were the least likely (58%) to have had such a visit.

Dental sealants are another effective intervention, preventing caries development in the pits and fissures of molar (back) teeth (Ahovuo-Saloranta, 2013). Dental sealants can be applied in dental offices or community settings such as schools, yet not all children are benefiting from this proven preventive service. In 2011-2012 in the U.S., only 31% of children age 6-8 years, 49% of children age 9-11 years, and 43% of adolescents age 12-19 years had dental sealants on at least one permanent molar (Dye, NCHS brief 191, 2015).

Sealant presence among some of Delaware's children appears to be somewhat better than in the U.S. overall. A survey of Delaware's third-grade children, conducted in 2013 by the BOHDS, demonstrated the presence of sealants in 54%. More recently, a 2018 assessment of sealant prevalence among

children age 6 to 9 years who were deemed to be at increased risk of caries and who received oral health care at a Delaware FQHC, also found that 54% had sealants on their first molars (HRSA, Bureau of Primary Health Care).

To reduce the prevalence of untreated dental decay, all individuals, regardless of income or dental insurance coverage, must have access to restorative dental care. Infrastructure, workforce, financing, and policy factors influence access to dental care. Policy factors include availability of low-cost clinics, dentist-to-population ratio, percent of dentists accepting government-funded dental insurance, reimbursement rates for government-funded programs, and dental practice acts involving supervision, scope of practice, and reimbursement (Phipps, 2013).

Periodontal Disease

Periodontal disease is another common public health problem in the United States. While periodontal disease is a disease of the gums, its impact is felt throughout the body. Links have been established between periodontal disease and heart disease, cerebrovascular disease, and diabetes (Wu, 2000; Janket, 2003; Preshaw, 2012). Links may also exist between periodontal disease and dementia, rheumatoid arthritis, and premature birth (WebMD, 2018).

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Exactly what is responsible for these links is unknown. One factor may be that the bacteria causing the periodontitis escapes into the bloodstream and migrates to other organs. Another factor may be that the gum inflammation, a hallmark of periodontitis, may result in widespread inflammation. Inflammation is known to be an underlying problem in heart disease and rheumatoid arthritis (WebMD, 2018). Whatever the links prove to be, periodontal disease clearly has implications well beyond the oral cavity.

Periodontitis is characterized by loss of the bony structure supporting the teeth; it results in partial or total tooth loss. Assessment of the prevalence and severity of periodontitis is included in the National Health and Nutrition Examination survey (NHANES), and involves taking measurements of adult participants' teeth to assess gum recession and depth of periodontal pocket at multiple sites per tooth. The combined 2009-2012 NHANES results revealed that 46% of U.S. adults 30 years and older had periodontitis, with 9% having severe periodontitis (Eke, 2015). (Severity was defined as per case definitions developed by the CDC and the American Academy of Periodontology [Eke, 2012]).

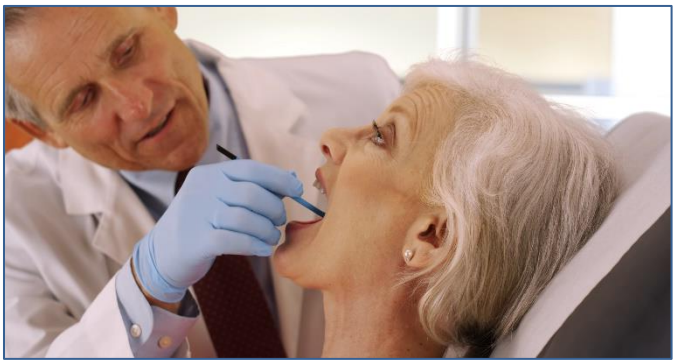
As with dental caries, substantial periodontal disparities exist. The prevalence of periodontitis (NHANES, 2009-2012) was:

- Higher in men (55%) than in women (38%);
- Higher among Hispanics and non-Hispanic blacks (68% and 60%, respectively) than among non-Hispanic whites (40%);
- Higher in adults with less than a high school education (67%) than among those with a high school education (56%) or with an education beyond high school (38%);

- Higher in adults below 100% of the federal poverty level (FPL) and those at 100-199% FPL (64% and 58%, respectively) than among those at 200-399% FPL: 48%; or at/above 400% FPL: 33%); and
- Higher among current smokers (67%) than among former smokers (49%) or non-smokers (38%) (Eke, 2015).

The most common risk factor for periodontitis is smoking. Tobacco use prevention and cessation could be a potentially effective population-level intervention strategy (Phipps, 2013).

No state- or local-level measures allow direct assessment of periodontal disease in adults. A "proxy" for such a measure might be tooth extractions, which sometimes result from periodontal disease. Questions related to tooth extractions are included in the BRFSS. One such question assesses the proportion of adults who have ever had any permanent tooth extracted due to dental caries or periodontitis; another examines the proportion of adults who have lost all their permanent teeth. The 2016 BRFSS found that 45% of Delawareans age 45-54 years and 56% of adults age 55-64 years had a permanent tooth extracted due to dental caries or periodontitis. Among adults age 65 years and older, 17% had had all their teeth extracted, though this varied by age group. Just 13% of adults age 64-75 had all their teeth extracted, compared to 24% of those age 75 years and older.



Cancers of the Oral Cavity and Pharynx

Although substantially less common than dental caries and periodontitis, cancers of the oral cavity and pharynx have a significant impact on the health care system and merit inclusion in public health surveillance (Phipps, 2013). The National Cancer Institute estimates that in 2017 there will be 49,670 new cases of and 9,700 deaths from cancers of the oral cavity and pharynx (SEER) in the United States. Cancers of the oral cavity and pharynx are more common in men than women, among those with a history of tobacco or heavy alcohol use, and among individuals infected with human papillomavirus (HPV) (Phipps, 2013).

Based on 2010-2014 data, the number of new cases of oral cavity and pharynx cancer in the U.S. was 11.2 per 100,000 people per year (SEER). In Delaware, the five-year incidence

rate during the period 2010-2014 was 12.6 per 100,000, with the incidence rate among men (19.7 per 100,000) three times that of the incidence rate among women (6.5 per 100,000). Oral cancer was more likely to be diagnosed at the local stage among women (43%) than among men (28%). The peak age for oral cancer incidence was 75-84 years for both men and women. Among whites, the incidence rate of 13.8 per 100,000 was significantly higher than the rate of 7.8 per 100,000 among non-Hispanic blacks (DHSS, Cancer I&M, 2018).

Delaware's 2010-2014 oral cancer mortality rate (2.9 per 100,000) was slightly above that of the U.S. (2.5 per 100,000). The oral cancer mortality rate among Delaware men (4.6 per 100,000) was significantly higher than among Delaware women (1.5 per 100,000) (DHSS, Cancer I&M, 2018).

Currently, the primary public health and personal prevention strategies for oral cancer are cessation of all tobacco practices (e.g., smoking, use of snuff, or chewing tobacco). Another strategy is to reduce alcohol consumption; about 70% of people with oral cancer have an alcohol use disorder (DHSS, Cancer I&M, 2018). Completing the HPV vaccine series might prevent oral cavity and pharynx cancers since they prevent initial infection with HPV types that cause these cancers. Studies to determine this have not yet been done (CDC, HPV).

Orofacial Clefts

For reporting purposes, orofacial clefts are generally classified as either: 1) cleft palate without cleft lip; or 2) cleft lip with and without cleft palate. Based on 2004-2006 data from 14 population-based birth defects tracking programs, the estimated U.S. incidence of cleft palate without cleft lip is one in 1,574 live births (2,651 cases annually), and the U.S. incidence of cleft lip with or without cleft palate is one in 940 live births (4,437 cases annually) (Parker, 2010). The average U.S. prevalence of cleft lip with or without cleft palate is 7.75 per 10,000 live births (Tanaka, 2012). Delaware birth defect surveillance program data for the five-year period 2010-2014, reveal an overall prevalence of cleft lip alone of 2.9 per 10,000 live births, cleft palate alone of 6.3 per 10,000 live births, and cleft lip with cleft palate of 6.3 per 10,000 live births (NCBDDD, 2017).

Cleft lip and cleft palate are thought to be caused by a combination of genes and other factors, such as using tobacco during pregnancy, maternal diabetes (diagnosed before pregnancy), and using certain medications used to treat epilepsy during the first trimester of pregnancy (CDC, 2017).

Financial Implications

The cost of treating dental disease is significant. The costs of oral disease treatment are significant, and the majority of those costs are paid by individuals or through private insurance. Many people cannot afford dental care or do not take advantage of public insurance benefits (Phipps, 2013).

Every $1 spent on community water fluoridation yields $38 in savings on dental treatment costs.

According to CMS, spending for dental services in 2017 was $129.1 billion, with out-of-pocket personal spending accounting for approximately 41% of all dental spending (CMS, 2017). Use of preventive measures, however, could substantially reduce these

costs. Fluoridation is one such measure. According to the CDC, every $1 invested in community water fluoridation saves $38 in dental treatment costs. An analysis of Medicaid dental program costs reveals that costs in fluoridated communities are less than half than those in non-fluoridated communities. State-based studies of dental costs also have documented savings in treatment costs through community water fluoridation (Lincoln & Alerte, 2013). In Delaware, community water systems served 781,582 people in 2018 (My Water's Fluoride, 2018), or about 80% of Delaware's total population of 974,051 (DPC, 2018). Of those served by community water systems, 670,990 (86%) had fluoridated water (My Water's Fluoride, 2018). Delaware law requires fluoridation of municipal water systems, but not rural water systems (Delaware Code, 1998).

While it seems likely that preventive oral health care among young children would result in reductions in the cost of non-preventive care, the evidence is scant. One carefully designed study of over 36,000 children enrolled in Alabama's Children's Health Insurance Program for at least three contiguous years between 1998 and 2010, showed an association between more preventive dental visits and fewer subsequent non-preventive visits and lower expenditures (Sen et al, 2013). However, the reduction in expenditures was insufficient to offset the cost of more frequent preventive visits (Sen et al, 2013).

A model developed by Ramos-Gomez and Shepard, of the University of California at San Francisco, assessed the cost effectiveness of various prevention strategies for low income children in California, and found the use of dental sealants to be highly cost-effective. Sealant use reduced decay by up to 60%, with an estimated cost savings for preventive care of $66 to $73 per cavity prevented among young Medicaid children (Ramos-Gomez FJ & Shepard DS, 1999, as cited by Lincoln & Alerte, 2013).

There may well be an association between early preventive oral health care and subsequent savings on non-preventive care. More in-depth studies – expanded to include factors that cannot be studied with currently available data – will be required to establish that association.

Societal Impact

The public health implications of poor oral health status are vast. Poor oral health impacts a person's ability to eat, speak, work, communicate, and learn. Although most oral diseases and conditions are preventable, virtually all adults—and many children—have experienced some oral disease (Phipps, 2013). Children with severe caries experience pain, disfigurement, acute and chronic infections, and problems with eating and sleeping. They may perform less well at school, and may also be at higher risk of hospitalization and higher treatment costs (Marmot & Fenton, 2015; Sheiham, 2005). Caries affect nutrition, growth and weight gain (Sheiham, 2005). The unaesthetic nature of untreated tooth decay compromises children's self-esteem and social development (Consequences, n.d.)

Poor oral health impacts a person throughout the lifecourse. Poorer school performance may lead to reduced employment opportunities, poor self esteem, and social isolation (Marmot & Fenton, 2015). Dental caries among adolescents and adults may cause impaired chewing, biting, and swallowing, impacting food selection and nutrition (Sheiham, Conway & Chestnutt, 2015; Sweeny, n.d.). Especially among older adults, poor oral health – including untreated caries, gum disease, and missing teeth – may result in malnutrition (Morris, Engelberg, Orozco & Schmitthenner, 2019). Dental caries also may cause

sleep problems and poorer work performance (Sheiham et al, 2015), as well as problems speaking, which can result in social isolation (Sweeny, n.d.). Physical attractiveness compromised by poor oral health may impact subjective wellbeing and social happiness (Listl & Wildman, 2015). Adults with incomes below 138% of the federal poverty level report that the appearance of their teeth and mouth affected their ability to interview for a job (Frakt, 2018).

Serious oral health disparities exist by gender, race, age, geography, educational attainment, and income (Phipps, 2013). People from disadvantaged backgrounds experience higher levels of dental diseases (Marmot & Fenton, 2015). Children in lower income groups have a higher rate of dental decay, often enduring chronic dental pain; children with poor oral health are almost three times more likely to miss days from school as a result of dental pain ad have poorer school performance (Sheiham, et al, 2015).

National and State Objectives on Oral Health

Assessing the burden of any disease requires broadly agreed, readily available, population-based measures which can be used to identify a baseline, develop a target to work toward, and measure progress toward that target. Several organizations and initiatives coalesced late in the 20th century and early in the 21st century to address oral health in the U.S. population.

Oral Health in America – the first-ever report on the status of Americans' oral health – was published just 20 years ago, in 2000.

