Oral Health in America: Advances and Challenges

Section 1: Effect of Oral Health on the Community, Overall Well-Being, and the Economy

Chapter 1: Status of Knowledge, Practice, and Perspectives

Oral health plays a vital role in the physical, mental, social, and economic well-being of individuals and populations (Peres et al. 2019). The oral cavity and its surrounding structures are essential parts of the human body, integral to its daily functioning and contributing substantially to the overall well-being of individuals. The oral cavity also is the main conduit of human interaction with society. Humans use it to verbally communicate with others, to take in nutrients and participate in communal eating, and to convey emotion. The appearance of an individual's teeth and surrounding structures greatly influences how others perceive them and how they perceive themselves. This perception has an impact on an individual's ability to work, contributes to one's social status, and can affect a person's socioeconomic position in society.

Although there is much to celebrate about ongoing improvements in oral health, many people still suffer from chronic oral conditions and lack of access to the dental care they need. Moreover, the incidence of oral diseases, like many chronic disease conditions, is socially patterned, with the largest burden of disease occurring among children living in poverty, racial and ethnic minorities, frail elderly, and other socially marginalized groups, such as immigrant populations. Marginalized groups include groups defined by race, religion, age, financial status, politics, and culture (Given 2008; Li et al. 2018; Hung et al. 2019). Others not defined by sociodemographic characteristics, but who have special health care needs (SHCNs), also can be marginalized. Not only do these groups suffer the highest burden of oral disease, they also face the greatest barriers to accessing routine preventive and other dental services (Parish et al. 2015; Velez et al. 2017; Lebrun-Harris 2021). The major barriers to accessing dental treatment include high cost, lack of accessible dental services in the community, geographic isolation, fear and anxiety, and other social and economic factors (National Advisory Committee on Rural Health and Human Services 2004; Nasseh and Vujicic 2014; Davis and Reisine 2015; Vujicic et al. 2016a; Gupta et al. 2019).

Beyond individual benefits, maintaining good oral health brings social and economic benefits to families and communities. As Listl and colleagues (2019) note, the effects of oral diseases are significant in economic terms. There are direct, indirect, and intangible costs, such as treatment expenditures, missed days from school and work, and lessening of the quality of life (Listl et al. 2015). In 2015, dental diseases around the world (with the exclusion of oral and pharyngeal cancers) accounted for approximately $545 billion (USD) in total costs, which included $357 billion in direct costs and $188 billion in indirect costs (Righolt et al. 2018). In high-income countries, such as the United States, significant numbers of days are lost every year from school, work, and daily activities, with productivity losses being similar to those associated with musculoskeletal injuries and disorders (Australian Research Centre for Population Oral Health 2012; Guarnizo-Herreño and Wehby 2012a; Hayes et al. 2013; Singhal et al. 2013). The academic performance of children, employment in adults, and productivity in the workplace are also affected (Mobius and Rosenblat 2006; Seirawan et al. 2012; Bóo et al. 2013; Singhal et al. 2013). In fact, securing employment and what one can earn is influenced by the appearance of the mouth and teeth (Hamermesh and Biddle 1994; Glied and Neidell 2010;

Bóo et al. 2013). Oral diseases worsen the impacts of other diseases, too, such as diabetes. Importantly, research demonstrates that periodontal treatment can reduce total and diabetes-related health care costs (Nasseh et al. 2017). The out-of-pocket costs that dental care can impose are also of concern, as they can put economically insecure families at risk of poverty (Bernabé et al. 2017). Finally, poor access to dental care also affects the health care system, resulting in inappropriate use of physician offices and hospital emergency departments (Allareddy et al. 2014; Vujicic and Nasseh 2014; Singh et al. 2019). As can be seen from the above, the economic benefits of improved oral health and access to dental care are substantial.

There are three broad-ranging factors that contribute to oral health and oral disease as they manifest at the community or population level. The first theme explores the important concept that oral health is integral to overall health and should be embedded in the broad framework of the whole body's health (Peres et al. 2019).

It has been more than 25 years since Surgeon General C. Everett Koop (Koop 1993) brought this notion to national attention when he said, "You're not healthy without good oral health." Having good oral health means, at a minimum, that an individual is free of oral infection and pain and has acceptable oral function and facial aesthetics. The FDI (French: Fédération Dentaire Internationale) World Dental Federation General Assembly recently updated its definition of oral health (Box 1) to emphasize that oral health must be thought of broadly and that it has numerous implications for an individual's physiological, social, and psychological well-being (Figure 1) (FDI World Dental Federation).

The second theme emphasizes that the benefits of good oral health extend beyond the individual to families and communities. When considering oral health from a population perspective, it becomes clear that the burden of oral disease falls most heavily on the most vulnerable groups in U.S. society. Oral diseases disproportionately affect population subgroups that have limited economic resources, low levels of educational attainment, poor access to dental care, and lower levels of social influence or political capital. This leads to recognizable oral health disparities and inequities.

Identifying the factors that contribute to poor oral health among vulnerable groups can provide guidance for developing and targeting oral health promotion strategies and reducing inequities. To that end, models of oral disease development have been created that bring attention to the multilevel factors now known to contribute to oral health status. Peres and colleagues' recent model (Figure 2) (Peres et al. 2019; World Health Organization 2020) shows that the determinants of oral health arise from the level of the individual, the family, the community, and the nation. Factors known to influence oral health status are classified into three levels, labeled as the structural, intermediate, and proximal determinants of oral health. Proximal determinants are related to an individual's biology and behavior, and the relationship of these determinants to health status often is readily apparent. For example, an individual's choices around diet, tobacco use, and oral hygiene all have clear links to oral health.

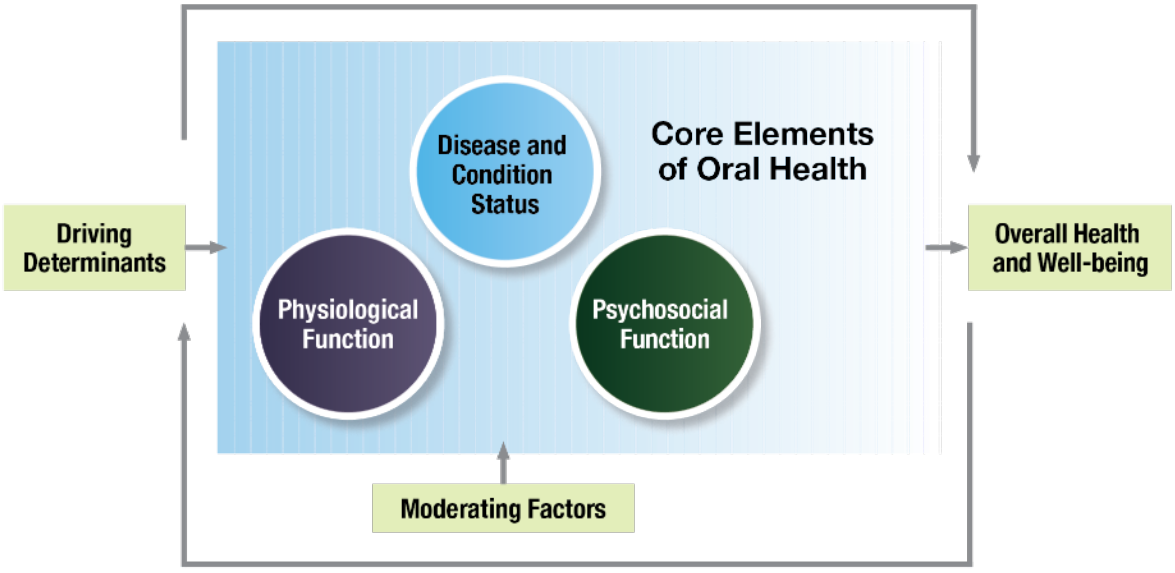
Box 1. FDI World Dental Federation definition of oral health

Oral health is multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow, and convey a range of emotions through facial expressions with confidence and without pain, discomfort, and disease of the craniofacial complex. Further attributes of oral health:

- It is a fundamental component of health and physical and mental well-being. It exists along a continuum influenced by the values and attitudes of people and communities.
- It reflects the physiological, social, and psychological attributes that are essential to the quality of life.
- It is influenced by the person's changing experiences, perceptions, expectations, and ability to adapt to circumstances.

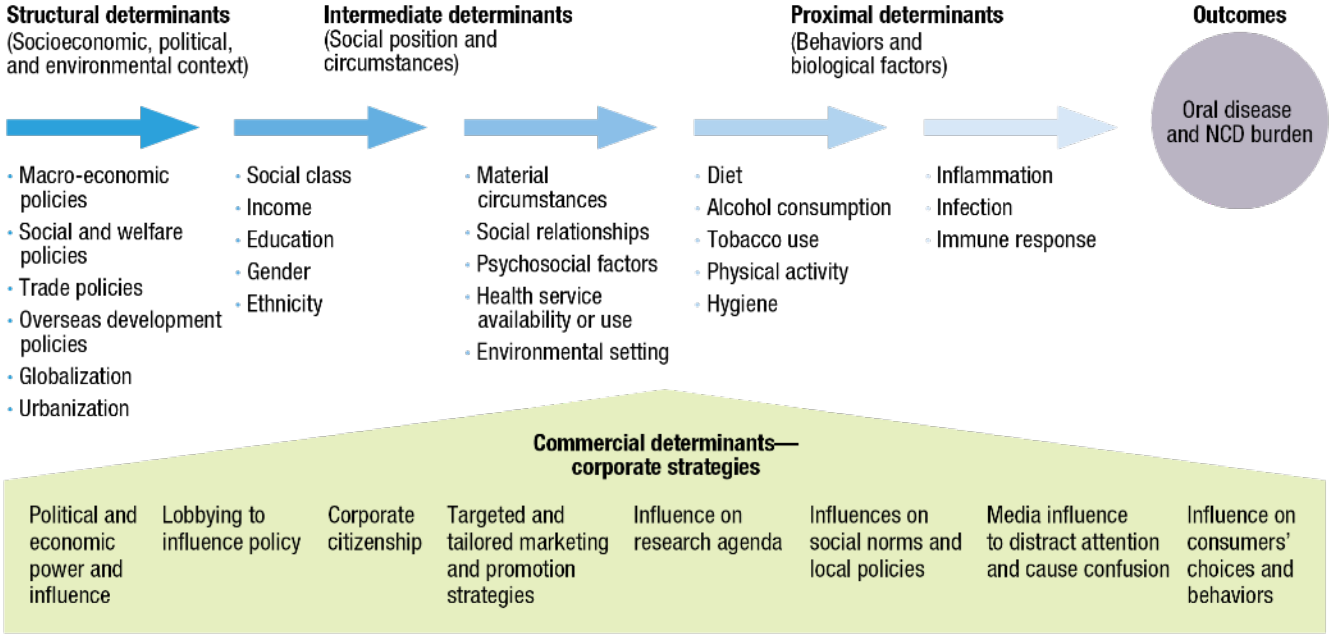
Source: FDI World Dental Federation, 2016.

Figure 1. Core elements of oral health



Source: FDI World Dental Federation (2020). © FDI World Dental Federation. Reprinted with permission.

Figure 2. Social and commercial determinants of oral health (Peres model)



Note: **NCD** = noncommunicable diseases.
Source: Peres et al. (2019). With permission from Elsevier.

The broader environmental context in which individuals live comprises both structural and intermediate determinants. Determinants at these levels generally are not under an individual's direct control and their linkage to oral health can seem less clear. Nevertheless, determinants at these levels are well understood to play an important role in influencing health status. Collectively, these structural and intermediate determinants are referred to as the social determinants of health (SDoH).

The World Health Organization (WHO) (2020) defines SDoH as:

> [T]he conditions in which people are born, grow, live, work, and age. These circumstances are shaped by the distribution of money, power, and resources at global, national, and local levels. The social determinants of health are mostly responsible for health inequities—the unfair and avoidable differences in health status seen within and between [social groups].

This definition is now commonly expanded to include the commercial determinants of health when they have contributed in important ways to health status. The commercial determinants of health are defined as the "strategies and approaches used by the private sector to promote products and choices that are detrimental to health" (Kickbusch et al. 2016 p. e895). Most notably, such products include cavity-promoting foods and beverages or substances such as tobacco products that are known to cause or promote oral disease. However, not all commercial determinants should be framed as negative, because commercial activity also results in continuously improving products for maintaining good oral health and can improve health education messages provided to the public about good oral hygiene habits.

The third broad-ranging theme involves the substantial ways in which dental care financing and delivery limit access to care and perpetuate disparities in oral health. The reasons that access to needed dental care remains challenging for many are complex, but they certainly are related to the historical separation of dentistry from overall health care, rendering dentistry one of the most siloed of the health professions. This partitioning of the dental profession is reflected in the educational model, in dental care financing (both public and private), and in how and where dental care services are provided. This contributes to an arbitrary disconnection between medicine and dentistry and results in dental care being viewed by some policymakers as a nonessential health service. This policy neglect is evident in the fragmented approach to dental care financing at both the federal and state levels. Public payment for dental care through Medicaid varies across states, with many offering only limited benefits, and in four states, no benefits at all for adults. Medicare, the main provider of medical insurance for older adults, contains no dental coverage. The scope of practice for some dental professionals, including, hygienists and dental therapists, also varies across states, and greater restrictions can contribute to the challenges of providing preventive dental services to reach vulnerable populations (including the institutionalized elderly, homeless people, and the rural poor).

When viewed from a population level, dental care financing and care delivery seem wholly insufficient to meet the needs of a diverse population. This existing system is not fulfilling its purpose (Vujicic 2018). Policy reform is urgently needed to resolve these structural barriers, to address social determinants that limit access to effective prevention, and to guarantee access to appropriate care for all. The benefits of these reforms can be demonstrated to fully justify the costs (Vujicic 2018).

Social Determinants of Health

SDoH have been a focus of public health for decades. Sydenstricker (1935) said that true improvements in population health required "control, so far as means are known to science, of all of the environmental factors that affect physical and mental well-being." That, he explained, includes economic security, healthy housing, availability of nutrient-dense food, opportunities for exercise, and efforts to provide social security for all. Link and Phelan (1995) described social factors such as low socioeconomic status and lack of social support (and arguably industry and market forces) as fundamental causes of disease. They base this assertion on evidence that the effect of SDoH persists even when intervening mechanisms such as individual health behaviors change.

Adler and colleagues (2016) noted that the best available evidence suggests using public funds to invest in addressing SDoH to achieve better population health, less inequality, and lower overall health care costs. Moreover,

social determinants are not restricted to those issues that have proximate links to health, such as tobacco policy, which means public health policies can be viewed more broadly to include those related to education, labor, criminal justice, transportation, and social welfare, given their potential contributions to population health. Patterns of health-promoting or health-damaging behavior emerge early as one develops physiologically and socially, and then continue to be shaped by positive and negative life circumstances. Oral health disparities, therefore, are attributable in part to public priorities and spending decisions. For example, insurance coverage and the amount of public spending on social programs in a nation influence both oral health and quality of life. Nations that spend more on social programs have populations with better oral health status (Guarnizo-Herreño et al. 2013). Similarly, the coverage and amount of social spending in a nation, particularly a welfare state, can influence the magnitude of income-related disparities in oral health or differences in oral health among income groups, but more research is needed to clarify different types of spending approaches (Sanders et al. 2009).

These effects extend to dental care utilization, as well. In nations with more public insurance coverage, differences among the numbers of dental visits reported by population groups are smaller (Palència et al. 2013). Further, this effect on dental care extends throughout the life course (Listl 2011; 2012). Because the U.S. public investment in dental insurance and direct provision of services is a mixture of programs that operate at the federal, state, and local levels, inevitable gaps are created in insurance coverage, in turn contributing to the development of oral health disparities and inequities.

Oral diseases are not equitably distributed within society as a result of the contributions to oral health status that arise from the social and economic environment. Viewed from a population perspective, it can readily be seen that the burden of many oral diseases disproportionately affects marginalized subgroups, giving rise to oral health inequities. However, when these disparities are the result of differences in the availability of social and economic health-promoting resources—including access to affordable healthy foods, professional dental prevention and treatment services, and dental insurance—they are considered avoidable, unnecessary, and amenable to policy action. As such, these disparities are viewed as unjust and are correctly described as inequities (Whitehead 1991; Braveman 2003). Leenan (1985) defined equity in health care using the following basic conditions:

- Equal access to available care for equal need;
- Equal utilization for equal need, and
- Equal quality of care for all.

Even at the local level of a neighborhood or built environment, the same effect is seen; namely, that the social, political, and economic characteristics of small residential areas are associated with oral health—independent of the characteristics of the individuals who live there. For example, among Black families with incomes below 250% of the federal poverty level, the quality of housing and available social supports appear to ameliorate the effect of poverty (Sanders et al. 2008b). Specifically, when low-income adults and children resided in better quality housing and had social supports, they were more likely to retain 20 or more teeth and have less tooth decay (Sanders et al. 2008a; Sanders et al. 2008b). This suggests that, in addition to the importance of addressing poverty, improving the built and social environments can result in resilience as a response to the harmful health effects of poverty itself.

The federal Healthy People 2020 initiative addressed SDoH as one of its four overarching goals for the decade, and this was reaffirmed and expanded in the launch of Healthy People 2030 in August 2020 (Hubbard et al. 2020; U.S. Department of Health and Human Services 2020a). This emphasis on SDoH also has been shared by other U.S. health initiatives, such as the U.S. Department of Health and Human Services' (HHS) Action Plan to Reduce Racial and Ethnic Health Disparities (U.S. Department of Health and Human Services 2011) and the National Prevention and Health Promotion Strategy (National Prevention Council 2011). Healthy People 2030 is focusing on the following five key determinants: economic stability, education access and quality, social and community context, health care access and quality, and the neighborhood and built environment (Figure 3). These determinants are addressed by interventions related to food insecurity, housing instability, early childhood education, literacy, civic participation, social cohesion, access to primary care, and environmental conditions.

Figure 3. Social determinants of health

Source: U.S. Department of Health and Human Services, Healthy People 2030 (2020).

When structured in favorable ways, all five determinants contribute to better oral health and facilitate favorable oral health trajectories during the life course (Gomaa et al. 2019). The new FDI definition of oral health (Box 1) and the Peres model (Peres et al. 2019) (Figure 2) reflect the importance of these factors in determining oral health status.

As part of the commitment by HHS to support improved health and well-being of the population, the Healthy People 2030 initiative sets 10-year measurable goals and objectives for the nation related to health promotion and disease prevention. Several of these objectives have an important role in oral health, such as reducing untreated dental disease, increasing water fluoridation, expanding access to dental insurance and improving access to care; improving population health through efforts to reduce added sugar consumption; and enhancing the dental public health infrastructure. It is noteworthy that Healthy People 2030 places strong emphasis on the importance of SDoH (Figure 3); all the social determinants listed in the figure are directly related to oral health. Focusing attention on their importance can foster both policy and research that leads to improved oral health for all.

Health professional education, including dentistry, also has identified SDoH as an important component of the curriculum of future professionals (National Academies of Sciences 2016; Sabato et al. 2018; Tiwari and Palatta 2019). In clinical dentistry as well, there is growing emphasis on understanding and incorporating SDoH as part of patient-centered care (Lévesque et al. 2016; da Fonseca and Avenetti 2017; Northridge et al. 2017; Edelstein 2018; Chi and Scott 2019).

Commercial Determinants of Health

In addition to the conventional SDoH, the Peres model (Peres et al. 2019) emphasizes the broad influence that commercial determinants and corporate strategies exert across all other factors. This concept has its roots in the decades-long battles fought by the U.S. federal and state governments against the tobacco industry, but in recent decades it also has matured into an understanding of the pervasive effects on health generated by a broad segment of commodity industries. As important influencers of consumption and the cultural and societal norms around activities such as behavior and diet, markets and industry play a key role in determining the health of individuals and populations and can drive associated disparities (Kearns et al. 2015; Friel and Jamieson 2019; Kearns and Bero 2019; Kearns and Watt 2019; Watt et al. 2019).

There is increasing recognition that rates of noncommunicable diseases (NCD), such as dental caries, periodontal disease, and oral cancer, are influenced by corporate strategies. Specifically, marketing, pricing, and subsidization of unhealthy products influence and drive consumption patterns of sugar and other sweeteners, tobacco, alcohol, and other unhealthy foods and beverages, giving rise to the concept of "industrial epidemics," a term emphasizing that a higher incidence of NCD is driven in part by the producers and marketers of commodities that are harmful to individual and societal health (Jahiel and Babor 2007; Collin and Hill 2015).

Commercial determinants shape consumer preferences, affect physical and social environments, and influence public policy development (Collin and Hill 2015). When addressing the Global Conference on Health Promotion in June 2013, WHO Director General Margaret Chan described the need to counter corporate threats to health policy beyond those of tobacco, citing the need to contend with "Big Food, Big Soda, and Big Alcohol," and arguing that the formulation of public policy for health must be protected from vigorous opposition and distortion by commercial or vested interests (Chan 2013). The WHO

FCTC (Framework Convention on Tobacco Control), adopted in 2003, provided the first treaty that legally binds the 181 ratifying countries to measures to ensure health through control of tobacco and could provide a model for future treaties focused on other health threats. One organization addressing the problem identified by Director General Chan is the World Economic Forum (WEF). WEF aims to be a platform upon which business, government, international organizations, civil society, and academia can interact to achieve a global impact. Through organizations such as this, corporate threats to health policy can be addressed via stakeholder engagement and cooperation aimed at developing a shared vision (World Economic Forum 2020).

The Tobacco Industry

The significant role of commercial efforts to influence personal choices that lead to health consequences should not be underestimated. For example, it is known that low-income high school students are disproportionally exposed to tobacco advertising and fast food availability near their schools (D'Angelo et al. 2016). Tobacco companies spent US$8.2 billion on advertising in 2019, marketing cigarettes and smokeless tobacco in the United States (Federal Trade Commission 2021a; 2021b). This amount translates to about $22.5 million each day, or nearly $1 million every hour. Tobacco advertising commonly targets low-income individuals, particularly low-income women (Brown-Johnson et al. 2014). The use of tobacco products is a major preventable cause of oral diseases and conditions. Cigarette smoking was established as a primary cause of cancers of the oral cavity and pharynx many decades ago (U.S. Department of Health 1979; International Agency for Research on Cancer 1986).

Cigarette smoking is a major cause of periodontitis (U.S. Department of Health and Human Services 2014) and a likely risk factor for dental implant failure (U.S. Department of Health and Human Services 2014). The use of smokeless tobacco products is a cause of oral cancer and periodontal destruction (U.S. Department of Health and Human Services 1986; International Agency for Research on Cancer 2007). The use of tobacco products has been implicated in a wide range of other oral diseases and conditions, such as delayed wound healing and compromised prognosis of oral surgical procedures or periodontal treatment. Although causality cannot be inferred, a relationship with dental caries also has been suggested (Warnakulasuriya et al. 2010). Cigar smoking has been specifically and causally linked to oral cancer and other adverse dental effects (Rostron et al. 2019). Consequently, tobacco prevention and control is an important aspect of oral disease prevention and health promotion.

Adversarial positions borne of competing interests have come to characterize tobacco control, with widespread recognition in the public health community that tobacco companies should be excluded from the development of public policy for health—a principle enshrined in Article 5.3 of the WHO Framework Convention on Tobacco Control (World Health Organization 2008; Collin and Hill 2015). The 2014 U.S. Surgeon General's report, *The Health Consequences of Smoking—50 Years of Progress* (U.S. Department of Health and Human Services 2014), concluded that the tobacco epidemic was initiated and has been sustained by the aggressive strategies of the tobacco industry, which has deliberately misled the public on the risks of smoking cigarettes, including the use of advertising and promotional activities that cause the onset and continuation of smoking among adolescents and young adults. The report also found that litigation against tobacco companies reduced tobacco use in the United States by increasing product prices, restricting marketing methods, and making available industry documents for scientific analysis and strategic awareness.

The Alcohol Industry

The International Agency for Research on Cancer (1988) concluded more than 30 years ago that alcohol consumption is a cause of cancers of the oral cavity, pharynx, larynx, esophagus, and liver. The role of alcohol as a cause of oral and pharyngeal cancer, independently and in combination with tobacco consumption, has been confirmed by more recent reviews (Tramacere et al. 2010; Reidy et al. 2011; de Menezes et al. 2013; Druesne-Pecollo et al. 2014; Roswell and Weiderpass 2015; Ogden 2018). Emerging evidence suggests that the alcohol industry was engaged in extensive misrepresentation of evidence about the alcohol-related risk of cancer (Petticrew et al. 2017). Alcohol producers have also used advertising and retail outlets to disproportionately target low-income neighborhoods (Hackbarth et al. 1995; Brenner et al. 2015). These activities have parallels with those of the tobacco industry and are important because the industry

is involved with developing alcohol policy and in disseminating health information to the public, including school children (Petticrew et al. 2017).

The Food and Beverage Industry

The commercial activity of the food and beverage industry has been identified as a potential determinant of ill health (Capewell and Lloyd-Williams 2018). This industry was first compared to the tobacco industry in 2009 (Brownell and Warner 2009). In 2012, *PLOS Medicine* published a series calling attention to the "gulf of critical perspectives" in medical journals on the food industry's role in creating the epidemic of obesity and associated diseases, including dental caries (PLoS Medicine Editors 2012). Since then, a growing number of studies have documented food and beverage industry strategies and tactics to maintain an environment that encourages obesity and dental caries, including aggressive lobbying of regulators, legislators, and governments; the co-opting of domestic and international nutrition experts; deceptive and attractive marketing to children; targeting of minorities and emerging economies; undisclosed conflicts of interest; shifting of the obesity research agenda toward physical activity; and opposition to beverage taxes and warning labels on sugar-sweetened beverages, among others (Nestle 2018).

Vulnerable Populations and Oral Health Disparities

Differences in oral health status among individuals and within groups can arise for a variety of reasons. Figure 2 provides a representation of these broad categories of disease determinants, including biological (genetics), behavioral (oral hygiene practices), and social or structural factors related to how society organizes, distributes, and incentivizes the use of resources such as dental insurance in ways that may either promote or harm oral health. The insidious effects of racism on health—not just as individually expressed bias, but as policies and practices that have been incorporated into the structures of health care delivery systems—also are now being recognized as major and complex determinants of health inequities (Bailey et al. 2021). The impact of these structural factors can be seen in dentistry as well.