One major motivator came from the U.S. Surgeon General's Office, which in 2000 published *Oral Health in America: A Report of the Surgeon General*, the first-ever report on Americans' oral health. The report introduced readers to oral health, outlined the status of oral health in the U.S., elucidated the links between oral health and general health, included recommendations on prevention, and served as a call to action to improve oral health. Before its publication, several organizations were working with the CDC to establish mechanisms enabling the assessment, monitoring, and measurement required to implement the report's recommendations. In 1999, the CSTE approved seven indicators of oral health developed under the leadership of the ASTDD, with support from the CDC's Division of Oral Health. Three of the seven indicators were for adults (most recent dental visit, most recent dental cleaning, and total tooth loss). Three indicators were for third grade children (presence of treated or untreated dental caries, untreated tooth decay, and use of dental sealants). One indicator was related to public water systems (the percentage of the population served by a public water system that receives optimally fluoridated water) (Malvitz, 2009).

In 2001, shortly after the Surgeon General's report was published, the CDC launched a website describing the National Oral Health Surveillance System (NOHSS) and providing access to data through which the oral health indicators related to adults and to public water systems could be monitored. (Data for the indicators related to children were added later.) Development of the indicators and creation of the NOHSS enabled states – in most cases, for the first time – to monitor oral health-related indicators (Malvitz, 2009).

Another national initiative undertaken by the DHHS, Healthy People, also looked at oral health. First established in 1979 as objectives for Healthy People 1990, the objectives are updated by decade, i.e., Healthy People 2000, Healthy People 2010, and Healthy People 2020 (HP2020). The initiative is based on the principle that setting national objectives and monitoring progress can incentivize state and local action. HP2020 includes oral health as one of the 42 topic areas; the identified overall HP2020 goal of oral health is to "…prevent and control oral and craniofacial diseases, conditions and injuries, and improve access to preventive services and dental care." (Phipps, 2013)

As it is a national initiative, HP2020 focuses on national-level data sources, many of which do not support state-level estimates. This limits the capacity of those sources to directly serve state-based oral health planning and implementation efforts. To address that gap, in 2012 a workgroup comprising representatives from ASTDD, CDC, and CSTE proposed expanding the data sources included in NOHSS to

enable state-level captures of a broader, richer array of data. By doing so, states could leverage many of the new electronic data sources that emerged after the NOHSS (and the original indicators) were developed. Examples of such data sources include electronic health records in many service sectors, vital statistics data, Medicaid and Children's Health Insurance Program (CHIP) data, National Survey of Children's Health (NSCH) data, and the Pregnancy Risk Assessment System (PRAMS) data. Additionally, ASTDD developed a new Basic Screening Survey (BSS) tool for states to use in collecting health data for groups that might not be included in existing sources, such as preschool children or vulnerable older adults (Phipps, 2013).

Using a broader array of data sources also enabled the expansion of the list of approved NOHSS indicators from the original seven in 1999 to 36 as of July 2017 (Table 1) (ASTDD, 2017; CSTE, n.d.). As the HP2020 and the NOHSS initiatives continue to focus on surveillance of two different populations, the nation as a whole (HP2020) and each state (NOHSS), there is not direct correlation among all measures. Each targets a different population, so specific indicators, indicator definitions, data collection methods, and data sources differ between the two. Work continues on harmonizing the indicators, to reduce the burden of data capture, and to leverage both the information collected and efforts undertaken to meet each set of measures.

Table 1. Approved National Oral Health Surveillance System (NOHSS) Indicators; Current Healthy People 2020 Objectives

NOHSS Indicator #	CSTE-approved Indicator for NOHSS	State Data Source[1]	HP2020 Objective[2]	National Data Source[1]
1	Preventive dental visit among children age 1-17 years	NSCH	OH-7: Dental visit in past year, age 2+ years	MEPS
2	Preventive dental service for children age 1-20 years enrolled in Medicaid / CHIP Medicaid expansion	CMS-416	OH-8: Preventive dental service past year, children age 2-18 years, <=200% Federal poverty level	MEPS
3	Dental visit among children age 1-17 years	NSCH	OH-7: Dental visit in past year, age 2+ years	MEPS
4	Any dental service for children age 1-20 years enrolled in Medicaid / CHIP Medicaid expansion	CMS-416		
5	Dental visit among adolescents in grades 9-12	YRBSS		
6	Dental visit among adults age =>18 years	BRFSS		
7	Dental visit among adults age =>18 years with diagnosed diabetes	BRFSS	D-8: Diabetics with annual dental exam	NHIS

Table 1. Approved National Oral Health Surveillance System (NOHSS) Indicators; Current Healthy People 2020 Objectives (continued)

NOHSS Indicator #	CSTE-approved Indicator for NOHSS	State Data Source[1]	HP2020 Objective[2]	National Data Source[1]
8	Population receiving oral health services at Federally Qualified Health Centers (FQHC)	UDS	OH-11: FQHC patients with a dental visit	UDS
			OH-10: Oral health programs in FQHCs	UDS
			OH-10: Oral health programs in local health departments	Synopses
9	Teeth cleaning among women *before* pregnancy	PRAMS		
10	Teeth cleaning among women *during* pregnancy	PRAMS		
11	Dental caries experience among children age 3-5 years attending Head Start	DSS	OH-1: Dental caries experience among children age 3-5 years	NHANES
12	Dental caries experience among children attending kindergarten	DSS		
13	Dental caries experience among 3rd grade children	DSS	OH-1: Dental caries experience among children age 6-9 years	NHANES
			OH-1: Dental caries experience among children age 13-15 years	NHANES
14	Untreated dental caries among children age 3-5 years attending Head Start	DSS	OH-2: Untreated dental decay among children age 3-5 years	NHANES
15	Untreated dental caries among children attending kindergarten	DSS		
16	Untreated dental caries among 3rd grade children	DSS	OH-2: Untreated dental decay among children age 6-9 years	NHANES
			OH-2: Untreated dental decay among children age 13-15 years	NHANES
			OH-3: Untreated dental decay among adults age 35-44 years	NHANES
17	Untreated dental caries among adults 65+ years of age in long-term care or skilled nursing facilities	DSS	OH-3: Untreated dental decay among adults age 65-74 years	NHANES

Table 1. Approved National Oral Health Surveillance System (NOHSS) Indicators; Current Healthy People 2020 Objectives (continued)

NOHSS Indicator #	CSTE-approved Indicator for NOHSS	State Data Source[1]	HP2020 Objective[2]	National Data Source[1]
18	Untreated dental caries among adults age 65+ years attending congregate meal sites	DSS	OH-3: Untreated dental decay among adults age 75+ years	NHANES
19	Urgent dental treatment need among children age 3-5 years attending Head Start	DSS		
20	Urgent dental treatment need among children attending kindergarten	DSS		
21	Urgent dental treatment need among 3rd grade children	DSS		
22	Dental treatment need among adults 65+ years of age in long-term care of skilled nursing facilities	DSS		
23	Dental treatment need among adult age 65+ years attending congregate meal sites	DSS		
24	Dental sealants among 3rd grade children	DSS	OH-12: Dental sealants on molar teeth among children age 3-5 years	NHANES
25	Dental sealant use among children age 6-9 years enrolled in Medicaid / CHIP Medicaid expansion	CMS-416	OH-12: Dental sealants on molar teeth among children age 6-9 years	NHANES
26	Dental sealant use among children age 10-14 enrolled in Medicaid / CHIP Medicaid expansion	CMS-416	OH-12: Dental sealants on molar teeth among children age 13-15 years	NHANES
27	No tooth loss among adults age 18-64 years	BRFSS		
28	Six or more teeth lost among adults age 65+ years	BRFSS	OH-4: Permanent tooth extraction among adults age 45-64 years (1+ tooth)	NHANES
29	All teeth lost among adults age 65+ years	BRFSS	OH-4: Permanent tooth extraction among adults 65-74 years (all teeth)	NHANES
30	Incidence of invasive cancer of the oral cavity or pharynx	NPCR	OH-6: Early detection of oral cancer (all ages)	NPCR/ SEER
31	Mortality from invasive cancer of the oral cavity or pharynx	NPCR	C-6: Oropharyngeal cancer death rate	NVSS

Table 1. Approved National Oral Health Surveillance System (NOHSS) Indicators; Current Healthy People 2020 Objectives (continued)

NOHSS Indicator #	CSTE-approved Indicator for NOHSS	State Data Source[1]	HP2020 Objective[2]	National Data Source[1]
32	School-based Health Centers that provide dental sealants	SBHCC	OH-9: School-based Health Centers with sealants	SBHCC
33	School-based Health Centers that provide dental care	SBHCC	OH-9: School-based Health Centers with dental care	SBHCC
34	School-based Health Centers that provide topical fluoride	SBHCC	OH-9: School-based Health Centers with topical fluorides	SBHCC
35	Population served by community water fluoridation	WFRS	OH-13: Community water fluoridation	WFRS
36	State-based oral health surveillance system	Synopses	OH-16: State-based oral health surveillance system	Synopses
			OH-5: Moderate or severe periodontitis among adults age 45-74 years	NHANES
			OH-14: Preventive interventions (tobacco cessation, oral cancer screening & glycemic control) in dental office - adults	NHANES
			OH-15: Craniofacial anomalies – recording system and referral system	Synopses
			OH-17: Health agencies with dental public health program – Local agencies =>250,000	Synopses
			OH-17: Health agencies with dental public health program – IHS/Tribal	IHS
			AHS-1.2: Persons with dental insurance	NHIS
			AHS-6.3: Ability to obtain dental care	MEPS

[1]Data source abbreviations are as follows: BRFSS: Behavior Risk Factor Surveillance System; BSS: Basic Screening Survey; CMS-416: Centers for Medicare and Medicaid Services, form 416; IHS: Indian Health Service; MEPS: Medical Expenditure Panel Survey; NHANES: National Health and Nutrition Examination Survey; NHIS: National Health Interview Survey; NPCR: Nation Program of Cancer Registries; NSCH: National Survey of Children's Health; NVSS: National Vital Statistics System; PRAMS: Pregnancy Risk Assessment Monitoring System; SBHCC: School-based Health Center Census; SEER: Surveillance, Epidemiology and End Results (program); Synopses: ASTDD State Synopses; UDS: Uniform Data Set; WFRS: Water Fluoridation Reporting System; YRBSS: Youth Risk Behavior Surveillance System

[2]Leading alpha-numeric is the HP2020 objective reference number. A few objectives related to oral health appear in topic areas other than the specific Oral Health topic area. The leading alphas indicate the topic areas: OH=Oral Health; C=Cancer; D=

Diabetes; AHS=Access to Health Services.

Sources: *Phipps, et al. (2013). State-based Oral Health Surveillance Systems*
Chronic Disease Committee, Council of State and Territorial Epidemiologists. (2015). Revision to the National Oral Health Surveillance System Indicators
ASTDD. (2017). Best Practice Approaches for State and Community Oral Health Programs & State Surveillance Data Reference Guide

CSTE has determined that a minimally acceptable state oral health surveillance system (SOHSS) must include at least 10 key indicators (Table 2) (ASTDD, 2017). Note that some individual NOHSS indicators are combined into a single CSTE indicator, e.g., individual NOHSS indicators for 1) cancer incidence and 2) cancer mortality were combined into a single CSTE "cancer incidence and mortality" indicator.

Table 2. CSTE-identified "key indicators," essential to a minimally acceptable state oral health surveillance system

NOHSS Indicator #	CSTE-Identified Key Indicators	Currency
36	A written oral health surveillance plan	Developed / updated in previous 5 years
13	Oral health status data which meets criteria for inclusion in NOHSS for a representative sample of 3rd grade children	Collected within previous 5 years
27-29	Permanent tooth loss data for adults	Obtained within previous 2 years
30-31	Data on oropharyngeal cancer incidence and mortality	Obtained annually
2 & 4	Data on percent of Medicaid- and CHIP-enrolled children with dental visit in past year	Obtained annually
3	Data on percent of children age 1-17 years who had a dental visit in the previous year	Obtained every 4 years
6-7	Data on percent of adults (age 18+ years) and adults with diabetes who had a dental visit in previous year	Obtained within previous 2 years
35	Data on fluoridation status of public water systems within the state	Updated every 2 years
36	Submission to ASTDD of annual data on state oral health programs and environment in which they operate, including workforce and infrastructure indicators	Submitted annually
All	Publicly available, actionable oral health data to guide public health policy and programs	Developed / updated in previous 5 years

Source: ASTDD, 2017 State Surveillance Data Reference Guide.

The burden of oral disease in Delaware – as measured using data available on the above-listed indicators and objectives – is detailed in the next section. Where possible, Delaware data are compared to national data, and to the HP2020 targets. When Delaware data is not available, but national data is, that data are included as items of information for stakeholders to use as they plan and implement programs and policies aimed at improving Delawareans' oral health. Stakeholders are communities, individuals and families, organizations, professionals, schools, worksites, decision-makers, and

government agencies.

The Burden of Oral Disease in Delaware

The BOHDS leads state efforts to monitor and improve Delawareans' oral health. BOHDS' mission is to promote and provide essential public health services to improve the oral health and well-being of all Delawareans. Its vision is that Delawareans will experience an enhanced quality of life through optimal oral health. The Bureau seeks to fulfill its mission by achieving four overarching goals:

1. To support access to quality oral health services particularly for families with disadvantaged backgrounds.
2. To decrease the burden of oral disease among Delawareans through the promotion of oral health and the delivery of essential preventive services.
3. To develop infrastructure that will enable and support community based public health activities prioritizing oral health.
4. To protect overall health through advancements in oral health care (BOHDS, 2019).

The Burden of Oral Disease in Delaware, 2020 provides stakeholders with oral health-related information and will serve as a baseline for BOHDS to measure progress.