Warnecke and colleagues (2008) make an important distinction between individual-level determinants and population-level determinants of health. Population-level determinants exert health effects, independent of individual characteristics, and consequently require population-level interventions to remediate their health-harming effects. They distinguish between population-level determinants that exert a health effect because of the inequitable distribution of health-promoting resources or that result from fundamental biological differences among groups. When it is the former, differences in health status are considered to be not only health disparities, but health *inequities* that require social or population-level remedies as a matter of social justice.

As defined by WHO, the SDoH are shaped by the distribution of money, power, and resources at global, national, and local levels. The distribution of money, power and resources are influenced by any number of policy choices (Marmot and Bell 2009). As a result, different forms of social and economic vulnerability or exclusion can be said to influence oral health and its related outcomes and result in disparities between groups when one is more advantaged and another less advantaged (Marmot and Bell 2009; World Health Organization 2020).

The federal government classifies certain groups as being at higher risk of developing health problems as a result of marginalization based on sociocultural status, reduced access to economic resources, age, gender, and ability. The Minority Health and Health Disparities Research and Education Act of 2000 [Public Law 106–525(d)] mandates that populations with health disparities include minority groups, as defined by the U.S. Office of Management and Budget, as well as rural populations, persons with low socioeconomic status, and sexual or gender minorities. The federal Healthy People 2020 initiative also identified the following groups as needing special attention and creative solutions to live a healthy life in the face of sobering health disparities and social injustices: (1) high-risk mothers, (2) chronically ill and disabled people, (3) people with HIV/AIDS, (4) mentally ill people, (5) individuals with substance use disorders, (6) homeless individuals, and (7) immigrants and refugees.

Several definitions of disparities have been adopted by the U.S. government. HHS describes health disparities as "differences in health outcomes that are closely linked with social, economic, and environmental disadvantage"

(U.S. Department of Health and Human Services 2011, p. 2). The National Institutes of Health defines a health disparity as a "difference in the incidence, prevalence, mortality, and burden of disease and other adverse health conditions that exist among specific population groups in the United States" (National Institutes of Health 2010). When these between-group differences are the result of unjust distribution of health-promoting resources, they are more appropriately referred to as inequities in health.

High-quality national data are available to document oral health disparities for several different population subgroups, including those with low income, African Americans (Black), Hispanics, Asian Americans, American Indians and Alaska Natives (AI/AN), and individuals with complex health conditions. However, the lack of nationally representative data or an adequate literature base hinders understanding of how differences in oral health may exist for other groups, such as the frail elderly, those with mental illness, and lesbian, gay, bisexual, transgender, queer, and other individuals.

Low-Income Populations

The idea that "the poor oral health of poor people is explained by personal neglect" (Sanders et al. 2006 p. 71) is not supported by research from the United States and Organization for Economic Cooperation and Development nations. Instead, oral health is determined by numerous factors that operate at the personal, social, and environmental levels. These determinants include genetics, behavior, and diet, as well as social, economic, and living conditions (Lee and Divaris 2014; Peres et al. 2019).

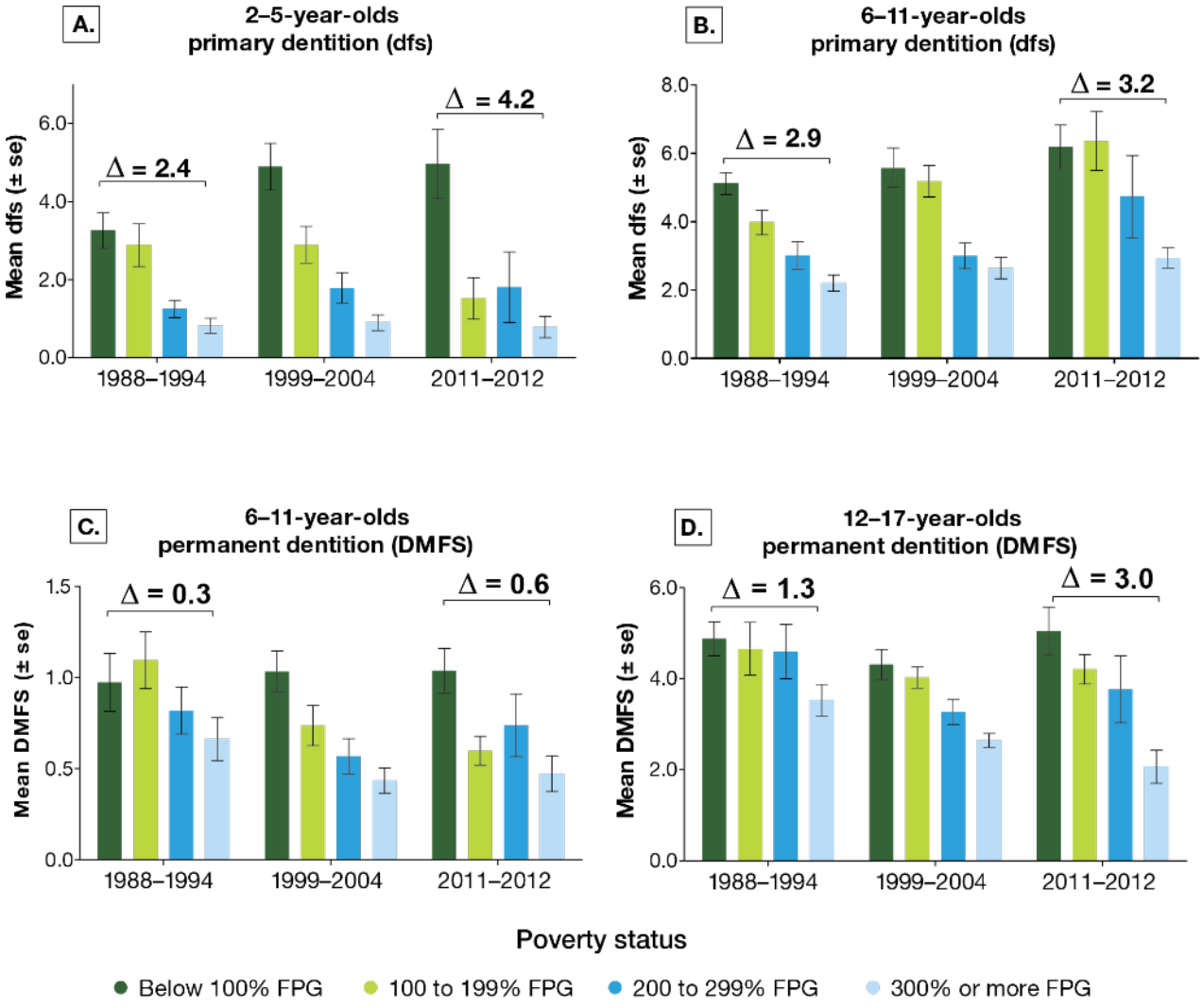
It is now generally recognized that the adverse relationship between economic circumstances and oral health spans the entire income distribution, although people who are worse off financially have more dental disease, on average, than those who are more affluent. For dental caries, not only has an income gradient persisted over time among U.S. children and adolescents, it may be worsening. Using nationally representative data from the National Health and Nutrition Examination Survey (NHANES) for three time points from 1988 to 2014, Slade and Sanders (2017) examined the income gradient for children and adolescents in three age groups. For each survey period, they computed four categories of the income-to-poverty ratio to illustrate this gradient in disease (Figure 4 A–D), adjusting for age, gender, race/ethnicity, rural–urban location, head-of-household education, and period since last dental visit. During 1988–1994, children aged 2 to 5 years living below the poverty threshold had 2.4 more decayed or filled primary tooth surfaces than their counterparts from families with income at least three times the poverty threshold. By 2011–2012, the disparity had increased to 4.2 affected tooth surfaces (Figure 4A). During the same interval, the disparity increased among older children in primary (Figure 4B) and permanent dentition (Figures 4C and 4D). For several groups, the magnitude of disparity in children's dental caries experience almost doubled during this period.

It is notable that this worsening of disparities in dental caries occurred during a period of increasing dental care utilization by low-income individuals aged 2 to 18 years, according to the Medical Expenditure Panel Survey. From 2000 to 2012, the rate of any use of dental services by children living in families below the poverty level increased from 27% to 36%, the greatest increase for any income group (Nasseh and Vujicic 2016b). Meanwhile, child poverty deepened in the United States, rising from 11% in 1999 to 15% in 2014 (Chaudry et al. 2016). Taken together, these findings demonstrate that, at a population level, increased utilization of dental care among low-income children did not lessen disparities in children's dental caries. One explanation could be that dental office visits alone have a limited capacity to prevent development of future carious lesions in primary teeth when disease risk is being driven primarily by social and commercial determinants.

Rural Populations

More than 60 million Americans (18%) reside in rural areas; of these, 34 million live in a dental health provider shortage area (Barnett et al. 2018). Compared to their urban counterparts, rural residents face worse oral health outcomes across the lifespan, are less likely to receive preventive dental services, and are more likely to seek dental care in the ED (Walker et al. 2014; Geiger et al. 2019). Rural adults have nearly double the prevalence of edentulism (tooth loss) than nonrural populations (Vargas et al. 2002). Rates of untreated dental caries are higher among rural populations in the South but not in other parts of the United States (Vargas et al. 2003; Maserejian et al. 2008; Dawkins et al. 2013).

Figure 4. Children's dental caries experience by primary or permanent teeth in four income categories: United States, 1988–1994, 1999–2004, and 2011–2012



Notes: Δ = absolute difference in mean caries between lowest and highest income groups; **FPG** = Federal Poverty Guideline.

Source: Slade and Sanders (2017). © The American Association of Public Health Dentistry. With permission from John Wiley & Sons.

Oral health disparities that persist in other subpopulations are compounded by rurality. Rural persons of color, including Black and AI/AN populations and migrant workers and their children, face disproportionately higher rates of untreated dental disease and have lower rates of dental utilization than their suburban and urban counterparts (Quandt et al. 2009; Wu et al. 2012; Schroeder et al. 2019). AI/AN adults and children, many of whom reside in rural areas, have extremely high levels of dental disease, including untreated dental caries, periodontal disease, oral pain, and tooth loss (Phipps and Ricks 2015; Phipps and Ricks 2016).

The causes of worse oral health outcomes in rural communities are multifactorial. Rural communities have fewer dentists and require longer travel time to reach dental care (Cao et al. 2017; Barnett et al. 2018). They also have lower rates of insurance coverage and Medicaid eligibility (Martin et al. 2012). Although rural dentists are more likely to accept Medicaid than their urban counterparts, rates of acceptance are still not high enough to meet the need for oral health services in the rural Medicaid population (Cao et al. 2017). In general, when compared to urban areas, rural areas have lower dentist-to-population ratios, more residents who lack dental insurance, and higher unemployment and poverty rates. As a result, roughly 2 in 5 rural Americans are essentially without access to dental care (National Organization of State Offices of Rural Health 2013).

In addition to these structural barriers to care, cultural norms, such as dental anxiety and pessimism about the achievability of oral health, also may contribute to rural-urban disparities in oral health outcomes (Chen et al. 2019). Rural populations have lower average levels of oral health literacy, a risk factor for poor oral health-related quality of life in rural communities (Gaber et al. 2017; VanWormer et al. 2018). Oral health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions" (National Institute of Dental and Craniofacial Research 2005). Adding to these risk factors, rural populations have less access to the preventive benefits of fluoridated water and use tobacco products more—both combustible and noncombustible—than urban residents, with the accompanying increased risk of periodontal disease and oral and pharyngeal cancers (Roberts et al. 2016). Combined, these factors contribute to a rural oral disease disparity through increased disease liability and reduced access to preventive and reparative dental services.

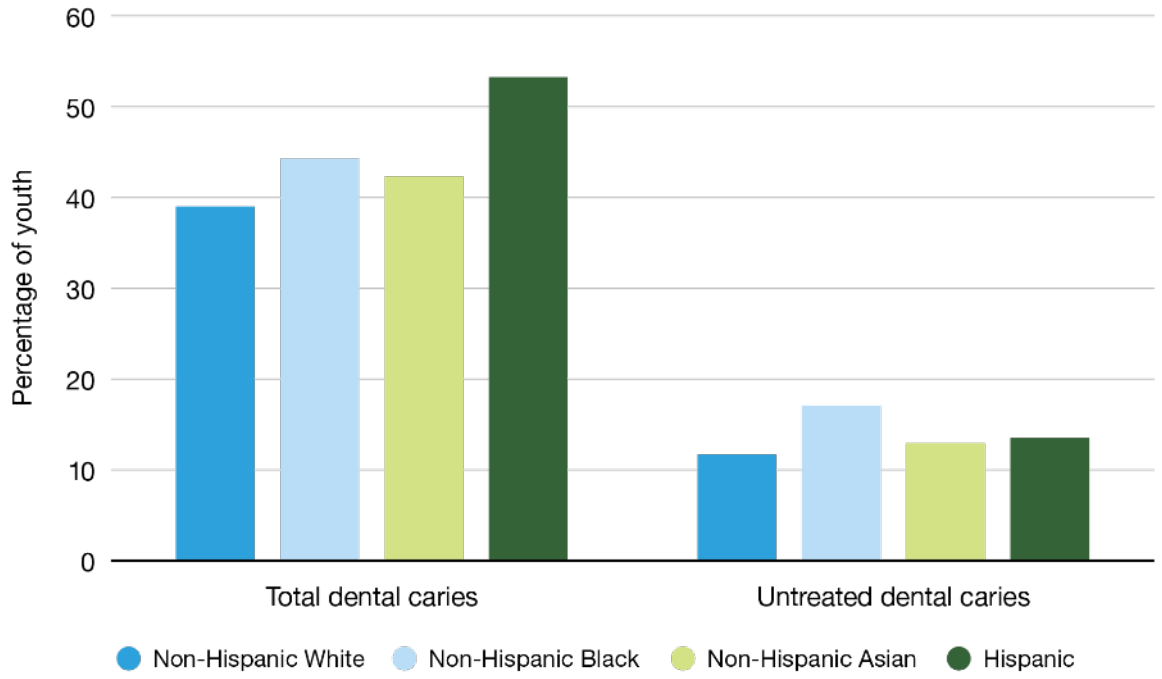
Black or African American Populations

Despite progress in past decades, more recent data show there are persistent and significant disparities in dental caries experience and untreated caries between non-Hispanic Black and non-Hispanic White populations. National Health Survey data have shown that among children and adolescents aged 2 to 19 years, the prevalence of total dental caries experience and of untreated caries were significantly higher in non-Hispanic Black youth compared with non-Hispanic White youth (Figure 5) (Fleming and Afful 2018). However, for working-age adults, dental caries were highly prevalent and consistent regardless of race/ethnicity, but substantial disparities do exist with the prevalence of untreated caries affecting 2 in 5 non-Hispanic Black adults (Figure 6). Root caries were significantly higher among non-Hispanic Blacks (40%) compared with non-Hispanic Whites (less than 20%) (Griffin et al. 2012).

Most current National Health Survey data show that the prevalence of periodontal disease among adults aged 30 years or older is higher among non-Hispanic Blacks (57%) and Mexican Americans (60%) compared with non-Hispanic Whites (37%), with severe periodontitis being more than twice as prevalent among Blacks (15%) compared to Whites (6%) (Eke et al. 2018). There also are clear disparities in tooth loss between Blacks and Whites, with complete tooth loss more prevalent among non-Hispanic Black adults 65 years or older (28%) compared with their non-Hispanic White adult counterparts (17%) (Dye et al. 2019). About 17% of Hispanics aged 65 and older are edentulous.

An analysis of 2000–2010 Surveillance, Epidemiology, and End Results incidence data showed that non-Hispanic White men had a higher age-adjusted incidence rate of oropharyngeal cancer (14.1 per 100,000) than non-Hispanic Black men (11.9 per 100,000) (Weatherspoon et al. 2015). This is contrary to the historical trend that Black men had a much higher incidence than White men (Morse and Kerr 2006). This reversal of incidence rates was linked to decreased rates of smoking and heavy alcohol use among Black men, decreased incidence rates

Figure 5. Percentage of youth ages 2–19 with total dental caries and untreated dental caries in primary and permanent teeth by race/ethnicity: United States, 2015–2016



Note: Includes dental caries in both primary and permanent teeth.
Source: Fleming and Afful (2018).

of human papillomavirus (HPV)-negative oral and oropharyngeal cancers, and an ongoing increase in the incidence of oropharyngeal cancer linked to HPV among White men and women (National Cancer Institute 2018). Non-Hispanic White women also had a higher age-adjusted incidence rate (5.3 per 100,000) than non-Hispanic Black women (4.0 per 100,000) (Weatherspoon et al. 2015).

Although the incidence trends in oral and oropharyngeal cancers have changed, disparities in survival rates persist. For example, in 2007–2013, the relative 5-year survival rate of cancers of the oral cavity and pharynx for Black men was 47%, compared with 68.7% in White men. A similar pattern was seen for Black and White women, with 60.3% and 70.1% survival rates, respectively (National Cancer Institute 2018).

Hispanic Populations

In the 1970s, ethnicity was introduced by the U.S. Census Bureau and used for categorizing Hispanics (Valdeón 2013); these were individuals who identified themselves as being of Spanish-speaking background. "Hispanic origin" currently is defined by the Census Bureau as "the heritage, nationality, lineage, or country of birth of the person or the person's parents or ancestors before arriving in the United States. Individuals who identify as Hispanic, Latinx, or Spanish may be any race" (U.S. Census Bureau 2019). Hispanics comprise the largest ethnic group in the United States, estimated at 18.1% in 2017 (U.S. Department of Commerce 2018). Although Hispanics are of diverse heritage (Rumbaut 2006), the largest subgroup is of Mexican origin (Pew Research Center 2012; Brown and Lopez 2013). Available clinical oral health data from the NHANES has focused on the Mexican American subgroup because of an insufficient number of non-Mexican Hispanics for subgroup analysis.

Hispanic adults have a higher prevalence of oral disease than non-Hispanic Whites. Hispanic children appear to be worse off than their White counterparts on other indicators of oral or health status and access to care, based on national survey data. Analysis of the 2007 National Survey of Children's Health (NSCH) found that Hispanic

children aged 3 to 18 years had worse oral health status (based on mothers' rating as "fair or poor") and were less likely to have obtained preventive dental care services in the past year than were non-Hispanic White or Black children (Guarnizo-Herreño and Wehby 2012b). In 2016–2017 NSCH estimates, the condition of 7.2% of Hispanic children's (aged 1–17 years) teeth was characterized as "fair or poor," compared with 4.2% among non-Hispanic Whites (Data Resource Center for Child and Adolescent Health 2020).

NHANES estimates are available for Mexican Americans and those who identify as Hispanic. In the 2015–2016 NHANES, dental caries experience was highest among Hispanic youth compared to non-Hispanic Black, Asian, and White youth with more than half (57%) of youth aged 2 to 19 years having caries (Figure 5) (Fleming and Afful 2018). Based on the 2011–2016 NHANES, 37% of Mexican American adults aged 20 to 64 years experienced untreated dental caries (Figure 6) and, for Mexican American adults 65 years or older, 36% had untreated dental caries, the highest among race/ethnic groups for older Americans (Centers for Disease Control and Prevention 2019). National Health Survey data show that Mexican American adults 30 years or older had the highest prevalence of periodontal disease among all racial or ethnic groups (Eke et al. 2018).

Tooth loss is an oral health status indicator for which Hispanics appear to be doing as well as or better than other racial or ethnic groups. The prevalence of complete tooth loss among Hispanic adults 50 years or older was similar to non-Hispanic Whites (9% vs. 11%) from 2009–2014. However, larger differences benefiting Hispanics exist between them and non-Hispanic Whites living in poverty (12% vs. 28%) (Dye et al. 2019).

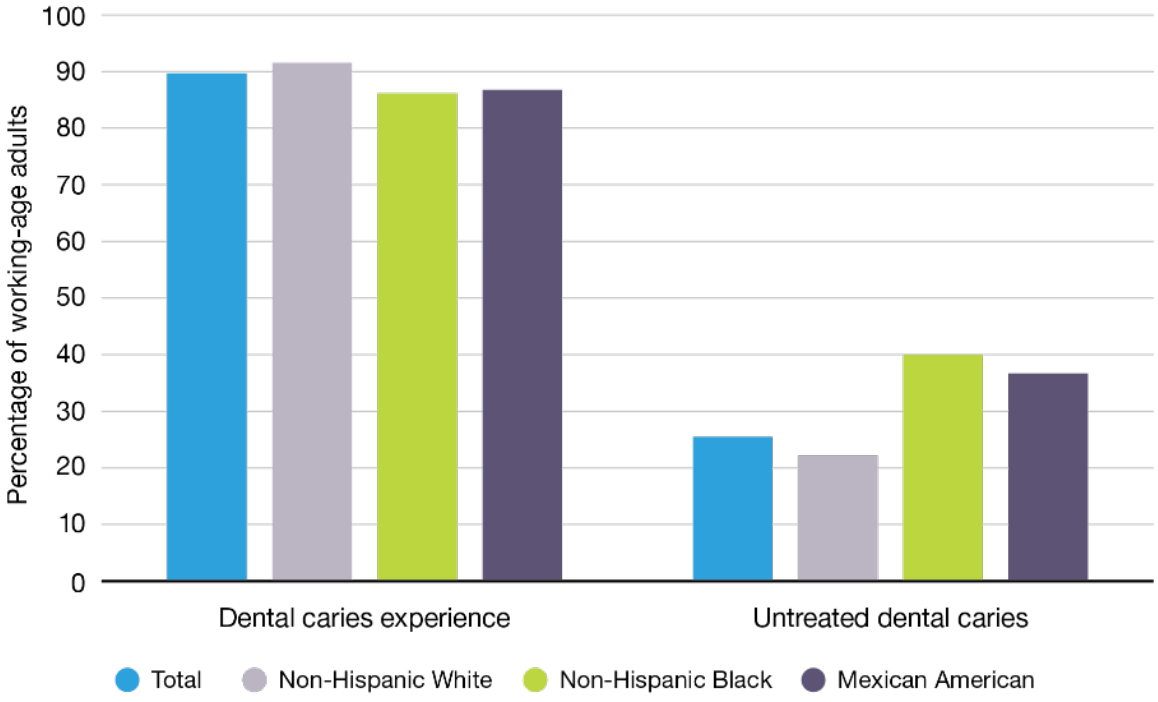
Currently, about half of Hispanic Americans were not born in the United States (Krogstad and Lopez 2014). Research with Hispanics often explores differences between U.S.-born and foreign-born people, and how those factors (e.g., duration of U.S. residence, level of acculturation, language preferences, ethnic identity) may influence health status and health behaviors. Acculturation plays a role in accessing adult dental services and may act to moderate differences in oral health behaviors and outcomes (Gao and McGrath 2010). English speakers are more likely to report a dental visit in the past year than Spanish speakers (Graham et al. 2005; Riley et al. 2008; Jaramillo et al. 2009). Spanish-speaking adults of Mexican origin in the 2009–2012 NHANES were 1.8 times more likely to have periodontitis than English speakers (Garcia et al. 2017).

A "Hispanic paradox" or "Latinx advantage" has been observed for many health conditions (McCarthy 2015), including some oral health status and related measures (Sanders 2010; Spolsky et al. 2012). Although many Hispanics live in poverty in the United States and may encounter access to care barriers, Hispanic immigrants often have better health outcomes than U.S.-born Hispanics. Better clinically assessed oral health also has been documented among Mexican immigrants compared to the U.S.-born (Spolsky et al. 2012) and the more acculturated immigrants (Gao and McGrath 2010). Better self-rated oral health quality of life also has been documented among first-generation Latino adults than among their U.S.-born Latino counterparts or Whites (Sanders 2010). However, varying elements of oral health quality of life can be influenced by the level of acculturation and Hispanic/Latino background (Silveira et al. 2020). Furthermore, a systematic review of Hispanic and immigrant paradoxes concluded that these health advantages are not consistently found across studies and groups (Teruya and Bazargan-Hejazi 2013).

American Indian and Alaska Native Populations

An estimated 5.2 million people identify as AI/AN, and about 29% live below the federal poverty line (Norris et al. 2012; Mauer 2017). For AI/AN adults, the burden of disease is greater than that of any other ethnic minority group (Batliner 2016). When compared to other racial or ethnic groups, AI/AN children aged 3 to 5 years have more than double the number of decayed teeth and nearly twice the overall dental caries experience than the next highest ethnic group, Hispanics (Mexican Americans), and almost three times that of White children (Figure 7) (Phipps et al. 2019). For AI/AN children aged 6 to 9 years, 80% have a history of dental caries compared with only 45% of the general U.S. population, and almost half of AI/AN children have untreated dental caries compared to just 17% of the general U.S. population in this age group.

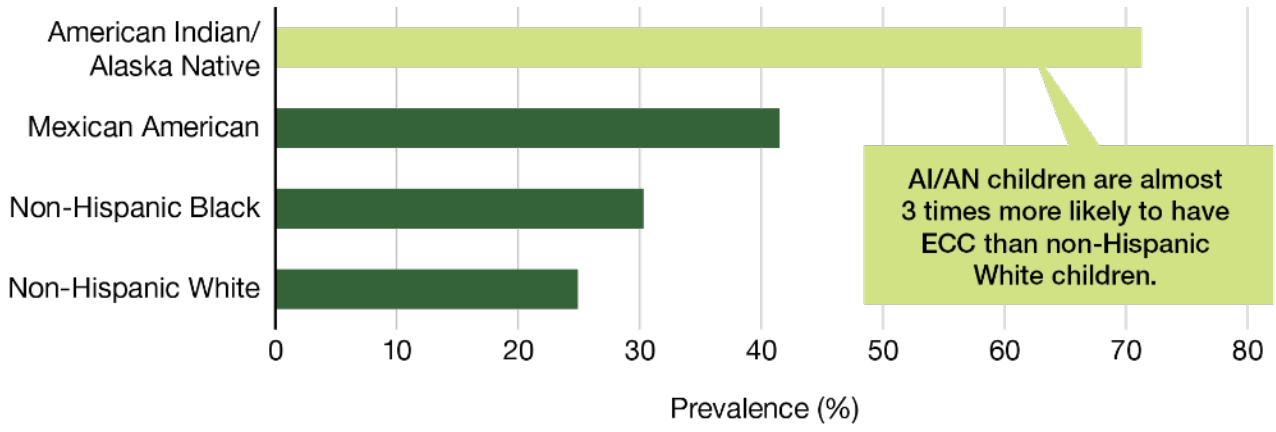
Figure 6. Percentage of adults ages 20–64 with dental caries and untreated dental caries by race/ethnicity: United States, 2011–2016



Notes: Prevalence of dental caries (DFT > 0) and untreated dental caries (DT > 0) in permanent teeth; Race/ethnicity is described as non-Hispanic White, non-Hispanic Black, and Mexican American.