Oral Health Assessment Indicators

Information on Delaware's status with regard to the CSTE-approved NOHSS indicators and HP2020 objectives are presented in the order that they appear in Table 1. The NOHSS indicators appear in **boldface** type. Note that in some cases, a single key indicator (e.g., "cancer incidence and mortality") is separated within the NOHSS into two indicators – in this example, one for incidence and one for mortality. Additional HP2020 objectives related to oral health, but not yet expressed as NOHSS indicators, follow the NOHSS indicators.

NOHSS Indicators for a State Oral Health Assessment

NOHSS Indicator	Description	Required Currency	In Place	Comment
All	Publicly available, actionable oral health data to guide public health policy and programs	Developed / updated in previous 5 years	~√	Delaware Smiles report was published in 2013; Burden of Oral Disease report will be published in 2020

Since the early 2000s, BOHDS has worked to provide actionable oral health data to its stakeholders. BOHDS published the results of its most recent third grade survey in its 2013 *Delaware Smiles* report. BOHDS also finalized a plan for an ongoing, state-based Oral Health Surveillance System (OHSS) in December 2019 and published its first comprehensive burden report in January 2020. BOHDS also

prepared multiple targeted publications, including *Recommendations for Oral Health in Long-term Care Facilities* in 2017, available on the bureau's website (https://www.dhss.delaware.gov/dhss/dph/hsm/ohpreports.html).

Related HP2020 Objective: All: The availability of data is essential to appropriate planning, effective implementation, and ongoing monitoring. Publicly available, actionable data speak also to HP2020's overarching mission, which includes increasing public awareness and understanding of the determinants of health, disease, and disability and the opportunities for progress; the use of measurable objectives and goals that are applicable at the national, state, and local level; and the engagement of multiple sectors to take actions to strengthen policies and improve practices that are driven by the best available evidence and knowledge (HP2020, n.d.).

NOHSS Indicator	Description	Required Currency	In Place	Comment
1 & 3	**Data on percent of children age 1-17 years who had a dental visit / preventive dental visit in the previous year**	Obtained every 4 years	√	Data are available from the most recent National Survey of Children's Health (2016).

The NSCH, most recently conducted in 2016 by the U.S. Census Bureau, found that 80% of Delaware's children age 1-17 years had seen a dental or other oral health care provider for preventive dental care within the preceding 12 months. The percentage was nearly identical across the sexes, with 79% of males and 81% of females having had such a visit. However, the percentage varied markedly across age groups. Fifty-five percent of children age 1-5 years had seen a dentist in the prior year, compared to 92% of children age 6-11 years and 90% of children age 12-17 years.

Related HP2020 Objectives: OH-7: Increase the proportion of children and adolescents who used the oral health care system in the past year
Target: 49.0%
Delaware: 80%: Exceeded target

NOHSS Indicator	Description	Required Currency	In Place	Comment
2 & 4	**Data on percent of Medicaid- and CHIP-enrolled children with a dental visit in the past year**	Obtained annually	√	Federal fiscal year (FFY) 2017 is the most recent data available.

On its Annual ESPDT Participation Report (Form CMS-416), for Fiscal Year 2017, Delaware reported the total number of individuals eligible to receive EPSDT services who received any dental or oral health services, dental diagnostic services, and oral health services provided by a non-dentist provider:

- Total individuals age 1-20 years eligible for EPSDT services: 130,586
- Received any dental or oral health service: 54,571
- Received a preventive dental service: 51,295

- Received a dental treatment service: 21,006
- Received oral health services provided by a non-dentist provider: 0

Related HP2020 Objective: OH-8: Increase the proportion of low income children and adolescents who received any preventive dental service during the past year
Target: 33.2%
Delaware: 41.8%: Exceeded target

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
5	Dental visits among adolescents in grades 9-12	None	√	YRBSS; dental questions included in 2015 survey tool for high school students and in 2017 survey tools for both middle school and high school students. No dental results are available for Delaware for the 2017 survey year.

Results of the 2015 YRBS survey of Delaware's high school students revealed that 73% had seen a dentist within the past 12 months for a check-up, exam, teeth cleaning, or other dental work. Eleven percent had seen a dentist in the past 12-24 months, and 6% had seen one more than 24 months ago. Just 2% reported never having seen a dentist, and 8% were unsure of the time since their last dental visit.

Seventy-seven percent of female high school students were more likely to have seen a dentist in the past 12 months, compared to 70% of male students. The likelihood of having seen a dentist in the past 12 months varied by age, with 76% to 78% of high school students younger than 18 years having done so, compared to only 55% of students age 18 years and older. White students were the most likely to have seen a dentist in the past 12 months (82%), followed by students of multiple races (79%), black students (64%), and Hispanic/Latino students (62%).

Related HP2020 Objective: OH-7: Increase the proportion of children, adolescents and adults who used the oral health care system in the past year.
Target: 49.0%
Delaware: 73% of high school students had seen a dentist in the past 12 months: Exceeded target

NOHSS Indicator	Description	Required Currency	In Place	Comment
6-7	**Data on percent of adults (age 18+ years) and adults with diabetes who had a dental visit in previous year**	Obtained within prior 2 years	√	Delaware included oral health-related questions in its 2016 BRFSS survey.

Delaware's 2016 BRFSS revealed that two-thirds (66%) of Delawareans overall had visited a dentist or dental clinic within the past year. Females were slightly more likely than males to have done so (68% versus 64%). Younger Delawareans (age 18-24) were the most likely (74%) to have had a dental visit in the previous year; those age 25-34 were the least likely (58%) to have had such a visit.

In the 2016 BRFSS, 559 people stated that they had diabetes; of these, fifty-six percent reported they had had a dental visit in the previous year. The remaining people with diabetes (44%) reported they had not had a dental visit in the previous year.

Related HP2020 Objective: OH-14: Increase the proportion of adults who receive preventive interventions in dental offices
Sub-objective OH-14.3: Increase the proportion of adults who were tested or referred for glycemic control from a dentist or dental hygienist in the past year
Target: 7.3%
Delaware: Over half of Delawareans reporting they have diabetes had seen a dentist in the previous year. This suggests an opportunity exists to provide preventive services and/or expand scope of services offered by another health care provider.

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
8	Population receiving oral health services at FQHCs	OH-10 & OH-11	~√	UDS; 2018 data are available from the HRSA data center

Data available include the number of patients and number of visits for a several types of dental services, including oral exams, prophylaxis, sealants, fluoride treatment, restorative services, oral surgery, rehabilitative services and emergency services. During 2018, 48,652 Delawareans received health care services from an FQHC. Nearly two-thirds (64%) of these were female; 36% were male. The number and percent receiving dental services appear in Table 6A (HRSA, 2018).

Table 3. Number and percent of Delawareans receiving dental services from an FQHC in 2016

Service	# of Patients	% of Patients
Oral exam	7,790	16%
Prophylaxis (adult or child)	5,749	12%
Restorative services	2,965	6%
Fluoride treatment (adult or child)	3,314	7%
Oral surgery (extractions / other surgical procedures)	1,324	3%
Rehabilitative services (endodontic, periodontal, prosthodontic, orthodontic)	1,472	3%
Emergency services	834	2%
Sealants*	543	1%

*An additional UDS assessment targets sealants specifically. This assessment looks at the number of total patients age 6 to 9 years who are identified as being at moderate to high risk for caries, and examines, via chart audit, the percent with a sealant to their first molars. For Delaware FQHCs, 490 children met age and risk criteria; 23% were found to have sealants on their first molars.
Source: Health Resources and Services Administration (HRSA). Bureau of Primary Health Care, 2018 Health Center Data

Related HP2020 Objective: OH-11: Increase the proportion of patients who receive oral health services at Federally Qualified Health Centers (FQHCs) each year
Target: 33.3% (of FQHC patients)
Delaware: Available counts are service-specific, e.g., "oral exam," or "prophylaxis." As one patient could have multiple services, it is not possible to ascertain an unduplicated count of the number of patients receiving *any* oral health service.

In 2018, Delaware's FQHCs reported having 10.87 dentist full-time equivalents (FTEs), 9.33 dental hygienist FTEs, and 14.86 "other dental personnel" (e.g., dental assistant) FTEs. Of all dental FTEs, 42% were "other dental personnel"; 27% were dental hygienists; and 31% were dentists. Nearly two-thirds (63%) of dental visits were to a dentist; 37% were to a dental hygienist. Of all clinic visits, 10% were to a dentist and 6% to a dental hygienist (HRSA, 2018).

Related HP2020 Objective: OH-10: Increase the proportion of local health departments and Federally Qualified Health Centers (FQHCs) that have an oral health program (NOTE: Delaware has no local health departments, so only FQHCs were included here.)
Target: 73.3%
Delaware: 100% of Delaware's FQHCs offers dental services: Exceeded target

Delaware has three FQHCs that operate multiple sites throughout the state; all three FQHCs offer dental services. Westside Family Healthcare offers dental services at four of its service sites; Henrietta Johnson Medical Center offers dental services at one of its service sites; and La Red Health Center offers dental care at one of its service sites.

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
9	Teeth cleaning among women *before* pregnancy	None	√	PRAMS

PRAMS data for 2014 reveals that 50% of those surveyed reported having had their teeth cleaned during the 12 months before pregnancy, a slight increase over the 49% of Delaware women who reported having had their teeth cleaned in the 12 months before pregnancy in 2012. In 2012, over all PRAMS sites combined, the average percent of women having had their teeth cleaned in the 12 months before pregnancy was 58%. (PRAMS, 2012-2014)

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
10	Teeth cleaning among women *during* pregnancy	None	√	PRAMS

PRAMS data for 2014 show that 41% of women surveyed reported having had their teeth cleaned during pregnancy, a result identical to the 2012 survey. For PRAMS sites overall, the 2012 average for having their teeth cleaned during pregnancy was 51%. (PRAMS, 2012-2014)

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
11	Dental caries experience among children age 3-5 years attending Head Start	OH-1	√	PIR, PIR / Dental Services

The Office of Head Start's Program Information Report (PIR) and PIR/Dental Services Report for 2017 provide information on Delaware's three Head Start and four Early Head Start programs (Table 4). The Head Start programs served 2,104 children for the year. Sixty-nine percent of the children enrolled in the Head Start programs had a dental home at the beginning of the enrollment year and 92% had a dental home by the end of the enrollment year. Eighty-two percent of children enrolled in Head Start completed an examination by a dentist during the year. Of those, 27% needed professional dental treatment and 68% received treatment. The Early Head Start programs served 574 children during the year. Fifty-five percent of the children enrolled in the Early Head Start programs had a dental home at the beginning of the enrollment year and 62% had a dental home by the end of the enrollment year.

Table 4. Delaware Head Start summary data compared to regional and national data

Parameter	Delaware	Region 3*	Nation
Dental home	85.3%	87.4%	89.5%
Preschool preventive care	81.8%	83.2%	83.0%
Preschool completed dental exam	86.1%	80.5%	82.1%
Preschool needed treatment	26.2%	14.8%	17.0%
Preschool received treatment	67.7%	67.1%	73.7%
Up-to-date on dental EPSDT schedule	73.0%	63.9%	68.9%
Pregnant women completed dental exam	17.8%	26.5%	32.6%

*Region 3 is composed of: Delaware, the District of Columbia, Maryland, Pennsylvania, Virginia and West Virginia.
Source: U.S. Department of Health and Human Services, Administration for Children and Families, Office of Head Start, 2017

Related HP2020 Objective: OH-1.1: Reduce the proportion of children aged 3 to 5 years with dental caries experience in their primary or secondary teeth.
Target: 30.0%
Delaware: Unknown: The PIR indicates that 27% of Head Start children needed professional dental treatment, but no details are available as to what type of treatment is required – i.e., whether the treatment is caries-related.

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
12	Dental caries experience among children attending kindergarten	OH-1	No	A survey of kindergarten children is being conducted during the 2019-2020 school year.

Related HP2020 Objective: OH-1.1: Reduce the proportion of children aged 3 to 5 years with dental caries experience in their primary or secondary teeth.
Target: 30.0%
Delaware: Unknown

NOHSS Indicator	Description	Required Currency	In Place	Comment
13	**Oral health status data which meets criteria for inclusion in NOHSS for a representative sample of 3rd grade children**	Collected within previous 5 years	No	Delaware most recently conducted a dental screening of third grade children in 2013. A screening is being done during the 2019-2020 school year.

In 2013, more than 800 of Delaware's third grade children, in 23 public elementary schools, received a dental screening. Screening included assessment of the three primary child indicators included in the NOHSS:

- Decay experience
- Presence of untreated tooth decay
- Use of dental sealants

Nearly half (47%) of children were found to have decay experience, i.e., treated or untreated tooth decay. In most cases, this was treated; only 16% of children had untreated tooth decay. Fifty-four percent of screened children have dental sealants on at least one permanent molar tooth (NOHSS, 2018). These findings represented substantial changes since the prior assessment in 2002, which found 55% of children to have decay experience, 30% with untreated tooth decay, and 34% with at least one dental sealant. (Delaware Smiles, 2013)

Related HP2020 Objective: OH-1: Reduce the proportion of children and adolescents who have dental caries experience in their primary or secondary teeth.
Sub-objective OH-1.2 (for children in age group most closely approximating "3rd grade"): Reduce the proportion of children age 6 to 9 years with dental caries experience in their primary or secondary teeth.
Target: 49%
Delaware: 47%: Exceeded target

Related HP2020 Objective: OH-2: Reduce the proportion of children and adolescents with untreated tooth decay
Sub-objective OH-2.2: Reduce the proportion of children age 6 to 9 years with untreated dental decay in their primary or secondary teeth.
Target: 25.9%
Delaware: 16%: Exceeded target

Related HP2020 Objective: OH-12: Increase the proportion of children and adolescents who have received dental sealants on their molar teeth
Sub-objective OH-12.2: Increase the proportion of children age 6 to 9 years who have received a dental sealant on one of more of the permanent first molar teeth
Target: 28.1%
Delaware: 54%: Exceeded target

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
14	Untreated dental caries among children age 3-5 years attending Head Start	OH-2	~√	PIR, PIR / Dental Services

For 2017, the PIR and PIR/Dental Services reports indicate that 27% of children enrolled in Head Start who received a dental screening needed professional dental treatment. It is not known if the condition requiring treatment was dental caries. Sixty-eight percent of the children requiring treatment received that treatment.