Source: Centers for Disease Control and Prevention (2019).

Figure 7. Percentage of American Indian/Alaska Native (AI/AN) children ages 3–5 with early childhood caries (ECC) during 2018–2019 in relation to other same-age children in the United States by race/ethnicity during 2013–2014



Source: Phipps et al. (2019).

Severe periodontal disease was reported for 17% of AI/AN adults aged 35 years or older (28% for those who smoke), compared to 10% of U.S. adults (Phipps and Ricks 2016). Tooth loss was common in AI/AN adults aged 40 to 64 years, where loss of at least one permanent tooth occurred in 83% of AI/AN adults (Phipps and Ricks 2016), compared to 66% for adults in the U.S. population as a whole (NHANES 2011–2012) (Dye et al. 2015).

Oral Health and Structural Racism

The racial concerns that permeate American society unmistakably contribute to the oral health disparities that have been observed throughout the United States and, as described above, represent one of society's greatest challenges. Systemic, or institutional, racism is created by factors embedded in a social structure that reflects the perspectives and needs of a white majority and that, consequently, disadvantage people of color. Structural aspects of public organizations focused on education, housing, criminal justice, and health care incorporate these biases in a variety of ways (Feagin and Ducey 2014), and dental care is no exception. Black populations, Hispanics, and some other minority racial populations have much lower family incomes and experience much higher rates of poverty than does the White population (Semega et al. 2020). These financial disparities interact with the dental health care system to create major disadvantages for members of racial minority groups. Structural features of the dental care system result in high out-of-pocket costs for many, and family-level economic factors such as income, poverty status, and dental insurance play critical roles in the ability to access routine dental care (Vujicic et al. 2016a). The delivery of dental care services usually requires the ability to pay personally or through individual insurance, thereby directly limiting care to those with greater financial resources. The ability to access dental insurance, which comes more readily with higher paying and more stable employment is, in turn, also linked to race. Moreover, dental services may not be readily available in areas where many people of color live, because the structure of payment for services provides lower incentives for providers who would locate in those areas. As a major contributor to the SDoH, systemic racism also indirectly impacts oral health through various structural, sociocultural, and familial mechanisms, that, like financial and educational resources, are differentially distributed across racial groups. Historical experiences with health care that can create mistrust of the system may be linked to race as well. A scoping review of the persistence of oral health disparities of African American children (Como et al. 2019) found numerous factors had contributed to poorer oral health among African American families, including less access to affordable non-cariogenic food, fear and distrust of the care delivery system, lower health literacy, and social stigmatization.

These patterns can be seen in the few published studies of inequity in dental care. Treatment for existing dental disease, a measure of access to dental care, is highly correlated with race/ethnicity (Gupta et al. 2018). This is reflected by the national data that show clearly that African American, AI/AN, and Hispanic populations all have higher rates of untreated dental caries and tooth loss, as well as poorer access to preventive services (Koppelman 2016a). Dentists' treatment decisions, too, have been shown to be affected by unconscious racial bias; for example, in a randomized clinical study of tooth restorability, treatment recommendations were found to favor extractions over root canal treatment for Black patients (Patel et al. 2019). Adding to these broad social problems, the profession of dentistry reflects substantial underrepresentation of Black dentists in the workforce (Mertz et al. 2017).

Increasing the diversity of the dental workforce could contribute in important ways to oral health equity through changes in dental practice arrangements (Mertz et al. 2016b) and enhanced patient trust and satisfaction with care (Cooper et al. 2003).

Impact of COVID-19 on Oral Health Inequities

The coronavirus (COVID-19) pandemic has upended every aspect of life and has clear and significant implications for the inequities related to oral health and access to dental care that are the focus of this chapter. Inequities related to COVID-19 have already been theoretically and empirically identified in terms of the risk of acquiring the disease, experience with the disease, the ability to access testing and be treated for the disease, mortality associated with the disease, outcomes associated with interventions that limit transmission of the disease,

and access to the personal protections provided by governments to facilitate survival during the pandemic.

Sadly, this is not surprising. It would make sense that, like almost all other diseases, medical conditions and/or associated preventive or curative treatments, exposure to SARS-CoV-2, and the outcomes of COVID-19 would be socially patterned and influenced by the social and commercial determinants of health.

In turn, such vulnerability may worsen existing inequities in oral health and access to dental care. The economic effects of COVID-19 have resulted in loss of work, income, insurance, and opportunity for individuals and families, which as this chapter has shown, are all causally linked to poor oral health and lack of access to dental care, whether at the individual or population level. Without appropriate supports, a racially, socially, and/or economically marginalized family may not have enough income to secure a healthy diet, will experience significant psychosocial stress, and will have less access to the benefits of dental care, all of which increase the risk for acquiring oral diseases and increasing their negative outcomes. Such a damning state of affairs represents a vicious cycle that engenders poverty and the loss of personal security, prosperity, and dignity (Armitage and Nellums 2020; Gausman and Langer 2020; Ji et al. 2020; Schmitt-Grohé et al. 2020; van Dorn et al. 2020; Van Lancker and Parolin 2020; Wang and Tang 2020; Yancy 2020; Yao et al. 2020).

Oral Health for Those with Special Health Care Needs

HRSA's Maternal and Child Health Bureau defines children with SHCN as "...those who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally" (McPherson et al. 1998; U.S. Department of Health and Human Services 2013 p. 5). Children with SHCNs become adolescents and adults with SHCNs and experience challenges throughout their lives. According to the 2017–2018 NSCH, about 1 in 6 children from birth to 17 years (18.51%) in the United States, or 13.6 million children, has SHCNs (Child and Adolescent Health Measurement Initiative 2020). In addition, an estimated 26% of U.S. adults, or 61 million people 18 aged years or older, have some type of disability (Okoro et al. 2018).

As the population of the United States is becoming more diverse, the incidence of SHCNs increasingly applies to persons with varying ethnic, racial, linguistic, and cultural backgrounds. It also includes individuals whose social living situations are restricted because of dependency needs or other factors that prohibit them from living in the community. These individuals include, but are not limited to, people residing in long-term care and institutional facilities, and prison settings. The presence of a special need, as described in this section, has a profound impact on the ability of an individual to function in society and on the organization, function, and economics of many societal structures.

Individuals with SHCNs may be at increased risk for oral diseases throughout their lives (Child and Adolescent Health Measurement Initiative 2020). Oral diseases can have a significant impact on the health and quality of life of those with certain systemic health problems or conditions. Patients with compromised immunity or cardiac conditions associated with endocarditis may be especially vulnerable to the effects of oral diseases (Thikkurissy and Lal 2009). Persons with physical, mental, and developmental disabilities who do not have the ability to understand, assume responsibility for, or cooperate with preventive oral health practices are susceptible, as well (Charles 2010; American Academy of Pediatric Dentistry 2016).

SHCNs also include disorders or conditions that manifest only in the orofacial complex (such as amelogenesis imperfecta, dentinogenesis imperfecta, cleft lip/palate, or oral cancer) (Charles 2010). Although these individuals may not exhibit the same physical or communicative limitations as other people with SHCNs, their needs are unique, impact their overall health, and require oral health care of a specialized nature (Charles 2010).

The importance of oral health care for individuals with SHCNs also was highlighted in the 2000 Surgeon General's Report on Oral Health and in Healthy People 2020 (U.S. Department of Health and Human Services 2000; 2010a). The Healthy People 2020 objectives included increasing the number of states (and the District of Columbia) that have an oral and craniofacial health surveillance system—a system for recording and referring

infants and children with cleft lips and palates—and a system for referring such children to rehabilitative teams.

Oral Health in Correctional Settings

The United States has the highest incarceration rate in the world, with 2.3 million people incarcerated annually (Sawyer and Wagner 2019). Incarceration disproportionately affects people of color and those of low socioeconomic status. Incarcerated individuals are the only individuals in the country with a legal right to health care, a precedent that has been ruled to include access to timely dental treatment (Nolasco and Vaughn 2019). Nonetheless, incarceration is associated with higher rates of chronic illness, serious mental illness, infectious disease, and a lower life expectancy (Wildeman and Wang 2017). These health conditions have shared behavioral and socioeconomic risk factors with poor oral health. Rates of dental disease are similarly elevated in incarcerated populations.

Compared to the noninstitutionalized population, individuals residing in correctional facilities have higher rates of untreated decay, worse periodontal health, and a higher prevalence of urgent dental needs; the number of decayed, missing, or filled teeth in this population is 17.0–22.1 in adults and 3.6 in juveniles (Mlxson et al. 1990; Clare 1998; Heng 2000; Bolin and Jones 2006). Although oral health status may improve somewhat during the period of incarceration, presumably because of increased access to dental care while incarcerated, prevalence of untreated disease remains high even after 3 years of incarceration (Clare 2002). In the 2004 Bureau of Justice Statistics Survey of Inmates in State Correctional Facilities (now known as the Survey of Prison Inmates), 60% of respondents reported having a dental problem during incarceration, and only 80% of adults in prison with a dental problem reported seeing a dentist (Nowotny 2017; Maruschak 2019).

Financing Dental Care

The dental care financing mix continues to differ significantly from that of medical care. In 2019, Centers for Medicare & Medicaid Services (CMS) programs accounted for 37% of medical care spending, with out-of-pocket payments accounting for 11% and private medical insurance, 31% (Centers for Medicare & Medicaid Services 2019a). In contrast, 10% of costs for dental care were paid by a CMS source, 40% were paid out of pocket, and 46% were covered by private dental insurance in 2018 (see Figure 3, Section 4 in this monograph) (Centers for Medicare & Medicaid Services 2020a). Dental care spending has grown more slowly than overall medical care spending with dental care accounting for 3.7% of total health care spending in the United States in 2017, compared to 4.5% in 2000 (American Dental Association 2017).

The cost of dental care remains an obstacle for many Americans, with dental care consistently presenting the highest financial barrier of any health service in the United States (Vujicic et al. 2016a). Dental insurance alleviates this concern for some, and in 2018, roughly 80% of Americans had some form of private or public dental coverage (National Association of Dental Plans 2020). However, dental insurance coverage varies substantially by age group in the United States with the percentage of coverage declining with age (see Section 2A, Figure 36). The majority of Americans, about two-thirds, received coverage through employment-based plans or through organizations like AARP, and a small percentage (around 10%) purchased coverage through private dental plans or as part of a medical plan (National Association of Dental Plans 2020). In 2018, publicly funded dental insurance provided coverage for roughly one-fourth of Americans through a variety of programs, including Medicaid, the Children's Health Insurance Program (CHIP), the Veterans Health Administration, the U.S. Department of Defense (DoD), the Indian Health Service, and others.

The result is that dental insurance coverage, when available, consists of a patchwork of public and private plans that vary widely in eligibility requirements, the benefits provided, and the availability of participating dentists. Moreover, many of those with dental insurance still incur high out-of-pocket costs. In 2018, about 66.7 million Americans had no dental coverage with a dentally uninsured rate of 2.5 times higher than the medically uninsured rate (National Association of Dental Plans 2020). For those without coverage, routine dental care is often financially out of reach. For example, older adults are less likely to have employment-based dental insurance, yet as of this writing, Medicare, the primary

provider of medical insurance for individuals aged 65 years and older, does not include routine dental care in its mandated services.

Having dental insurance, either public (Medicaid) or private, has been shown to improve access to dental care. Among older adults, having private insurance increased preventive service use by 25% and having Medicaid coverage increased major service use by 36% (Meyerhoefer et al. 2019). Expansion of dental coverage in Medicare also is estimated to improve access to dental care for older adults (Kreider et al. 2015). Insurance coverage alone will not be sufficient to increase access to dental services for older adults, however. Other factors, such as having an accessible and sufficient dental professional workforce, a culture of self-care and utilization of health care, and social support, particularly for older adults, must accompany improvements in dental care financing. Current federal government-sponsored dental health insurance programs include Medicaid and CHIP. Medicaid provides health coverage for millions of Americans, including eligible low-income adults, children, pregnant women, older adults, and people with disabilities. Medicaid is administered by states, according to federal requirements, and jointly funded by states and the federal government. CHIP provides health coverage to eligible children through both Medicaid and separate CHIP programs. To date, nearly all state Medicaid programs have expanded dental program services and are implementing a variety of models aimed at increasing dental care access and capacity for a growing number of eligible individuals, although earlier expansion had benefited children more than adults. There are currently two states that do not provide a Medicaid dental benefit to the adult base population (Figure 8) (Center for Healthcare Strategies, 2019).