Related HP2020 Objective: OH-2.1: Reduce the proportion of children aged 3 to 5 years with untreated dental decay in their primary teeth.
Target: 21.4%
Delaware: Unknown, as it is unknown what condition indicated a need for treatment. Of those needing treatment, 32% were untreated at the end of the enrollment year.

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
15	Untreated dental caries among children attending kindergarten	OH-2	No	A survey of kindergarten children is being conducted during the 2019-2020 school year.

Related HP2020 Objective: OH-2.1: Reduce the proportion of children aged 3 to 5 years with untreated dental decay in their primary teeth.
Target: 21.4%
Delaware: Unknown

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
16	Untreated dental caries among 3rd grade children	OH-2	√	Delaware Smiles, the report of results of the dental screening of third grade children Delaware conducted in 2013.

See Key Indicators: Indicator 13.

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
17	Untreated dental caries among adults 65+ years of age in long-term care of skilled nursing facilities	OH-3	√ (partial)	Minimum Data Set (MDS) 3.0 Frequency Report

The Minimum Data Set (MDS) 3.0 Frequency Report summarizes information for active residents currently residing in nursing homes; the source of data for the report are the MDS assessment records for such residents. Data are compiled from all types of MDS records; the most recent value assigned in a given episode (i.e., period of residency in a single nursing home) is the one used for the report. Residents younger than 65 years are included in the assessments, so summary results would include such residents (CMS, 2012).

An MDS Summary Report prepared January 25, 2018 for the fourth quarter of 2017 noted the presence of dental cavities or broken teeth in 15% of 3,955 residents, i.e., ~604 residents. Additional dental assessments included:

- Broken or loosely fitting dentures: 1%
- No natural teeth or tooth fragments: 24%
- Abnormal mouth tissue: <0.5%
- Inflamed or bleeding gums or loose natural teeth: 0.5%

Related HP2020 Objective: OH-3.2: Reduce the proportion of adults age 65 to 74 years with untreated coronal cavities
Target: 15.4%
Delaware: ~15% (dental cavities and broken teeth are combined into one MDS assessment; it is not possible to determine from the data the contribution of each): Meets target

Related HP2020 Objective: OH-3.3: Reduce the proportion of adults age 75 years or older with untreated root surface caries
Target: 34.1%
Delaware: Unknown: This level of specificity is not available within the MDS data

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
18	Untreated dental caries among adults 65+ years of age *attending congregate meal sites*	OH-3	No	No data source has yet been identified for this indicator

Related HP2020 Objective: OH-3.2: Reduce the proportion of adults age 65 to 74 years with untreated coronal cavities
Target: 15.4%
Delaware: Data for adults age 65+ years attending congregate meal sites unavailable

Related HP2020 Objective: OH-3.3: Reduce the proportion of adults age 75 years or older with untreated root surface caries
Target: 34.1%
Delaware: Data for adults age 65+ years attending congregate meal sites unavailable

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
19	Urgent dental treatment need among children age 3-5 years attending Head Start	None	No	No data source has yet been identified for this indicator

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
20	Urgent dental treatment need among children attending kindergarten	None	No	No data source has yet been identified for this indicator

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
21	Urgent dental treatment need among 3rd grade children	None	No	No data source has yet been identified for this indicator

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
22	Dental treatment need among adults 65+ years of age in *long-term care of skilled nursing facilities*	OH-3	√ (partial)	MDS 3.0 Frequency Report

Results of an MDS Summary Report prepared January 25, 2018, for the fourth quarter of 2017 demonstrate a need for treatment:

- 15% of residents were found to have dental cavities or broken teeth

- 1% were reported to have broken or loosely fitting dentures
- A very small percentage (<0.5%) had abnormal mouth tissue
- 0.5% were reported to have inflamed or bleeding gums or loose natural teeth

Related HP2020 Objective: OH-3.2: Reduce the proportion of adults age 65 to 74 years with untreated coronal cavities
Target: 15.4%
Delaware: ~15% (dental cavities and broken teeth are combined into one MDS assessment; it is not possible to determine from the data the contribution of each): Meets target

Related HP2020 Objective: OH-3.3: Reduce the proportion of adults age 75 years or older with untreated root surface caries
Target: 34.1%
Delaware: Unknown: This level of specificity is not available within the MDS data

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
23	Dental treatment need among adults 65+ years of age *attending congregate meal sites*	None	No	No data source has yet been identified for this indicator

Related HP2020 Objective: OH-3.2: Reduce the proportion of adults age 65 to 74 years with untreated coronal cavities
Target: 15.4%
Delaware: Data for adults age 65+ years attending congregate meal sites unavailable

Related HP2020 Objective: OH-3.3: Reduce the proportion of adults age 75 years or older with untreated root surface caries
Target: 34.1%
Delaware: Data for adults age 65+ years attending congregate meal sites unavailable

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
24	Dental sealants among 3rd grade children	OH-12	√	Delaware Smiles, the report of results of the dental screening of third grade children Delaware conducted in 2013.

See also (Key) Indicator 13.

Related HP2020 Objective: OH-12: Increase the proportion of children and adolescents who have received dental sealants on their molar teeth
Sub-objective OH-12.2: Increase the proportion of children age 6 to 9 years who have received a dental sealant on one of more of the permanent first molar teeth

Target: 28.1%
Delaware: 54%: Exceeded target

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
25	Dental sealant use among children age 6-9 years enrolled in Medicaid / CHIP Medicaid expansion	OH-12	√	CMS-416

Related HP2020 Objective: OH-12: Increase the proportion of children age 6 to 9 years who have received dental sealants on one or more of their permanent first molar teeth
Target: 28.1%
Delaware: During fiscal year 2017, 3,566 low income children age 6-9 years received a sealant on a permanent molar tooth. This represents 12% of the 29,465 children age 6-9 years who were eligible to receive EPSDT services in 2017, and falls short of target.

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
26	Dental sealant use among children age 10-14 years enrolled in Medicaid / CHIP Medicaid expansion	OH-12	√	CMS-416

Related HP2020 Objective: OH-12-3: Increase the proportion of adolescents age 13 to 15 years who have received dental sealants on one or more of their permanent molar teeth
Target: 21.9%
Delaware: During fiscal year 2017, 4,399 low income children age 10-14 years received a sealant on a permanent molar tooth. This represents 16% of the 26,964 children age 10-14 years who were eligible to receive EPSDT services in 2017. Age range only partially overlaps that of the HP2020 Objective; unable to assess status with regard to target.

NOTE: EPSDT data report supplies counts for only the 6-9 year and 10-14-year-old age Groups.

NOHSS Indicator	Description	Required Currency	In Place	Comment
27-29	**Permanent tooth loss data for adults**	Collected within previous 2 years	√	Delaware included oral health-related questions in its 2016 BRFSS survey.

Delaware's 2016 BRFSS revealed that 44% of adult Delawareans have not had any permanent teeth extracted; 56% have had at least one permanent tooth extracted (Table 5). The percentage who had had a permanent tooth extracted varied considerably by age. Just 9% of Delawareans age 18-24 years

had had at least one permanent tooth extracted, while nearly three-quarters (73%) of those age 65 years or older had done so.

Table 5. Percentage of Delaware Adults (age 18+ years) who have had at least one permanent tooth extracted

Age Range (years)	Percentage
18 to 24	9%
25 to 34	29%
35 to 44	36%
45 to 54	45%
55 to 64	56%
65+	73%

Source: Centers for Disease Control and Prevention (CDC), Behavioral Risk Factor Surveillance System, 2016.

A second question in the same BRFSS survey examined the percentage of Delawareans age 65 years and older who had had *all* their natural teeth extracted. Among all adults age 65 years and older, 17% had had all their natural teeth extracted; 83% remained dentate. The likelihood that all-natural teeth had been extracted varied by age group. Among adults age 65-74 years, just 13% had had all their natural teeth extracted; this rose to 24% among adults age 75 years and older.

Related HP2020 Objective: OH-4: Reduce the proportion of adults who have ever had a permanent tooth extracted because of dental caries or periodontal disease
Sub-objective OH-4.1: Reduce the proportion of adults age 45-64 years who have ever had a permanent tooth extracted because of dental caries or periodontal disease
Goal: 68.8%
Delaware: age 45-54: 45%; age 55-64: 56%: Exceeded target

Sub-objective OH4.2: Reduce the proportion of adults age 65-74 years who have lost all their permanent teeth
Target: 21.6%
Delaware: 13%: Exceeded target

NOHSS Indicator	Description	Required Currency	In Place	Comment
30-31	**Data on oropharyngeal cancer incidence and mortality**	Obtained annually	√	Delaware's Central Cancer Registry submits data annually to the CDC's National Program on Cancer Registries. Public use data are currently available through 2014 (i.e., submissions

				through November 2016).

Delaware's most recent cancer incidence and mortality report, published in July 2018, reports on the five-year period 2010-2014. During that time period, Delaware reported a total of 700 cases of oropharyngeal cancer, with an incidence rate of 12.6%, placing Delaware at 11th in state rankings for oral cancer. For the same time period, Delaware reported 158 deaths from oropharyngeal cancer, for a mortality rate of 2.9%; this was slightly above the overall U.S. mortality rate during this time period (2.5%). In 2010-2014, 32% of oral cancers were diagnosed at the local stage, 46% at the regional stage, and 18% at the distant stage. For 4%, the stage was unknown. Females were more likely to have oral cancers diagnosed at the local stage (43%) than males (28%).

Related HP2020 Objective: OH-6: Increase the proportion of oral and pharyngeal cancers detected at the earliest stage
Target: 35.9%
Delaware: 32%: Target not yet met overall. Target exceeded for females (44%), but fell short for males (27%)

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
32	School-based Health Centers that provide dental sealants	OH-9	No	No data source has yet been identified for this indicator

Related HP2020 Objective: OH-9-1: Increase the proportion of school-based health centers with an oral health component that includes dental sealants
Target: 18.8%
Delaware: Unable to assess

NOHSS Indicator	Description	HP2020 Objective	Available for DE	Data Source for DE
33	School-based Health Centers that provide dental care	OH-9	√ (partial)	Delaware Smile Check program data
34	School-based Health Centers that provide topical fluoride	OH-9	√ (partial)	Delaware Smile Check program data

Related HP2020 Objective: OH-9.2: Increase the proportion of school-based health centers with an oral health component that includes dental care
Target: 7.0%

Related HP2020 Objective: OH-9.3: Increase the proportion of school-based health centers with an oral health component that includes topical fluoride
Target: 22.7%

Delaware Smile Check, a school-based oral health outreach program, launched in 2016. The program offers dental screenings and applications of fluoride varnish. A screening "report card" is sent home with the student, and help is provided to those needing to connect with dentists for follow-up care of caries or to meet urgent dental needs.

NOHSS Indicator	Description	Required Currency	In Place	Comment
35	**Data on fluoridation status of public water systems within the state**	Updated every 2 years	√	Delaware routinely participates in the CDC's data collection related to fluoridated water.

Related HP2020 Objective: OH-13: Increase the proportion of the US population served by community water systems with optimally fluoridated water

Target: 79.6%

Delaware: 87% of people served by a community water system receive fluoridated water; 86% receive optimally fluoridated water: Exceeded target

CDC's About My Water website includes Delaware's Fluoridation Status Report for 2017. This report designates 51 community water systems as "fluoridated"; 180 are designated as non-fluoridated. The fluoridated systems serve 715,773 people; non-fluoridated community water systems serve 102,337 people. Given a population of 818,110 people served by a community water system, 87% of those have fluoridated water. Given a statewide population of 934,695, just over three-quarters (77%) of Delaware's entire population is served by a fluoridated water system. (Water, 2017)

DHHS recommends a fluoride level of 0.7 milligrams per liter of fluoride in drinking water. Three of the community water systems designated as fluoridated have levels below 0.7 mg/L; these systems serve about 2,400 people. Eight community water systems, serving ~6,500 people, have concentrations above 0.7 mg/L. (CDC, 2017)

NOHSS Indicator	Description	Required Currency	In Place	Comment
36	A written oral health surveillance plan, with annual submission of data to ASTDD on state oral health programs and the environment in which they operate, including workforce and infrastructure indicators	Developed / updated within previous 5 years	√	Delaware has a current Oral Health Surveillance Plan. 2017 ASTDD Summary Report of State Dental Public Health Programs (data for FY2015 – 2016) confirms submission of data to ASTDD

Delaware's Oral Health Surveillance Plan, modeled after the ASTDD template for surveillance plans, was finalized in December 2019.

Related HP2020 Objective: OH-16: Increase the number of states and the District of Columbia that have an oral and craniofacial health surveillance system.
Target: 100%
Delaware: On target

Related HP2020 Objective: OH-17: Increase health agencies that have a dental health program directed by a dental professional with public health training. (NOTE: Sub-objectives addressing local and Indian Health Service / Tribal health programs do not apply.)
Target: 25.7%
Delaware: On target; i.e., state dental health program has such leadership

Additional Indicators Identified by HP2020

Some HP2020 oral health-related objectives have no corresponding NOHSS indicator; these objectives appear below with any related Delaware data.

HP2020 Objective #	Description	Available for DE	Data Source for DE
OH-5	Moderate or severe periodontitis among adults age 45-74 years	√ (minimal)	MDS 3.0 Frequency Report

Target: 40.8%
Delaware: The MDS Frequency Report provides some information on this objective for a small percentage of Delaware's adult population: One assessment reported is the presence of "inflamed or bleeding gums or loose natural teeth" among the long-term care / nursing home residents assessed. For this population (3,959 people for the 4th quarter 2017 summary report), 0.45% (~18 people) were reported as having this condition (MDS, 2018).

No data on this topic are available, however, for the majority of Delawareans; e.g., there are no specific questions regarding periodontitis on the BRFSS. The lack of state- / local-level data for this topic is recognized and, in 2016, an article by PI Eke, X Zhang, H Lu et al (*Predicting Periodontitis at State and Local Levels in the United States*) was published in the Journal of Dental Research. The article used periodontitis probabilities estimated from NHANES, along with data from the BRFSS, the American Community Survey (ACS) and US 2010 census to develop estimates of periodontitis by small geographic areas. It is possible a similar approach could be applied to develop estimates for Delaware, but no existing work on those estimates was found (ADA, 2016).

HP2020 Objective #	Description	Available for DE	Data Source for DE
OH-14	Preventive interventions (tobacco cessation, oral cancer screening & glycemic control) in dental offices - adults	No	No state-level data source has yet been identified for objective

Target: OH14.1: Tobacco use / smoking cessation: 13.2%
OH14.2: Oral / pharyngeal cancer screening: 28.6%
OH14.3: Tested or referred for glycemic control from a dentist or dental hygienist: 7.3%

HP2020 Objective #	Description	Available for DE	Data Source for DE
OH-15	Craniofacial anomalies – recording system and referral system	√ (partial)	National Birth Defects Prevention Network (www.nbdpn.org)

Target: 39 states
Delaware: The Delaware Birth Defects Registry has been operational since 2007, in part satisfying the "recording" portion of this objective; i.e., there may be additional anomalies, beyond those currently reported, which would qualify as "craniofacial."

Delaware's Birth Defects Registry captures information on the occurrence of a variety of birth defects, including cleft lip (alone), cleft palate (alone) and cleft lip with cleft palate. The most recent published data are for the five-year period 2009-2013 and report the number of cases and prevalence per 10,000 live births (Table 6).

Table 6. Number and prevalence per 10,000 live births of oral health-related anomalies

Anomaly	# of cases	Prevalence / 10,000 live births
Cleft lip alone	10	2.2
Cleft palate alone	27	6.0
Cleft lip with cleft palate	28	6.2

Source: National Birth Defects Prevention Network (NBDPN), 2016

Within this same time period (2009-2013), the NBDPN reported that in Delaware, the highest prevalence of these anomalies among maternal racial and ethnic groups was 12.2 cases of cleft lip with cleft palate per 10,000 live births among Hispanic women. The rate of this same anomaly among white non-Hispanic women was 5.7 per 10,000 live births, compared to 4.2 per 10,000 live births among black non-Hispanic women.

The NBDPN does not include information on referral systems.

HP2020 Objective #	Description	Available for DE	Data Source for DE
OH-17	Health agencies with dental public health program – local agencies =>250,000	N/A	No local health agencies in Delaware

HP2020 Objective #	Description	Available for DE	Data Source for DE
OH-17	Health agencies with dental public health program – IHS/Tribal	N/A	No IHS/Tribal jurisdictions in Delaware

HP2020 Objective #	Description	Available for DE	Data Source for DE
AHS-1.2	Increase the proportion of people with dental insurance	No	No state-level data source has yet been identified for this objective

Target: 55.3%

HP2020 Objective #	Description	Available for DE	Data Source for DE
AHS-6.3	Reduce the proportion of people who are unable to obtain or delay in obtaining necessary dental care	No	No state-level data source has yet been identified for this objective

Target: 5%

Disparities in Oral Health

Oral health disparities are profound in the U.S. (CDC, 2016). In the U.S., oral health disparities exist among low-income racial/ethnic minority groups, those residing in medically and dentally underserved areas, and those with developmental or acquired disabilities (Fischer, 2017). Rates of untreated dental caries are twice as high among Hispanics and non-Hispanic black children age two to eight years than among non-Hispanic white children in the same age group (Fischer, 2017). Adults age 35-44 years who had less than a high school education experienced untreated tooth decay nearly three times as often as adults with at least some college education (CDC, 2016). Periodontal disease is higher in men than in women, and the five-year survival rate for oral pharyngeal cancers among black men is much lower than among white men.

Limited or infrequent access to dental care contributes to poor oral health. Unfortunately, in the U.S. about 15% of children aged 2-17 years did not visit a dentist in 2015. For adults age 18 and older, 37% report having no dental visit within the past year. Among adults, substantial disparities exist by education, income and race/ethnicity. Forty-seven percent of Hispanics, compared to 36% of whites, reported no dental visits within the past year (Health, United States, 2016). According to the same source, 55% of those with an annual income below 100% of the Federal Poverty Level (FPL) reported no

dental visits within the past year, compared to 20% of those with an annual income at least 400% of the FPL. (Health, United States, 2016).

Disparities exist in Delaware, as well. According to Delaware's 2016 BRFSS, of adults age 18 and older, 70.1% of non-Hispanic whites report having visited a dentist or dental clinic in the past year, but only 60.7% of non-Hispanic blacks and 50.2% of Hispanics report having done so. Disparities are striking among groups with different levels of education. While 81.9% of college graduates report having visited a dentist or dental clinic in the past year, the percentage falls to 61.7% among those with a high school or GED education, and to 29.8% among those with less than a high school education. People of differing income levels also report differing patterns of dental visits. Of those with annual incomes of $50,000 or more, 81.4% report having a dental visit in the past year, but only 37.7% of those with an annual income of $15,000 to $24,999 report having done so.

While over 80% of college graduates report having visited a dentist or dental clinic in the past year, only about 30% of adults with less than a high school education have done so.

In the preceding section, disparate results were briefly noted for several individual indicators. More detailed information, organized by groups often confronting disparities, appears in the following. Very comprehensive reporting of disparities for many indicators is precluded for reasons such as:

- Delaware is a small state – in terms of population as well as size – so, in some cases there simply are not enough people within a given survey or data submission to enable analysis for individual groups, e.g., for each race or ethnicity or socioeconomic status.
- In other cases, the information that would enable stratification - e.g., sex or age or ZIP code - is not collected by a given survey or included in a required data submission.

Racial and Ethnic Groups

Racial and ethnic variables are available for a number of national and state surveys, including the National Survey of Children's Health (NSCH), the Youth Risk Behavior Survey (YRBS) and Behavioral Risk Factor Surveillance System (BRFSS). Results of these surveys can be examined to determine if they reveal racial and ethnic disparities within responses provided by Delawareans. In most cases, no pronounced racial and ethnic disparity was found.

National Survey of Children's Health (NSCH)

The 2016 NSCH included oral health measures for children age 1-17 years, and also racial and ethnic variables enabling report for four sub-groups within Delaware: Hispanics, non-Hispanic whites, non-Hispanic blacks and "non-Hispanic Other" races and ethnicities. Results for both Hispanics and "non-Hispanic Other" should be interpreted with caution, as there were only a small number of people representing each of these sub-groups.

Delaware's results for the oral health measures typically met or exceeded those for the nation as a whole:

- Condition of a child's teeth was reported as "excellent or very good" for 82% of Delaware children versus 78% of children nationwide. Report of excellent or very good condition for Delaware's children ranged from 74% (Hispanic children) to 88% ("non-Hispanic Other" race) children. Eighty-five percent (85%) of non-Hispanic white children and 79% of non-Hispanic black children were reported to have excellent or very good tooth condition.
- Presence of an oral health problem (e.g., toothaches, bleeding gums or dental caries) during the past 12 months was reported for just 13% of Delaware's children; this is identical to the national average. Approximately 10% of non-Hispanic white children and non-Hispanic black children were reported as having had a problem, as were 25% of Hispanic children and 15% of non-Hispanic Other race children.
- Across all racial and ethnic groups, the majority of children (77% - 82%) were reported to have had a preventive dental care visit within the past 12 months.

Youth Risk Behavior Survey (YRBS)

The 2015 YRBS asked high school students about their most recent dental visit and also collected racial and ethnic data which enabled reporting of the same four sub-groups for Delaware as the NSCH, as well as a fifth group: non-Hispanic multiracial students. Between 62% (Hispanic students) and 82% (non-Hispanic white students) reported having had a dental visit within the past 12 months; 64% of non-Hispanic black students and 79% of non-Hispanic multiracial students reported having had a dental visit within this time frame. Groups where a lower percentage reported having had a visit within the past 12 months had a higher percentage reporting a visit within the past 12-24 months: 14% of Hispanic students and 15% of non-Hispanic black students. As a result, over three-quarters of all students within each racial and ethnic group reported having had a dental visit within the preceding 24 months.

Behavioral Risk Factor Surveillance System (BRFSS)

Delaware's 2016 BRFSS, surveying adults age 18 years and older, included questions related to oral health, reporting results for five racial and ethnic groups: non-Hispanic whites, non-Hispanic blacks, non-Hispanic Asians, non-Hispanic multiracial individuals, and Hispanics. The percentage of people reporting having had a dental visit (for any reason) within the past year ranged from 50% (Hispanics) to 73% (non-Hispanic Asians); 70% of non-Hispanic whites, 61% of non-Hispanic blacks and 59% of non-Hispanic multiracial people reported having had such a visit. Rates for multiracial and Asian people should be interpreted with caution, due to small numbers of responses within each group.

A question about removal of any permanent teeth yielded very similar results across all racial and ethnic groups with a sufficient number of people responding: 44% of non-Hispanic whites, 48% of non-Hispanic blacks and 46% of non-Hispanic multiracial people reporting having had at least one permanent tooth extracted. Adults age 65 years and older were asked about extraction of all teeth; there were sufficient numbers in only two racial and ethnic groups to allow calculation of a rate. Sixteen percent of non-Hispanic whites and 20% of non-Hispanic blacks reported having had all their teeth extracted.

Girls' / Women's Health

All three surveys examined for racial and ethnic disparities (NSCH, YRBS and BRFSS) include collection of sex, enabling reporting for male and female sub-groups of Delawareans.

National Survey of Children's Health (NSCH)

Results for the 2016 NSCH were virtually identical across the sexes:

- Eighty-one percent of males and 83% of females were reported to have "excellent or very good" teeth.
- Seventy-nine percent of males and 81% of females had had a preventive care dental visit within the past 12 months.
- Eleven percent of males and 15% of females were reported to have had an oral health problem within the past 12 months.

Youth Risk Behavior Survey (YRBS)

Results for the 2015 YRBS showed some variation between the percent of students reporting a dental visit within the past 12 months. Seventy percent of male students indicated they had had a visit, as did 77% of female students. A virtually identical percentage of each sex reported having had a dental visit in the past 12-24 months. Eighty-seven percent of female students had a dental visit within the past 24 months, compared to 80% of male students.

Behavioral Risk Factor Surveillance System (BRFSS)

Results for the 2016 BRFSS show that overall, adults age 18 years and older were less likely to have had a dental visit in the past 12 months than were high school students or children age 1-17 years. Sixty-six percent of adults reported such a visit, versus 73% of all high school students and 80% of children age 1-17 years. The slight gender gap hinted at among high school students continued among adults, with 64% of males and 68% of females reporting they had a dental visit in the past 12 months. There was a slight difference between the percentage of males (43%) and females (45%) who reported having at least one permanent tooth extracted. The percentage of males and females age 65 years and older who reported having all their natural teeth extracted was the same: 17% for each sex.

Cancer Incidence and Mortality in Delaware, 2010-2014

This data source revealed a disparity in oropharyngeal cancer incidence and mortality rates between males and females; both rates favored females. Far more males than females (506 versus 194) were diagnosed with cancer of the oral cavity or pharynx during the most recently reported five-year period (2010-2014), accounting for 72% of all cancers of this type. Males also had far fewer oral cancers diagnosed at the local stage (28%) than did females (43%). Males had a higher oropharyngeal cancer mortality rate during the 2010-2014 time period than did females: 4.6 per 100,000 v. 1.5 per 100,000.

People with Access and Functional Needs

Few data sources capture information related to people with access and functional needs. The YRBS and the BRFSS are not designed in such a way that people with certain access and functional needs are able to participate. For example, the BRFSS is a telephone survey that may require 45 minutes to complete; people unable to use a telephone – or who find it difficult to use one for an extended period of time – cannot participate. The YRBS is a pencil-and-paper survey completed in a school setting; students who do not attend brick-and-mortar schools or who are not able to complete a written survey would not be able to participate. Ways in which these students might be enabled to participate in

future surveys is being explored by the University of Delaware's (UD) Center for Disabilities Studies (CDS).