Having dental insurance has been shown to provide a substantial increase in children's use of needed dental services, resulting in less untreated disease. Importantly, children enrolled in public insurance programs such as Medicaid or CHIP have been shown to receive the greatest benefit in terms of access and disease reduction, compared to those who are not publicly insured (Yu et al. 2017). Moreover, when Medicaid coverage is offered to adults there is some evidence that the benefits go beyond increased access to care and include improved oral health, improved job outcomes, and possibly decreases in oral health disparities (Kieffer et al. 2021). Additional discussion on dental insurance can be found in Section 4.

In addition to dental insurance, the federal government supports funding for direct patient care through the Health Resources and Services Administration (HRSA). HRSA's mission is to improve health outcomes and address health disparities through access to quality services, a skilled health workforce, and innovative, high-value programming (Health Resources and Services Administration 2019a). The agency provides primary health care to the geographically isolated and to the economically or medically vulnerable, such as people with HIV/AIDS, pregnant women, and mothers. HRSA supports the training of health professionals, the distribution of providers to areas where they are needed most, and improvements in health care delivery.

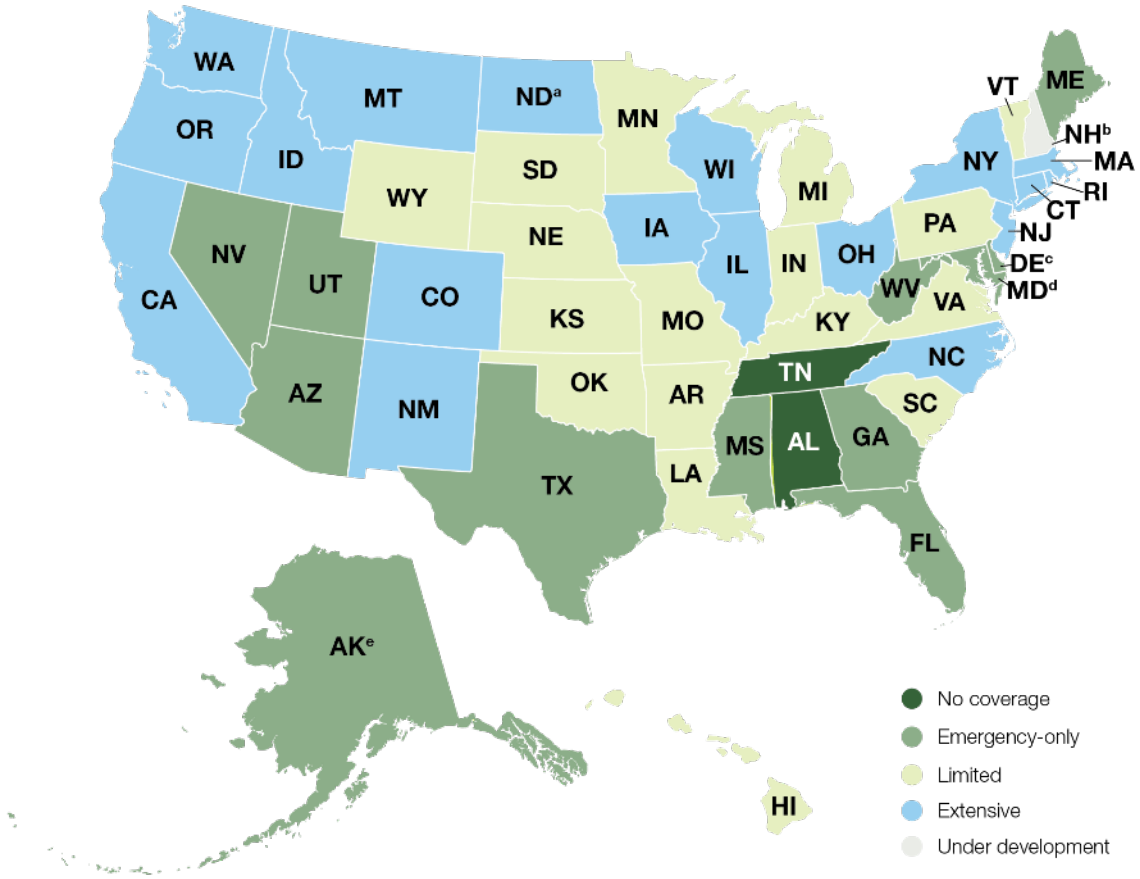
Dental Care Delivery Models

The delivery of dental care occurs in a wide variety of settings using different models of care that vary with respect to their financing and workforce structure. Dentists typically work in settings that include private practice, armed forces and other federal services (e.g., Public Health Service, U.S. Department of Veterans Affairs [VA]), Federally Qualified Health Centers (FQHCs), state or local government employees, dental school faculty and staff and hospital personnel, and a variety of other health/dental organizations. Licensed dentists also are enrolled as graduate students, interns, and residents. Detailed information on the members of the dental team is provided in Section 4.

Private Practice

In the United States, private practice has been and remains the predominant setting in which most Americans receive dental care. In 2018, an estimated 93% of dentists reported that private practice was their primary care delivery setting (American Dental Association 2020a). This proportion has been roughly stable since 2000, and private practice remains the career aspiration for most current dental students (Wanchek et al. 2015).

Figure 8. Status of Medicaid adult dental benefit coverage by state: United States, 2019



Notes:

[a] North Dakota does not offer adult dental benefits to its Medicaid expansion population.

[b] Under New Hampshire's bill, the Department of Health and Human Services is directed to develop a "comprehensive plan to ensure that Medicaid recipients can safeguard their smiles and their overall health."

[c] Under Delaware's bill, the state will offer preventive and restorative dental coverage to adult Medicaid beneficiaries.

[d] Maryland offers treatment for symptoms in emergency situations but does not cover emergency surgery.

[e] Alaska's state budget was passed, keeping adult dental coverage intact; however, the Governor's line-item vetoes in the budget will result in cuts to the state's Medicaid program, including dental, unless the legislature moves to rescind them.

Source: Center for Health Care Strategies (2019).

However, there have been changes to the structure of typical private practices since 2000. Namely, the proportion of dentists in solo practice has declined from 64% in 2000 to 50% in 2018, as dentists increasingly practice in larger group settings (American Dental Association 2021). There also is a growing interest among dental students in salaried positions in corporate or non-profit organizations (Wanchek et al. 2015).

Federally Qualified Health Centers

The federal Health Center Program (HCP) is authorized in Section 330 of the Public Health Service Act of 1944 (42 U.S.C. Sections 201 et seq.) and is administered by HRSA. FQHCs form a cornerstone of the health care safety net. They are required to provide health care to all individuals regardless of their ability to pay and must be located in geographic areas with relatively few health care providers (Heisler 2015; Crall et al. 2016). HRSA funds nearly 1,400

health centers operating more than 13,000 service delivery sites. Nearly 29 million people in every state, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the Pacific Basin rely on HRSA-funded health centers for care. In 2020, HRSA's HCP provided primary health care to 1 in 11 individuals of all ages in the United States, 1 in 9 children, 1 in 5 rural residents, 1 in 3 people living in poverty, and more than 376,000 veterans (Health Resources and Services Administration 2021a). Most of these patients were publicly insured for medical care: 46.9% were covered by Medicaid/CHIP, 10.4% by Medicare, and 21.8% were uninsured (Health Resources and Services Administration 2021a). These groups generally face substantial barriers to oral health care access, thereby underscoring the importance of additional investments geared toward expanding the oral health care capacity at more FQHC sites.

FQHCs have become an important dental care access point for vulnerable populations. An estimated 25% of low-income dental care patients received their care at an FQHC in 2017, compared to 7% in 2001. In 2020, HRSA's HCP facilities provided more than 11.3 million dental visits to nearly 5.2 million patients (Health Resources and Services Administration 2021b). Most of these patients were publicly insured for medical care—46.9% were covered by Medicaid/CHIP, 10.4% by Medicare, and 21.8% were uninsured (Health Resources and Services Administration 2021a). These groups generally face substantial barriers to oral health care access, thereby underscoring the importance of additional investments geared toward expanding the oral health care capacity at more FQHC sites.

Nearly 93% of HRSA's health center grantees provide preventive dental services either on-site or by paid referral (Health Resources and Service Administration 2021b).

School-Based Health Centers and School-Based Dental Programs

School-based health centers (SBHC) are systems of interdisciplinary health services provided to students within pre-K–12 schools (school-based centers) or at offsite health facilities linked to the schools (school-linked centers). SBHCs often are established in schools that serve predominantly low-income communities. They must provide primary health care and also may include mental health care, social services, dentistry, immunizations, reproductive health services for adolescents, substance abuse counseling, complex case management—including management of such chronic illnesses as asthma and obesity—and nutrition and general health education. Student participation requires parental consent.

The 2013–2014 Census of SBHCs showed that there were 2,315 SBHCs nationwide, and 18% of SBHCs had oral health professionals on site. School-based oral health programs provide a range of services that encourage an ongoing relationship with a dentist, including oral health education and promotion, dental screenings and referrals, dental sealants, fluoride mouth rinses or tablets, fluoride varnish applications, case management, and restorative treatment. Advantages of school-based oral health programs include improvements in access to dental care, timelier oral health care for children with unmet treatment needs, positive peer modeling, the elimination of barriers (such as lack of transportation and need for parental time off from work), and fewer missed school days for dental appointments. The majority of school-based oral health programs are operated by dental organizations or state oral health programs and are funded by state and local governments (including state block grants), corporations, private foundations, and billings to Medicaid, CHIP, private insurance, and patients' families. Challenges in this setting include school leadership and staff buy-in, dependence on parental consents, care coordination for further treatment, and quality assurance tracking.

The Community Preventive Services Task Force (CPSTF), whose members are appointed by the Centers for Disease Control and Prevention (CDC), was established in 1996 to identify evidence-supported population health interventions that can save lives, increase lifespans, and improve quality of life (Community Preventive Services Task Force 2021). CPSTF recommends the implementation and maintenance of SBHCs in low-income communities, based on evidence that they improve educational and health outcomes and that their societal benefits are greater than the intervention costs (Community Prevention Services Task Force 2016a). CPSTF also recommends school-based sealant delivery programs based on evidence that dental sealants resulted in a significant reduction in tooth decay among school children aged 5 to 16 years and the economic benefits of

this reduction exceeded the cost of the programs (Community Preventive Services Task Force 2016b).

Veterans' Health Administration

Although veterans usually qualify for health benefits from VA, most do not qualify for dental care. Dental services offered through VA facilities are more limited than medical services and are restricted to certain categories of veterans. Currently, less than 5% of the total U.S. veteran population is eligible to receive dental care from VA (U.S. Department of Veterans Affairs 2019). Because Medicare does not cover dental care and so few are eligible to access VA oral health services, many veterans—most of whom are older—have unmet dental needs. Overall, veterans have a higher prevalence of periodontal disease, dental caries, and missing teeth, compared to non-veterans, but this higher prevalence is strongly associated with membership in other groups at high risk for poor oral health (older adults, smokers, males, and diabetics) (Schindler et al. 2021). As a group, veterans' unmet oral health care needs are primarily related to periodontitis (Schindler et al. 2021).

The VA Office of Dentistry provided oral health care to more than half a million U.S. military veterans in fiscal year 2018, totaling 1.7 million visits. VA dental clinics provide care at 236 sites. These dental clinics are staffed by 3,500 dental team members made up of more than 1,000 dentists, 400 dental hygienists, and 1,500 dental assistants. VA manages the dental care of veterans through both in-house care and community provider networks. Twenty-one percent of veterans' dental care was provided by community care providers in 2018. Since 2000, the number of VA dental patients has increased 73%. In the past 8 to 10 years, the number of veterans needing dental care has risen nearly 24%. VA dentistry has responded to that challenge with a similar increase in dentists and a 33% increase in dental hygienists. Veterans seeking care through VA dental clinics often have a higher disease burden than the general adult population (Boehmer et al. 2001; Jurasic et al. 2014).

Teledentistry

Telehealth is the delivery of health care and the exchange of health care information across distances. Teledentistry is the application of telehealth to dentistry, using health information technology and telecommunications for oral care, consultation, education, and public awareness with the broad goal of improving oral health (Daniel and Kumar 2014).

The American Dental Association (ADA) defines telehealth as a broad variety of technologies and tactics to deliver virtual medical, health, and education services—not a specific service, but a collection of means to enhance care and education delivery (American Dental Association 2020b). In 2018, two teledentistry codes were added to the Current Dental Terminology code set, which will facilitate both inclusion of relevant services in dental practice and the relationship between dental care providers and relevant payer organizations. These two codes distinguish the two modalities commonly used in telehealth care. Synchronous telehealth is live videoconferencing—a two-way video link between a patient and health care provider. Asynchronous telehealth refers to "store and forward" transmission of health information for later review by a health care provider (Office of the National Coordinator for Health Information Technology 2020). For additional information about teledentistry, see Sections 4 and 6.

Teledentistry and telehealth studies and some few systematic reviews conducted in the United States and abroad agree that telehealth interventions appear generally equivalent to in-person care (Nutalapati et al. 2011; Khan and Omar 2013; Alabdullah and Daniel 2018; Shigekawa et al. 2018). High levels of validity and reliability have been found when comparing diagnostic information and treatment planning outcomes for midlevel screeners and a dental expert panel. In addition, providers and patients reported high levels of satisfaction with telehealth encounters (Estai et al. 2016a; Estai et al. 2016b).