National Survey of Children's Health (NSCH)

The NSCH collects disabilities-related information; categorizing children only as "children with special health care needs" (CSHCN) and "not children with special health care needs" (NCSHCN). Children with special health care needs, as defined by HRSA's Maternal and Child Health Bureau, are those who "…have or are at increased risk for chronic physical, developmental, behavioral or emotional conditions and who also require health and related services of a type or amount beyond that required by children generally."

Results of the 2016 NSCH reveal that a lower percentage of CSHCN were reported to have "excellent or very good" teeth than NCSHCN: 75% v. 84%. However, when level of complexity of the health needs was considered, it became clear that CSHCN whose health needs were "more complex" were responsible for the lower percentage. Seventy-one percent of children with more complex health needs were reported to have teeth in excellent or very good condition, while 84% of children with less complex health needs were as likely to have teeth in excellent or very good condition as NCSHCN. Approximately three-quarters (74%) of children whose emotional, behavioral and/or developmental issues led to their designation as CSHCN were reported to have excellent or very good teeth; 76% of children who gained that designation on a basis unrelated to mental health were reported to have excellent or very good teeth.

The percentage of CSHCN reported to have oral health problems (14%) was almost identical to the percentage of NCSHCN reported to have such problems (13%). Only 9% of CSHCN whose health needs were less complex were reported to have oral health problems, but 16% of CSHCN whose health needs were more complex had such problems. Fifteen percent of CSHCN who had emotional, behavioral, or developmental issues were reported to have oral health problems, as compared to 13% of CSHCN whose needs were unrelated to mental health.

Delaware's Survey of Oral Health for People with Disabilities

Recognizing the paucity of information available on the oral health of Delawareans with access and functional needs, in 2016 the BOHDS contracted with UD's CDS to conduct a dental care survey of these individuals. A total of 276 people – 170 adults with disabilities and 106 parents of children with disabilities – participated in the survey. (The children upon whom parents reported could be adult children.) Participants were asked to identify each type of disability they had; 72% of those surveyed reported having conditions classified as intellectual and/or developmental disabilities. For the purpose of this survey, intellectual and/or developmental disabilities included learning disabilities, intellectual disabilities, autism, Asperger's, cerebral palsy, Down syndrome, and "other" developmental disabilities (Lee, 2017).

Seventy-nine percent of those surveyed reported having a usual source of dental care. Over two-thirds (70%) reported having visited a dentist or dental clinic in the last year; most of these visits were for a dental cleaning (83%) and/or a general dental exam (81%). Thirty-nine percent of the survey participants reported the condition of their mouth and teeth to be very good or excellent; this percentage is far below the 75% of children with special health care needs reported by the NSCH survey to have teeth in very good or excellent condition. However, the participants in the UD/CDS survey were much older (median age = 32.5 years) than the children included in the NSCH survey (Lee, 2017); only 20% of the children in the UD/CDS survey were 17 years or younger.

Adult participants in the UD/CDS survey (i.e., not parents) were asked to report the number of permanent teeth they had lost due to tooth decay, infection, or gum disease. Fifty-one percent reported having lost none (Lee, 2017); this percentage is comparable to that reported by adult Delawareans participating in the BRFSS, where 56% reported having had no permanent teeth extracted. Ten percent of participants in the UD/CDS survey reported having lost six or more – but not all – of their permanent teeth; 5% reported having lost all their permanent teeth (Lee, 2017). Although BRFSS asks a question regarding loss of all permanent teeth, it is asked only of Delawareans age 65 years and older. Since only 26 of the participants in the UD/CDS survey fell within that age group, the results of the two surveys cannot be compared.

Socioeconomic Disparities

Socioeconomic data are collected in the NSCH and BRFSS surveys, and are implied in other data sources. Data related to Medicaid expenditures or to Head Start and Early Head Start programs reflect the experience of people qualifying for those services.

National Survey of Children's Health (NSCH)

The 2016 NSCH used four socioeconomic strata in reporting results: children whose household incomes were at 0-99% of federal poverty level (FPL), at 100-199% of FPL, at 200-399% of FPL, and at 400% FPL or higher.

- The percentage of children reported to have "excellent or very good" teeth varied across the four strata, with percentages rising as the distance above FPL rose:
    - Of children at 0-99% FPL*, 65% were reported to have excellent/very good teeth.
    - Of children at 100-199% FPL, 73% were reported to have excellent/very good teeth.
    - Of children at 200-399% FPL, 81% were reported to have excellent/very good teeth.
    - Of children at 400% FPL or higher, 89% were reported to have excellent/very good teeth.
- Between 81% and 84% of children in all three upper levels of FPL had had a preventive care dental visit within the past 12 months, as had 72% of children at 0-99% FPL*.
- The percentage of children reported to have had an oral health problem within the past 12 months was highest in the lowest FPL and lowest in the highest FPL:
    - Of children at 0-99% FPL*, 17% had an oral health problem within the past 12 months.
    - Of children at 100-199% FPL, 14% had an oral health problem within the past 12 months.
    - Of children at 200-399% FPL, 14% had an oral health problem within the past 12 months.

- Of children at 400% FPL or higher, 9% had an oral health problem within the past 12 months.

*Results must be interpreted with caution for this category, due to the small number of children falling within this group.

CMS-416 and Delaware Smiles

While there are many differences between the CMS-416 report, which includes basic, summary information for the Medicaid child health program, and the Delaware Smile report, which summarizes results of Delaware's 2013 survey of third grade children, making very general comparisons between the results reported in each may be useful. For example, each includes a question related to dental visits occurring within the past year; each looked at the need for dental treatment services and the use of dental sealants. The Delaware Smile report included two income strata: children who did – or did not – qualify for the free and/or reduced-price lunch (FRL) program.

The CMS-416 provides information on ESPDT services received by children younger than one year to 20 years; some services are related to oral health. Of the 130,586 Delaware children age 1-20 years included on Delaware's 2017 report, 42% received any dental services during the year; 39% reported receiving preventive dental services; and 16% reported receiving dental treatment services. (Categories are not mutually exclusive; i.e., children could have been reported as receiving both preventive and treatment services.) Six percent of children were reported to have received a dental sealant.

The 42% of children reported to have received any dental services during the year is far lower than the 78% reported to have visited a dentist in the last year during Delaware's 2013 third grade survey. However, the 16% reported (on the CMS-416 report) to have received dental treatment is consistent with the 16% found in the 2013 third grade survey to need care, and similar to the 20% of the students qualifying for the FRL program. Dental sealants were found to have been applied for 54% of all third-grade students (and nearly 60% of students qualifying for the FRL program), compared to just 6% of the children reported on the 2017 CMS-416 report ((CMS, 2017; Smiles, 2013).

Behavioral Risk Factor Surveillance System (BRFSS)

The BRFSS provides results across five socioeconomic strata, representing households with an annual income of:

- Less than $15,000
- $15,000-$24,999
- $25,000-$34,999
- $35,000-$49,999
- $50,000 or more.

Among adult Delawareans participating in the 2016 BRFSS, the percentage reporting they had visited a dentist or dental clinic for any reason during the past year varied markedly across income groups, ranging from a low of 38% (income group $15,000-$24,999) to a high of 81% (income of $50,000 or more). The percentage reporting extraction of any permanent teeth was more similar across the groups, ranging from 52% to 61% for the lower four groups; only the highest income group reported a

substantially lower percentage: 35%. The percentage of adults age 65 years and older reporting extraction of all their natural teeth again varied widely, from 40% of those in the lowest income group to just 7% of those in the highest income group (Table 7).

Table 7. Affirmative responses to 2016 Delaware Behavioral Risk Factor Surveillance Survey; oral health questions by household income

Oral Health Measure	<$15,000	$15,000-$24,999	$25,000-$34,999	$35,000-$49,999	$50,000+
Visited a dentist / dental clinic for any reason in past year	42%	38%	59%	63%	81%
Have had any permanent teeth extracted	61%	56%	52%	55%	35%
Have had all-natural teeth extracted (adults age 65+ only)	40%	28%	22%	21%	7%

Source: 2016 BRFSS, Centers for Disease Control and Prevention

Educational Attainment

Among adults, the level of education attained is one factor demonstrated to have impact for many health measures. The 2016 BRFSS examined oral health results across four educational levels, reflecting the responses of people who had:

- Less than a high school education
- High school diploma or GED
- Some post-high school education
- College degree.

Responses varied widely across educational levels; individuals with lower levels of educational attainment were far less likely to have visited a dentist in the past year (30%) than were college graduates (82%). Among those 65 years and older, people with less than a high school education (39%) were far more likely to have had all their teeth extracted than their counterparts who were college graduates (5%). The percentage of people at each educational level responding affirmatively to all three oral health questions appears in Table 8.

Table 8. Affirmative responses to 2016 Delaware Behavioral Risk Factor Surveillance Survey; oral health questions by educational attainment

Oral Health Measure	<High school	HS diploma / GED	Some post-HS education	College graduate
Visited a dentist / dental clinic for any reason in past year	30%	62%	72%	82%
Have had any permanent teeth extracted	59%	50%	46%	31%
Have had all-natural teeth extracted (adults age 65+ only)	39%	23%	12%	5%

Source: 2016 BRFSS, Centers for Disease Control and Prevention

Summary

While the percentage of people able to maintain good oral health practices and/or experience good oral health clearly differs by various factors (e.g., race and ethnicity, sex, socioeconomic level and education), the reasons why is not always equally clear. For example, while Hispanics and non-Hispanic black adults were less likely than non-Hispanic white adults to have seen a dentist in the last year, this might be due less to race and ethnicity than to household income or to educational attainment. Only 18% of Hispanics reported having a household income of less than $50,000 in 2016, compared to 56.1% of non-Hispanic whites and 44.4% of non-Hispanic blacks. In addition, while 50% of Hispanics reported having less than a high school education, only 8% of non-Hispanic whites and 13% of non-Hispanic blacks reported the same. These economic and educational disadvantages may also contribute to the lower levels of oral health (e.g., condition of teeth; dental visits) often observed among Hispanic children and adolescents (IOM, 2011).

RISKS AND PROTECTIVE FACTORS AFFECTING ORAL DISEASES

Use of Tobacco

Use of tobacco in any form – smoking cigarettes, pipes, or cigars, or using smokeless tobacco – compromises oral health. It may contribute to the prevalence of dental caries, has been proven to raise the risk of periodontitis, and has long been associated with an increased risk of cancers of the oral cavity and pharynx.

Dental caries is known to be more prevalent among smokers than non-smokers. However, the evidence to date is suggestive and not definitive, as other factors may account for at least part of that difference. For example, smokers are less likely to have seen a dentist in the preceding 12 months than non-smokers. Smokers also tend to employ less frequent or less effective oral health practices than their non-smoking counterparts. These factors, in turn, may result from socioeconomic factors that commonly differ between smokers and non-smokers, such as smokers often having lower household incomes and lower levels of education than non-smokers (Health Consequences, 2014).

These factors are evident among Delawarean adults who responded to the 2016 BRFSS. Overall, 17% of participants reported they are current smokers. Rates of current smoking were higher among those with lower household incomes (33% of current smokers had annual household incomes of less than $15,000) and markedly lower among those with high household incomes (13% of current smokers had annual household incomes of $50,000 or more.) Similarly, 29% of those with less than a high school education reported that they currently smoked, compared to 9% of who were college graduates.

The evidence of a causal link between smoking and periodontitis in the adult U.S. population, however, has been established. An analysis of the 2009 and 2010 National Health and Nutrition Examination Survey (NHANES) demonstrated that current smokers were among those with the highest rates of periodontal disease. Indeed, smokers have twice the risk of developing periodontitis compared with non-smokers (Eke et al, 2012). This may be because smoking weakens the immune system, making it harder for the body to

Smokers are twice as likely to develop periodontitis as non-smokers.

fight gum infections, or because smoking makes it harder for the gums to heal (CDC, 2013).

While it is not possible to specifically identify people with periodontitis who participated in the 2016 BRFSS, it is possible to examine current smoking status among people age 65 years and older who reported that they had had all of their natural teeth extracted. Periodontal disease is one major reason for the loss of all of one's natural teeth. Among Delawarean participants in the 2016 BRFSS, 25% of those who reported they were current smokers had had all their natural teeth extracted, compared to 16% of those who reported they did not currently smoke.

Smoking and the use of smokeless tobacco are strongly associated with an increased risk of cancers of the oral cavity and pharynx (ADA, 2018). The incidence rate of oral cancer in both Delaware and the U.S. increased between the five-year periods of 2000-2004 and 2010-2014: in Delaware, the incidence rate rose 9%, and in the U.S., it rose 4% (Cancer I&M, 2018). This may reflect the aging of the population, as oral cancer is most often diagnosed in later life. In Delaware, the peak age of diagnosis for oral cancer is 75-84 years of age. Oral cancer incidence rates are higher in Delaware among non-Hispanic whites (13.8 per 100,000) than among non-Hispanic blacks (7.8 per 100,000) (Cancer I&M, 2018). Non-Hispanic whites, at 19%, were also the most likely to report being current smokers in the 2016 BRFSS.