The global pandemic of COVID-19, a coronavirus spread by short-range aerosol, contact, and droplet transmission, has been responsible for millions of cases of severe illness and hundreds of thousands of deaths worldwide since its emergence in late 2019 (Johns Hopkins University & Medicine 2021). This pandemic disrupted the delivery of dental care throughout the United States, leading to the closure of most of the nation's dental care facilities or restriction of services to emergency care only (American Dental Association 2020c). The sudden and widespread closure of most sources of oral health care led to a rapidly

increased interest in teledentistry and its largely untapped potential (Emami 2020; Maret et al. 2020). Although there are no definitive data regarding the extent of teledentistry efforts during the COVID-19 pandemic, there are reports in the popular press that suggest widespread use of various teledentistry models throughout the country (Wicklund 2020).

Medical Settings

Interest continues to grow regarding the role of non-dental health care providers delivering dental services in non-dental settings. The value of this approach to dental service delivery is still being determined, but the rationale is clear. More Americans visit a physician than a dentist annually. Thus, integration of dental services into the primary care setting may better serve the needs of at-risk patient groups, particularly young children for whom pediatric well-child visit schedules result in 12 medical office visits before age 3. In addition, when medical personnel engage with patients over oral health issues, it can increase awareness among all parties about the importance of oral health to overall health and provide a rationale for closer coordination and integration of medical and dental care delivery (Haber et al. 2015; Vujicic 2015a).

Impact of COVID-19 on Dental Practice

The ADA Health Policy Institute has been examining the economic impact of COVID-19 on dentists in private practice, as well as those working in public health settings. When the White House Coronavirus Task Force, CMS, and CDC were recommending delaying elective dental care in March 2020, the vast majority of dentists were seeing only emergency cases. Informal reports indicate that during this period, many dentists and dental team members were supporting other departments by providing testing and screening services related to COVID-19.

The overall economic impact to the dental care sector of delaying elective care has been devastating. According to the Bureau of Labor Statistics, dentistry lost more than half a million jobs in April 2020 (U.S. Bureau of Labor Statistics 2020). ADA Health Policy Institute data indicate that 45% of dentists in private practice were not paying any of their staff in April (American Dental Association 2020d). Dentists in public health settings were not immune either, with 29% reporting being paid partially or not at all in April (American Dental Association 2020e).

Early forecasts of the medium- to long-term economic impact of COVID-19 on the dental economy suggest anywhere from a 30% to 66% reduction in U.S. dental spending in 2020 and up to a 30% reduction in 2021 (Nasseh and Vujicic 2020). However, these early analyses assumed a very gradual and slow U-shaped economic recovery in the United States and a lagging dental sector recovery. Early data on reopening suggest these early estimates were pessimistic. In other words, the data on the first 3 weeks of reopening—spanning May 4 through the end of the week of May 18, 2020—showed that patient volumes and economic activity in dental offices were rebounding (American Dental Association 2020b). Data for the week of May 18 indicated that, on average, patient volume in private practices was up to 38% of pre-COVID-19 levels. Looking only at the 27 early opener states (those that opened in late April through the first week of May 2020), patient volume had rebounded to 54% of pre-COVID-19 levels by the third week after reopening. Thus, the recovery data, at least in the first few weeks, suggests cautious optimism.

Beyond the economic impact, COVID-19 is likely to have a lasting impact on dental practices, both in private and public settings. Beyond the new protocols for personal protective equipment, innovations such as teledentistry are likely to remain in place. ADA Health Policy Institute data indicated that 24% of dentists in private practice had used and billed for teledentistry during the period when elective care was postponed (American Dental Association 2020f). COVID-19 also is likely to accelerate other trends in dentistry, such as practice consolidation.

The Burden of Oral Disease

Oral Health and the Economy

At the societal level, the impact of oral disease on economic activity and work participation often is underestimated or poorly understood. The annual total costs of dental disease at the global level in 2015 were estimated to be US$545.4 billion (Righolt et al. 2018). Among the 21 WHO Global Burden of Disease regions, the highest levels of per capita productivity losses were found for Western Europe, Australasia, high-income

North America, high-income Asia Pacific, and Central Europe. Severe tooth loss (having fewer than nine remaining natural teeth) accounted for 67% of global productivity losses because of dental diseases, followed by severe periodontitis (a Community Periodontal Index score of 4, a clinical attachment loss more than 6 millimeters [mm], or a gingival pocket depth more than 5 mm) at 21%, and untreated caries at 12% (Marcenes et al. 2013).

Listl and colleagues (2019) note that poor oral health can limit both the ability to secure employment and workplace productivity. These authors point to research suggesting that the appearance of the mouth and teeth influences hiring practices and earnings (Hamermesh and Biddle 1994; Harper 2000). For example, one study estimated that improved oral health enhanced earnings among U.S. women by 4%, with low-income women seeing the biggest effect (Glied and Neidell 2010). Another analysis found that 29% of low-income adults and 60% of low-income adults living in states that did not provide dental benefits to adults in Medicaid reported that the appearance of their mouth and teeth affected their ability to interview for a job (American Dental Association 2015a). Evidence from Canada indicated that improved oral health among social assistance recipients led to better job-seeking empowerment (Singhal et al. 2015a).

Research also has indicated that the appearance of a person's teeth may influence what characteristics others ascribe to them, such as intelligence, honesty, or leadership potential, and could affect employability (Henson et al. 2011; Pithon et al. 2014). Moreover, this link is strongest among low-income individuals. As Listl and colleagues (2019) argue, "with the resulting improvements in population oral health and overall wellbeing, such measures imply substantial economic benefits not only in terms of potentially reduced treatment costs and appropriate use of healthcare resources, but also due to fewer productivity losses in the labor market and beyond."

Globally, untreated oral disease has been considered one of the 10 leading causes of years lived with disability (Institute for Health Metrics and Evaluation 2016), contributing to missed workdays and reduction in usual activity (Australian Research Centre for Population Oral Health 2012). Moreover, dental pain has been demonstrated to predict productivity losses (Hayes et al. 2013). Overall productivity losses in the United States associated with untreated oral disease were estimated to be $45.9 billion in 2015, with the United States ranking highest among 195 countries (Righolt et al. 2018). In 2008, an estimated 67.5% of adults aged 18 years or older reported lost work or school hours because of unplanned dental visits, a total of 92.4 million lost hours for nonroutine care (Kelekar and Naavaal 2018). Furthermore, limited cross-sectional studies have found that parents of children who have a history of dental pain are more likely to report having missed work or school because of their child's dental problems (Seirawan et al. 2012; Ribeiro et al. 2015).

In addition, oral health issues have an impact on academic achievement among students, in turn, influencing the choices they make in adulthood. For many years oral health professionals have often circulated "51 million" as a statistic to quantify the expected number of missed school hours for children because of dental problems. Indeed, this number appears in the Surgeon General's report on oral health, published in 2000. Since that time, additional research has shown that U.S. children with poor oral health were more likely to have absences from school, poor grades, and self-image issues (Pourat and Finocchio 2010; Seirawan et al. 2012; Guarnizo-Herreño and Wehby 2012a). For example, the odds of children with dental problems completing all required homework were 24% less than children without dental problems (Guarnizo-Herreño and Wehby 2012a). Data based on students in the Los Angeles Unified School District indicated that students with toothaches were almost four times more likely to have a low grade-point average. About 11% of students who did not have access to needed dental care missed school, compared with 4% of those with access. For every 100 elementary and high school youth, 58 and 80 school hours, respectively, were missed each year as a result of dental problems (Seirawan et al. 2012). However, these reported hours also included missing school for nonurgent dental appointments.

Parents averaged 2.5 days absent from work or school per year because of their children's dental problems (Seirawan et al. 2012). These relationships are especially prevalent among disadvantaged children. For instance, in 2007, 59% of children in California with no dental insurance missed 2 or more days of school because of dental problems,

compared with 33% of children with private dental benefits and 43% with public dental benefits (Pourat and Nicholson 2009). A systematic review reported an association between measures of poor oral health and poor academic performance. The authors cautioned, however, that the current evidence is of low quality (based on inconsistent methodology) and highlight the need for further research (Ruff et al. 2019). Although the actual number of hours missed from school or work because of serious dental problems or oral pain may not be known, the impact to the individuals and families affected is pronounced and consequential. As explained in an earlier commentary regarding the "51 million" lost hours, it's not the statistic that is important, but the real people affected by the pain and discomfort from the disease that matters (Edelstein and Reisine 2015).

Medical Costs

There is strong evidence linking oral health to overall health. Numerous studies have demonstrated associations between periodontal disease and conditions such as diabetes, heart disease, pregnancy outcomes, and dementia, although clear causation has been difficult to establish. Setting aside possible biological relationships, health services research has shown some beneficial effects of periodontal disease treatment on overall health care costs. However, the results are mixed. Several studies have shown that when periodontal therapy is provided to members of a health plan, overall costs for all health care decrease (Jeffcoat et al. 2014; Nasseh et al. 2017; Pihlstrom et al. 2018), whereas others have suggested the interpretation of findings from these types of studies needs to consider some limitations before drawing any definitive conclusions (Sheiham 2015; Pihlstrom et al. 2018).

Emergency Departments

The use of EDs to receive care for dental-related problems is an important concern to the U.S. health care system. For example, among all encounters at the Virginia Commonwealth University Health System ED during 2007–2009, 4.3% were for dental-related problems, more than half were uninsured (52%), 40% had Medicaid or Medicare, and only 8% had private health insurance (McCormick et al. 2013). During this period, national statistics estimated that ED visits for dental problems accounted for at least 1% of all ED visits, with uninsured patients accounting for nearly 41% of the encounters (Allareddy et al. 2014).

In 2014, there were 2.43 million ED visits for nontraumatic dental conditions (NTDC), representing more than $1.6 billion in charges; the average charge per visit was $994 for adults and $971 for children (Kelekar and Naavaal 2019). NTDC ED visit rates are highest among young adults and individuals who are uninsured or have Medicaid coverage. Medicaid was the primary payer for these visits, accounting for 67% of visits by children and 36% of visits by adults (Kelekar and Naavaal 2019). Analyses of national trends found that NTDC ED visits exceeded the growth rate for ED visits overall and for nondental ambulatory care-sensitive conditions (Lee et al. 2012; Okunseri et al. 2012a). NTDC visits represent significant costs in terms of both health outcomes and health care delivery system resources.

Care provided in the ED for NTDC is rarely comprehensive or curative. For instance, an estimated 90% of patients received only pain medication or antibiotics (Okunseri et al. 2012b; McCormick et al. 2013), and most patients were referred to dental providers for treatment of underlying disease (Lewis et al. 2003; Cohen et al. 2011; Hocker et al. 2012). Moreover, the majority of patients who sought dental treatment at an ED were doing so for nonurgent conditions that could have been treated at dental offices (Wall and Vujicic 2015). Because ED care is primarily palliative, it is essential to link patients to a source of dental care after the ED visit. Yet, evidence suggests this does not happen routinely. For example, fewer than half of Medicaid- and CHIP-enrolled children in Florida and Texas had a follow-up visit with a dental provider within 30 days of a dental ED visit (Herndon et al. 2017), and 48% of Medicaid-enrolled adults in Iowa did not have a dental visit within 6 months of a dental ED visit (Singhal et al. 2016). Although dental coverage may contribute to reducing dental-related ED visits (Cohen et al. 1996; Singhal et al. 2015b; Laniado et al. 2017), reduction of other barriers to accessing dental care, such as provider availability, also needs to be addressed (Fingar et al. 2015). In states opting to provide dental coverage for adults through Medicaid, adults are more likely to use routine dental service (Decker and

Lipton 2015), have a reduced likelihood of untreated dental decay with fewer broken or missing fillings (Decker and Lipton 2015), and have less periodontal disease (Silverstein 2015).

Oral Health and National Security

Maintaining the health status of members of the armed services is critical for ensuring an effective military force. Each branch of the armed services maintains a dental component charged with ensuring that dental conditions do not degrade military readiness. From this perspective, providing oral health care is essential for maintaining military readiness because service members are not deployable until they meet dental readiness criteria (Assistant Secretary of Defense for Health Affairs 2002). When concern arose over the large percentage of dental conditions and emergencies among service members (15% per year), DoD added dental readiness as one of the six categories of military readiness in 2002 (Lee et al. 2019).

The DoD dental readiness classification (DRC) system helps assess the oral health of personnel, with the following four levels of DRC for service members: 4 – Requires an annual examination because their dental readiness is unknown; 3 – Has some type of oral condition that is likely to result in a dental emergency within 1 year (these individuals are not considered to be worldwide deployable); 2 – Requires clinical preventive dental care or treatment for some type of oral condition which is unlikely to develop into a dental emergency within the next year (these individuals are considered to be worldwide deployable); and 1 – No dental treatment needed and are worldwide deployable (Assistant Secretary of Defense for Health Affairs 2002; King 2008; Assistant Secretary of Defense for Manpower & Reserve Affairs 2018). The predictive power of this classification system is reasonably good; for example, soldiers who were DRC 3 were up to 8 times more likely to have a dental emergency during field operations or deployment than soldiers who were DRC 1 (Chaffin and Moss 2008).