Smoking and the use of smokeless tobacco are strongly associated with increased risk of cancer of the oral cavity and pharynx.

The link between tobacco use and oral health is one that can be addressed well before adulthood is achieved. According to results gleaned from Delaware's 2015 YRBS, which defined "current" smoking/use as "at least 1 day during the 30 days before taking the survey," many high school students currently smoke or use tobacco products. Ten percent (10%) of high school students participating in the survey reported they currently smoke cigarettes, 4.5% reported current smokeless tobacco use, and 11% reported they currently smoke cigars. Overall, 17% of high school students reported current smoking and/or current use of smokeless tobacco.

Delaware has been working to control and prevent the use of tobacco since 1994, when the state received a CDC grant to develop a plan to prevent and control tobacco use. One of the first actions taken under the grant award was to form the IMPACT Tobacco Prevention Coalition, composed of representatives of community service and health-related organizations with an interest in tobacco prevention efforts. CDC subsequently awarded funds for Delaware's use in developing tobacco control infrastructure and implementing statewide tobacco programs (IMPACT, 2017).

Tobacco control efforts have included the statewide Clean Indoor Air Act, passed in 2002 to protect non-smokers from involuntary exposure to environmental tobacco smoke; the proliferation of local smoke-free policies that provide smoke-free college and hospital campuses, parks, beaches and private workplaces; and laws prohibiting the sale of tobacco products to minors. These efforts have had an impact:

- The percentage of Delawarean adults who currently smoke has declined from 23% in 2000 to

17% in 2016 (BRFSS, 2016).

- The prevalence of current smoking (smoked cigarettes at least 1 day in the past 30) among high school students declined from 32% in 1999 to 10% in 2015; the prevalence of regular smoking (smoked cigarettes at least 20 days in the past 30) declined from 18% in 1999 to 4% in 2015.
- The Clean Indoor Air Act and Youth Access laws were expanded to include e-cigarettes and vaping products (IMPACT, 2017).

Currently, prevention and control activities are at risk. Funding from the Delaware Health Fund to support tobacco prevention and control efforts was cut by 50% between 2011 and 2017, and now stands at less than half the $13 million per year recommended by the CDC. Tobacco products are still affordable in Delaware; the cost of cigarettes is lower than in surrounding states (IMPACT, 2017).

Dental care providers can play an important role in promoting a tobacco-free lifestyle, encouraging their patients who smoke to quit, and referring those wishing to do so to available cessation resources.

Dental care providers have a role to play in the prevention and control of smoking. Oral exams provide an opportunity not only to inspect the oral cavity for smoking-related problems, but also to provide patients with information on the impact of smoking on their teeth, gums and pharynx and to promote a smoke-free lifestyle. Dental providers also can encourage patients who smoke to quit and refer those who are receptive to DPH's cessation program, the Delaware Quitline. Such activities are consistent with HP2020's objective OH-14, aimed at "Prevention interventions (tobacco cessation…) in dental offices…"

Community Water Fluoridation

The CDC has recognized community water fluoridation as one of the 10 great public health achievements of the 20th century, yet not everyone has access to fluoridated water (CDC, 1999). Delaware is going well with regard to fluoridated water, as evidenced by Delaware's 2017 Fluoridation Status Report, found on CDC's About My Water website. This report designates 51 community water systems as "fluoridated"; 180 are designated as "non-fluoridated." The fluoridated systems serve 715,773 people; non-fluoridated community water systems serve 102,337 people. Given a population of 818,110 people served by a community water system, 87% of those have fluoridated water. Given a statewide population of 934,695, just over three-quarters (77%) of Delaware's entire population is served by a fluoridated water system (Water, 2017).

DHHS recommends a fluoride level of 0.7 milligrams per liter of fluoride in drinking water. Three of the community water systems designated as fluoridated have levels below 0.7 mg/L; these systems serve about 2,400 people. Eight community water systems, serving ~6,500 people, have concentrations above 0.7 mg/L. (CDC, 2017)

Teeth Cleaning

Professional cleaning of the teeth, typically performed by a dental hygienist, involves removal of plaque which can build up on teeth and between the teeth and gums, even in the presence of routine brushing

and flossing. Teeth cleaning can help to prevent tooth decay and periodontal disease; avoiding the latter is especially important, as links have been established between periodontal disease and heart disease, cerebrovascular disease, and diabetes (Wu, 2000; Janket, 2003; Preshaw, 2012). Links may also exist between periodontal disease and dementia, rheumatoid arthritis, and premature birth (WebMD, 2018).

While no data specifically on "teeth cleaning" is available, Delawareans who report having had a dental visit/preventive dental visit are likely to have received or at least been made aware of the desirability of teeth cleaning. The address of Delawareans appear to have made such a visit within the past year:

- Per the 2016 NSCH, 80% of Delaware children age 1-17 years had seen a dentist or other dental provider for preventive dental care within the past year.
- Eighty-two percent of children participating in a Delaware Head Start or Early Head Start program completed a professional dental exam during the program year.
- Per the YRBS, 73% of high school students had seen a dentist within the past 12 months.
- Per the BRFSS, 66% of adults age 18 years and older had visited a dentist or dental clinic within the past year.

There are, however, Delawareans who do not appear to have had a recent preventive dental visit and who, as a result, are unlikely to have had – or been encouraged to have – their teeth cleaned:

- Just 10% of Delawareans receiving care at an FQHC had dental prophylaxis.
- Forty-one percent of women participating in the 2014 PRAMS reported having their teeth cleaned during pregnancy; 50% reported have had their teeth cleaned in the 12 months before pregnancy.
- Only 42% of children age 1-20 years who were eligible for EPSDT services received an oral health service in Federal Fiscal Year 2017.
- Just 50% of Hispanics participating in the 2016 BRFSS reported having visited a dentist or dental clinic in the past 12 months.

Use of Dental Sealants

Dental sealants are an effective oral health intervention, preventing caries development in the pits and fissures of molar (back) teeth (Ahovuo-Saloranta, 2013). Dental sealants can be applied in dental offices or community settings (e.g., schools), yet not all children are benefiting from this proven preventive service. In 2011-2012 in the U.S., only 31% of children age 6-8 years, 49% of children age 9-11 years, and 43% of adolescents age 12-19 years had dental sealants on at least one permanent molar (Dye, NCHS brief 191, 2015).

Sealant presence among some of Delaware's children appears to be somewhat better than in the U.S. overall. A 2013 survey of third grade children demonstrated the presence of sealants in over half (54%) (Smile, 2013). However, a 2016 assessment of sealant prevalence among children age 6-9 years who were deemed to be at increased risk of caries and who received oral health care at a Delaware Federally Qualified Health Center (FQHC), found that just 33% had sealants on their first molars. Further, the 2017 CMS-416 report for Delaware found dental sealants were applied for just 12% of children age 6-9 years and 13% of children age 10-14 years who were eligible to receive EPSDT services in 2017.

UTILIZATION OF DENTAL SERVICES

Dental Visits

Among All Delawareans

Regular dental visits are a basic component of good oral health care. Among many Delawareans, such visits have become routine:

- Of Delaware's children between the ages of 1 and 17 years, 80% had a preventive dental visit within the past 12 months (NSCH, 2016)
- Eighty-six percent of Head Start and Early Head Start children completed a dental exam during the program year (OHS PIR, 2017).
- Seventy-eight percent of Delaware's third graders were reported to have had a dental visit within the past year (Delaware Smile, 2013).
- Seventy-three percent of high school students reported a dental visit within the past 12 months, with an additional 11% reporting such a visit in the preceding 12-24 months (YRBS, 2015).
- Sixty-six percent of adults age 18+ years reported having had a dental visit within the past year (BRFSS, 2016).

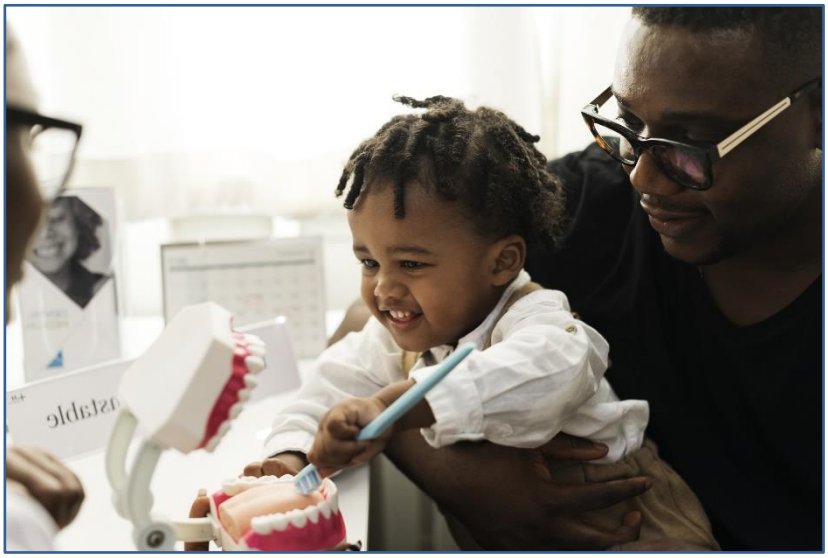
While these overall findings are encouraging, they may mask less-encouraging results for some sub-groups within Delaware. For example:

- Only 55% of children age 1-5 years were found, in the NSCH, to have had a dental visit within the past 12 months; this is masked by the 92% of children age 6-11 and 90% of children age 12-17 who had such a visit.
- Of children age 1-20 years who were eligible to receive EPSDT services, 42% received a preventive dental service during Fiscal Year 2017. Among these same children, 16% received a dental treatment service.
- Of the children and adults who received dental care at an FQHC, 10% received prophylaxis in 2016; 13% received an oral exam. (Percentages are not mutually exclusive.)
- Fifty-five percent of students age 18 years or older reported having seen a dentist in the preceding 12 months on the YRBS, as did just 62% of Hispanic students.
- Fifty-eight percent of adults age 25-34 years participating in the 2016 BRFSS reported having seen a dentist in the last year, as did just 50% of Hispanic participants (of any age).

Among Children

In addition to the routine dental visits described previously, children may avail themselves of services such as treatment of dental caries, application of fluoride varnishes and /or sealants, and restorative or rehabilitative dental services. Information on the use of these services is available from only a few sources, and often cannot be derived from a question about a broad array of services. For example, the NSCH question concerning dental visits in the past 12 months includes visits for "…preventive dental care, such as check-ups, dental cleanings, dental sealants, or fluoride treatments." The individual components are not parsed, so information specific to each cannot be gleaned from the results.

A separate question on the NSCH relates to oral health problems, but asks only if problems such as toothaches, bleeding gums, or decayed teeth or cavities occurred; service utilization for treating these problems is not collected. Thirteen percent of all Delaware children (age 1-17 years) reportedly experienced an oral health problem but it is unknown if they received treatment. By age group, children age 6-11 years were most likely to be reported as having an oral health problem (16%), followed by those age 1-5 years (14%); and those in the 12-17 year age group (10%) Females were somewhat more likely to have had an oral health problem (15%) than males (11%). Hispanic children were the most likely to have experienced an oral health problem in the past 12 months (25%), compared to 15% of non-Hispanic Other race children and 10% of both non-Hispanic white and non-Hispanic black children.



A need for dental treatment (type unspecified) was reported for 26% of Delaware Head Start or Early Head Start participants; of these, 68% were reported to have received treatment during the program year.

Information related to the receipt of dental sealants was captured for children age 6-9 years who received services at an FQHC during 2016 and who were deemed to be at moderate to high risk of caries. Of 577 Delaware children meeting the age and risk criteria, 191 (33%) received a dental sealant.

Among the 130,586 Delaware children age 1-20 years who were eligible to receive EPSDT benefits, 54,571 (42%) received a dental service of some type. A total of 51,295 (39%) received a *preventive* dental service; 21,006 (16%) received a dental *treatment* service (specific treatment type unknown). Among the 62,394 children age 6-14 years who were eligible to receive EPSDT benefits, 7,965 (13%) received a sealant on at least one permanent molar.

Delaware's Smile Check program, which works with schools to provide oral health care services to underserved children, conducts screenings and – for children considered to be at high risk for tooth decay – applies fluoride varnish treatments. During the 2016-2017 program year, varnishes were applied for 3,819 of the total 3,857 children (99%) who received oral screenings.

Among Pregnant Women

Physiologic changes during pregnancy may adversely impact women's oral health. As oral health is an important component of overall health, it is important to commence pregnancy with oral health intact and to maintain good oral health throughout pregnancy. Pregnancy does not preclude either preventive

or treatment-related dental care (Consensus Statement, 2012).

Not only will maintaining oral health throughout pregnancy benefit women's general health; it also is likely to benefit the future oral health of their infants. Evidence suggests that most infants and young children acquire caries-causing bacteria from their mothers. Promoting good oral health practices among pregnant women may reduce the likelihood of bacteria transmission, thereby delaying or preventing the onset of caries among their children (Consensus Statement, 2012).

Among women participating in Delaware's 2014 PRAMS survey, it appears that efforts to promote awareness of oral health during pregnancy are enjoying some success. Eighty-eight percent reported they were aware it was important to care for their teeth and gums during pregnancy. Nearly half (48%) indicated that a dental or other health care worker had talked with them about how to care for their teeth and gums. Fifty percent reported having had their teeth cleaned before they became pregnant, and 41% reported having their teeth cleaned during pregnancy.

While pregnancy status is not a variable collected in the BRFSS, both sex and age are, enabling an overall look at women of childbearing age. Per the 2016 BRFSS, 68% of all females (all ages) had a dental visit in the past year, though this percentage varied across the age ranges during which most pregnancies occur:

- Of women age 18-24 years, 74% had a dental visit in the past year.
- Of women age 25-34 years, 58% had a dental visit in the past year.
- Of women age 35-44 years, 62% had a dental visit in the past year.

BARRIERS TO UTILIZATION OF SERVICES

Barriers to the receipt of dental care include poor oral health literacy, a lack of dental providers, limited - or no dental insurance coverage, and limited financial resources. Other factors are transportation, geographic location, preferred language, education, and cultural norms. In many cases, multiple factors are involved simultaneously (ASDA, 2017). A comparison of the access barriers identified by participants in the 2003-2004 and 2011-2012 NHANES studies found that the most common barrier to care was "cannot afford the cost," reported by 13% and 12% of participants, respectively (Wall, 2014). Consumer Reports estimated in 2017 that about 40% of Americans lack dental insurance, and most who have insurance lose coverage upon retirement (Consumer Reports, 2017).

Many of these factors impact Delawareans. Much of Delaware lacks an adequate dental workforce, as evidenced by its multiple designated dental health provider shortage areas that include the entirety of Kent and Sussex counties. While most of Delaware's children (85%) have either private or public dental insurance (Smile, 2013), many adult Delawareans lack insurance coverage for dental care. Very limited preventive dental coverage is available to adult Medicaid recipients, or to individuals enrolled in standard Medicare plans. Many employed Delawareans are uninsured or underinsured for dental care; their dental insurance coverage may have high deductibles and/or pay out relatively low dollar amounts ($1,000 - $1,500) per benefit year.

Patterns of dental care access suggest other factors that likely constitute or contribute to barriers to care: Hispanic adults were the least likely to report having had a dental visit within the last year on the

2016 BRFSS, with just 50% having had such a visit. While the percentage of Hispanic high school students who reported having seen a dentist in the past 12 months was far higher – 75% - a higher percentage of students in every other racial and ethnic groups reported having seen a dentist in this time frame. Thirty percent of individuals with less than a high school education reported having seen a dentist in the past year on the 2016 BRFSS. Those with an annual household income of $15,000-$24,999 were the least likely to report having seen a dentist in the past year (38%), compared to those with an annual income of $50,000 or more (81%). While sample sizes were low – so results must be interpreted with caution – Hispanic children and non-Hispanic children of other (i.e., not white/Caucasian or black/African American) race were the least likely to have seen a dentist or oral health care provider in the past 12 months, per results of the NSCH. In each case, just 77% reported having done so.

Dental Health Professional Shortage

HRSA has designated large portions of Delaware as dental care health professional shortage areas (HPSAs). Designation as a HPSA may be based on geography, demography (e.g., a low-income population), or an institution (e.g., the people served by a comprehensive health center or a federally qualified health center (FQHC)). The designation requires a population-to-provider ratio of at least 5,000:1 or – if there are high needs in the area – 4,000: 1 (KFF, 2016). Areas in Delaware designated as dental care HPSAs are: all of Kent County (population group: low income); all of Sussex County (population group: low income; facility: LaRed Health Center); and portions of New Castle County (population group: low income – Wilmington / New Castle County sub-county; facility: Westside Health Services) (HRSA, 2018). The Kaiser Family Foundation (KFF) estimated that as of December 31, 2016, 381,733 Delawareans - 41% of Delaware's total population - lived in a dental care HPSA. An additional 56 dentists – distributed appropriately throughout the HPSAs – would be required to eliminate the shortage (KFF, 2016).

FQHCs are community-based organizations which provide comprehensive primary care and preventive care services to people of all ages, regardless of their ability to pay or health insurance status. FQHCs offer general health, oral health and mental health / substance abuse services. Delaware has three FQHCs, which among them operate 15 service sites throughout the state. All three offer dental services, though none offer those services at all their sites:

- Westside Family Healthcare has five service sites, and offers dental services at four;
- Henrietta Johnson Medical Center operates four sites, offering dental services at one; and
- La Red Health Center has two sites of service, offering dental care at one site.

Dental Workforce and Capacity

The most recent survey of Delaware's dentists was conducted by the University of Delaware; the work was contracted jointly by the BOHDS and the Bureau of Health Planning and Resources Management. The results of the survey appear in *Dentists in Delaware 2016*, published in May 2017. Survey results estimated there were 437 dentists actively practicing in Delaware, noting this is an increase over the estimated 380 dentists actively practicing in Delaware in 2012 (Toth, 2017).

However, the number of full time equivalent (FTE) dentists—calculated per federal guidelines detailed in

the report—decreased from 381 in 2012 (Gilman, 2013) to 370 (Toth, 2017). Adding to concerns about future capacity, at the time of the 2012 survey, the average age of Delaware dentists was 52; nearly 45% were 55 years of age or older (Gilman, 2013). At the time of the 2016 survey, the average age was 59, and 45% of Delaware dentists were 55 years of age or older (Toth, 2017).

In the 2016 survey, almost all dentists (98%) stated they accepted new patients. The reported wait time between call for an appointment and a non-emergency visit varied by patient status (new versus established) and type of dentist (generalist/pediatric versus specialist) but average wait times ranged between five and fourteen days for the state overall. Wait times in Kent County were typically the highest among the counties, ranging as high as a wait of nearly a month (26.4 days) for a new patient appointment with a generalist/pediatric dentist, and nearly six weeks (40.5 days) for a new patient appointment with a specialist. Less than 50% of dentists were accessible during non-traditional hours (i.e., evenings and/or Saturdays); such dentists were located chiefly in New Castle County (Toth, 2017).

Most of Delaware's dentists participated in dental insurance plans, offered flexible payment plans, and provided charity care. For the state as a whole, about 83% of generalist/pediatric dentists and 88% of specialists participated in at least some dental insurance plans. Eighty-nine percent of generalist/pediatric dentists and 83% of specialists provided a flexible payment plan. Seventy-five percent of generalist/pediatric dentists and 85% of specialists provided charity care within their offices (Toth, 2017).

Factors such as race, ethnicity, and real or perceived language barriers (each of which may impact access) could be influencing the dental care usage patterns observed in Delaware. The vast majority of Delaware's dentists (86%) are white, and an even larger majority (99%) are non-Hispanic. Only about half of all dental practices (56% of generalist/pediatric practices and 55% of specialist practices) spoke a language other than English at the practice site; Spanish was the most commonly mentioned second language (Toth, 2017).

One indication of perceived capacity is how dentists describe the staffing of their practices (e.g., Do their practices have an adequate number of qualified dental hygienists, dental assistants, and office staff?). The majority of all practices – 89% of generalist/pediatric dentists and 83% of specialists – reported on the 2016 survey that they were fully staffed. Despite most dental practices being fully staffed, 44 of generalist/pediatric dentists and 46% of specialists reported that they had a shortage of qualified dental hygienists and dental assistants. Twelve percent reported having difficulty hiring a qualified dental hygienist, 48% had experienced difficulty hiring a dental assistant, and 40% had had difficulty hiring general office staff (Toth, 2017).

Dental Medicaid Coverage in Delaware

Comprehensive dental coverage, including coverage for oral health screening, diagnosis, and treatment services, is mandatory for children enrolled in Medicaid (Paradise, 2016). In Fiscal Year 2016, 101,541 Delaware children age 1-20 years were eligible to receive dental services through Medicaid. Of these children, 54% received some type of dental service during that year. The percentage receiving a dental service varied considerably by age group, suggesting areas where increased efforts to heighten awareness of the importance of oral health care might be warranted. Fifteen percent of children younger than 1 year through 2 years of age received any dental service; this rose to 61% of children age 3-5 years and 71% of children age 6-9 years. The percentage of children receiving some type of dental service then began to decline at age 10-14 years (67%), age 15-18 years (56%), and age 19-20 years (39%).

Although dental coverage for children is federally mandated, dentists are not mandated to accept patients who are insured through Medicaid. In Delaware, a 2016 survey of dentists actively practicing in the state revealed that just under two-thirds (62%) of general/pediatric dentists accepted Medicaid payment; an even lower percentage of specialist dentists (59%) accepted Medicaid (Toth, 2017).

Dental services are not federally mandated for adults eligible for Medicaid. As each state is therefore able to define adult benefits, coverage for dental services varies markedly across states. Within states, dental coverage may differ between those in the Medicaid-base population and those in the population who qualified for Medicaid under the Affordable Care Act expansion (CHCS, 2019).

Most states offer at least some dental benefits to adults insured under Medicaid but, historically, Delaware has not been among those states. In 2019, Delaware was only one of three states – the other two being Tennessee and Alabama – which provided no adult dental benefits under Medicaid.

As a result, Delawareans with low incomes find themselves in a particularly vulnerable position. They have no insurance benefits covering dental services and, by definition, likely lack the resources to pay out-of-pocket costs for the oral health services they need.

The 2016 BRFSS results may serve to suggest the impact of the combined lack of insurance coverage and lack of resources: 58% of adults with an annual income of less than $15,000 reported they had not visited a dentist or dental clinic in the past year, as did 62% of adults with an annual income of $15,000-$24,999. Only 19% of adults with an annual income of $50,000 or more reported having had no dental visits in the past year. Failure to receive regular preventive dental care may contribute to undesirable outcomes such as extractions of permanent teeth. According to the 2016 BRFSS, nearly two-thirds (61%) of adults with an income of less than $15,000 reported having had at least one permanent tooth extracted; only about one-third (35%) of those with an income of $50,000 or more reported the same.

As of April 1, 2020, Delaware will begin to offer limited dental coverage to adult Medicaid beneficiaries.

In 2019, the General Assembly took steps aimed at improving the dental health of Delaware's adult Medicaid population, passing legislation which will provide limited benefits to adults enrolled in Medicaid. Senate Substitute 1 for Senate Bill 92 was signed into law

August 6, 2019 by Governor John Carney, and goes into effect April 1, 2020. As of that date, Delaware will begin to offer limited dental coverage to adult Medicaid beneficiaries.

CONCLUSIONS

Oral disease is a disfiguring and disabling burden. It impacts people's ability to eat, learn, communicate, and interact successfully with others. It also often is preventable. Dental sealants are a proven method to caries prevention, early detection and treatment of dental caries reduces periodontitis and tooth loss, and avoiding tobacco drastically reduces the incidence of oropharyngeal cancer. Oral health improvements can improve general health as well. Links have been established between periodontitis and heart disease, cerebrovascular disease and diabetes; links may exist as well to other diseases. Investing in oral health may lead to cost savings for individuals and the health care system. Delaware's Oral Health Surveillance Plan 2020-2025, which aims to improve oral health among all populations, includes details the efforts underway to improve Delawareans' oral health and addresses the existing barriers to success.

There are many positives to highlight within the findings contained in this report. Delawareans meet or exceed many of the oral health targets identified by the HP2020 initiative:

- Delaware's third grade children fared better than HP2020 targets on all three measures: dental sealant use, decay experience, and untreated decay.
- Adult Delawareans exceeded HP2020 targets related to tooth loss.
- Nearly half of Delaware children enrolled in Medicaid or CHIP received a dental service in 2016, exceeding the HP2020 target for this measure.
- The percentage of Delaware's children age 1-17 years who had a dental visit in the previous year far exceeded the target set by HP2020.
- The percentage of Delawareans served by a public water system who receive fluoridated water exceeds the percentage targeted by HP2020.

Delaware has yet to meet the HP2020 target on one key measure:

- The percentage of Delawareans whose oropharyngeal cancer is diagnosed at the local stage is lower than the percentage targeted by HP2020 – meaning that more Delawareans are diagnosed at the regional or distant stages instead of in the early stage. Diagnosis of this cancer among Delawarean males is responsible for the failure to achieve the target; diagnosis of Delawarean females at the local stage disease exceeds the HP2020 target.

HP2020 targets do not represent an ideal state. They are designed to represent an ambitious, but achievable, target for measuring the nation's progress over time. For example, while Delaware's third grade children exceeded the HP2020 target for the use of dental sealants, there is room yet for improvement. Only 54% of those children had a sealant on at least one permanent molar, and 16% had untreated dental caries. Clearly, these percentages are in need of further reduction.

There also are substantial challenges ahead, as BOHDS seeks to further improve the oral health of all Delawareans. Some challenges involve reaching across language, racial, ethnic, and cultural barriers; others involve removing barriers within broader health systems. In a state which already has multiple

dental HPSAs, the declining number of dentists is a worrisome trend. HRSA estimates that 56 additional dentists, deployed strategically statewide, are required to eliminate the state's dental health provider shortage areas. Another systemic barrier relates to insurance. Delaware is one of the last states to offer dental benefits to adults enrolled in Medicaid; these benefits—which are modest—will be available beginning April 1, 2020. The historic lack of dental benefits likely contributes to poor oral health among those individuals.

Significant progress has occurred in recent years to determine and monitor Delawareans' oral health. More people are visiting the dentist and receiving preventive services, and less are using tobacco. BOHDS's efforts to reach the most underserved children are meeting with some success. Yet, much work remains to achieve a high standard of oral health among all Delawareans. Stakeholders in Delaware have a long history of working together to meet challenges and achieve goals. Delawareans' oral health will benefit from this same spirit of collaboration.

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