Dealing with dental injury and disease in a combat environment presents challenging logistical issues and must be properly managed to prevent loss of combat effectiveness. A RAND Corporation study of dental readiness noted the high cost in personnel time, and hence combat effectiveness, that result from dental emergencies in a combat zone (Brauner et al. 2012). The authors of the RAND study reported that, "a dental emergency can require three convoy vehicles with up to nine personnel for security in-theater for the sole purpose of medical evacuation" (Brauner et al. 2012 p. 3). Estimates of expected rates of dental emergency in deployed military members vary widely, depending on pre-deployment readiness and deployment length. Chaffin and Moss (2008) reported that rates between 156 and 170 dental emergencies per 1,000 deployed Army personnel should be expected. Monetary costs of dental injuries in deployed U.S. Army troops found that direct costs of dental conditions (nonbattle injury) totaled $21.9 million from July 1, 2010, through June 30, 2011; 32% of these injuries required additional follow-up care during a 2-year period (Colthirst et al. 2013).

Even in garrison, soldiers experience significant levels of dental treatment needs. The 2016 Sample Survey of Military Personnel showed that Army troops frequently experienced oral health-related difficulties that affected their daily lives (U.S. Army Research Institute for the Behavioral and Social Sciences 2016). Dental pain affected 23.5% of enlisted soldiers in garrison, and oral problems prevented 16.5% from eating certain foods, 26% from sleeping, and 20.6% from concentrating on work, and forced 14% to miss work because of sick call or healing time in quarters (Simecek et al. 2014).

The extent to which oral health affects military readiness of active-duty members varies by service branch and activity (i.e., combat, deployment, or garrison). All service branches are required to sort out the oral health status of incoming recruits and each service branch maintains its own oral health-related criteria for accepting new recruits. Poor oral health among potential recruits leads to either their disqualification for service or the need for costly dental treatment.

The U.S. Navy Dental Corps maintains dental readiness for a population of 327,577 active-duty sailors serving in the U.S. Navy and 185,830 active-duty marines serving in the U.S. Marine Corps across the world (Assistant Secretary of Defense for Manpower & Reserve Affairs 2018). The Navy Dental Corps comprises 1,125 active-duty dentists serving on a variety of platforms, including ships, Marine Corps bases, Navy Mobile Construction

Battalions, and overseas and shore facilities (Assistant Secretary of Defense for Manpower & Reserve Affairs 2018). According to the Navy Bureau of Medicine and Surgery, Navy dental clinics provide more than 1,485,000 patient visits annually. All dental care is provided free of charge.

The U.S. Army Dental Corps workforce comprises a mixture of military, government service, and contracted civilians. This workforce consists of 1,170 dentists, 263 registered hygienists, 154 prophylaxis (tooth cleaning) technicians, and 2,801 dental assistants. Dentist-to-population ratios guide workforce determinations in the Army Dental Corps. Variations in the size of the active-duty soldier population or the proportion of non-Army treatment-eligible patients who receive treatment from Army dental facilities present challenges for developing and managing an effective dental workforce. For example, during 2018, there were nearly 417,600 active-duty soldiers, but active-duty Army soldiers composed 80% of the population treated; others eligible to receive treatment included members of the National Guard and Reserve, retirees, and family members. Thus, an estimate of the average eligible population is closer to 522,000, with the estimated dentist-to-population ratio between 1:500 and 1:600. Because poor oral habits are common in this population, about one-third of soldiers are prone to developing new dental treatment needs every year; consequently, the larger cadre of oral health providers will likely be needed for some time to come (Joint Chiefs of Staff 2018).

The U.S. Air Force Dental Corps consists of more than 900 active-duty general dentists and specialists, along with nearly 2,000 enlisted dental assistants, hygienists, and laboratory technicians who serve in group practices at 76 Air Force bases around the world. They provide dental care for more than 300,000 active-duty airmen and numerous additional DoD beneficiaries, totaling nearly 1.3 million dental visits annually.

The general trend toward improved oral health of U.S. adults is not fully reflected in U.S. military recruits. On average, about 17% of potential Army recruits are found to have disqualifying medical conditions upon examination, and about 44% of those identified are granted waivers for their conditions (Joint Chiefs of Staff 2018). As a result, an estimated 10% of those examined are rejected for medical conditions. In 2008, the DoD Recruit Oral Health Study (Leiendecker et al. 2011) found that only 25% of new recruits did not require restorative dental treatment, which was a marginal improvement from 20% in the 1994 study. Nearly 53% of 2008 Army recruits were DRC 3 and could not deploy until their conditions had been treated, an increase from 33% in 1994 and 42% in 2000. Data from 2018 revealed that out of 94,516 new recruits examined, 21,971 (23.3%) were placed in DRC 3 (Military Health System 2019). To ensure that most of the new recruits were deployable, the Army has implemented a program called First Term Dental Readiness (FTDR), which attempts to treat all incoming DRC 3 conditions. The FTDR program has succeeded in meeting the 95% readiness goal set by DoD Health Affairs, with a DRC 3 prevalence of 4.66% among graduating soldiers for 2018 (Gourley 2018).

Fewer than 1% of potential Air Force recruits are rejected because of significant dental caries or severe malocclusion. However, of those new recruits who do enter the Air Force, nearly all have some level of unmet dental treatment needs and about a quarter (23%) suffer from severe oral conditions that prevent them from deploying (Irwin 2019a). In 2001, nearly half (45%) of airmen had either DRC 2 or DRC 3 oral health conditions that required treatment.

Today, all branches of the service report that roughly 90% of their personnel are DRC 1 or 2, and therefore dentally ready to deploy. Managing dental problems during field training or deployments, however, remains a major focus of military dentistry. Dental problems have accounted for between 5–22% of all sick-call patients presenting to U.S. Army field medical treatment facilities (Allen and Smith 1992; Nasser and Storz 1994; Dunn 2004; Darakjy et al. 2006). The top three oral conditions that affected soldiers during deployment were dental caries (including the pulpal disease caused by it), periodontal disease, and painful or infected third molars (Simecek et al. 2014). Wojcik and colleagues (2015) noted that incidence figures for dental disease and non-battle injuries (DNBI) for Iraq and Afghanistan operations (Joint Chiefs of Staff 2018) were much higher than the DNBI rates they had previously found among admissions for other medical conditions. In the most recent systematic review of the impact of dental conditions on military readiness, Lee and colleagues (2019) estimated that nearly 12% of all troops

deployed to hostile environments will experience a dental emergency or an oral-maxillofacial injury with dental emergency rates varying by service and duty environment (Figure 9).

The National Defense Authorization Act of 2017 began the process of shifting responsibility for delivering the health care benefit for military beneficiaries from individual services to a single, mostly civilian-run organization, the Defense Health Agency (DHA) (National Defense Authorization Act 2016). This ongoing effort cedes the management and control of all nondeployed or afloat military treatment facilities (MTF) to DHA, with the services providing much of the clinical and administrative staffing. Consolidating three service medical enterprises into one is intended to improve business practices and reduce duplication as part of DoD's effort to reform business practices. Uniformed health care providers will be loaned to DHA-managed MTFs to maintain clinical skills and for educational purposes.

Oral Health and Quality of Life

Good oral health is fundamental for overall health and well-being. It contributes to effective chewing and healthy nutrition, speech, social confidence, and—in the case of older adults—better cognitive and functional capacity (World Health Organization 2002; Petersen and Yamamoto 2005; Stewart et al. 2008; Scannapieco and Cantos 2016). The WHO Active Ageing Policy Framework supports the maintenance of oral health as a key piece in the overall strategy to foster active aging (World Health Organization 2002).

In moving away from a disease-based focus toward a biopsychosocial model, the broader determinants of health were recognized in an updated definition for oral health adopted by the World Dental Federation in September 2016 (Box 1) (Glick et al. 2016). This definition has implications for clinical practice and policy.

Dental, periodontal, and mucosal diseases typically are chronic in nature and tend to accumulate during a lifetime. Objective measures of dental disease status, such as the Decayed Missing and Filled Index (Klein et al. 1938) or the International Caries Detection and Classification System (Ismail et al. 2007), and such measures as periodontal probing depths (Holtfreter et al. 2015) are useful for staging disease severity and planning treatment. However, these clinically derived measures fail to capture how patients experience both disease processes and treatment. It is now widely acknowledged that disease affects individuals differently. Each person's perception of well-being, pain, physical function—their quality of life—varies based on personal and sociocultural factors (Baiju et al. 2017).

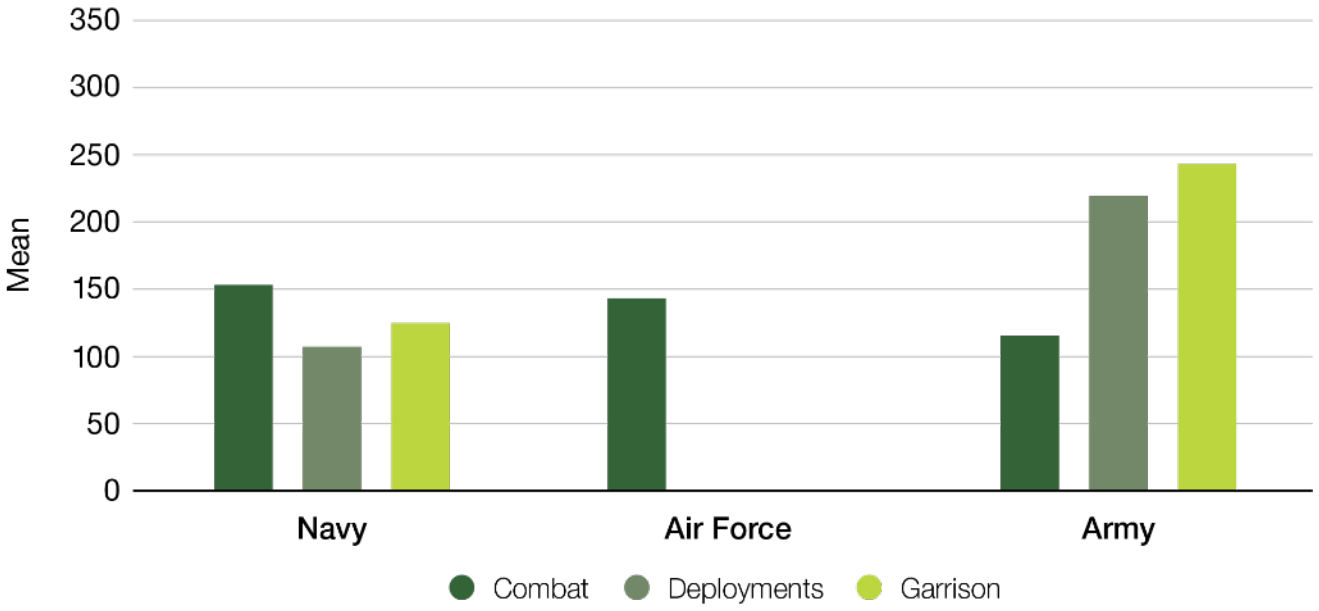
Assessing quality of life is important for guiding public health interventions and for providing a foundation for patient-centered care. Quantitative measures of health-related quality of life are now in common use in descriptive population surveys and clinical intervention studies.

Oral Health Promotion and Oral Health Literacy

Health promotion is "the process of enabling people to increase control over, and to improve, their health" (World Health Organization 1986). Oral health promotion activities include individual behaviors, such as eating healthy foods and brushing teeth, as well as health care provider behaviors, such as adhering to prescribing guidelines and counseling patients to quit smoking. They also include public policies and programs, such as public health insurance programs, dental sealant programs, and media campaigns to discourage smoking (Griffin et al. 2017) and to encourage community water fluoridation (Horowitz 1996). Health promotion programs often are developed to help individuals make healthy decisions, generally through education and communication to raise awareness about healthy behaviors.

How a health promotion message is communicated will affect a person's understanding and community actions. For example, messages that use jargon or highly technical words may lessen the patient's understanding. Nine in ten adults reported having difficulty understanding basic health information (Institute of Medicine 2004). This is because individuals have different levels of health literacy, which is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (Ratzan and Parker 2000, p. vi).

Figure 9. Dental emergency rates by military service and environment: United States, 1966–2012



Notes: Means and standard deviations of dental emergency (DE) rates by service and environment. Number of DE rates reported for each environment and service: Navy: Combat N = 6; Deployed N = 3; Garrison N = 1. Air Force: Combat N = 3. Army: Combat N = 10; Deployed N = 3; Garrison N = 5. Mean = average annual DE rate per 1,000 personnel per year.
Source: Lee et al. (2019).

Low health literacy is associated with lower use of preventive care, poorer health, and higher mortality rates compared to individuals with adequate health literacy (Berkman et al. 2011). The knowledge of, and ability to, understand benefits and payments associated with medical and dental insurance, also known as health insurance literacy, influences the use of dental care (Paez et al. 2014).

Older adults are more likely to have low health literacy compared to younger adults (Macek et al. 2011). Social determinants also have been associated with health literacy disparities (Sørensen et al. 2012; Shin et al. 2013). Blacks, Hispanics, and people for whom English is not their first language are more likely to have low health literacy compared with White and Asian/Pacific Islander adults and with adults who are native English speakers (Kutner et al. 2006; Lee et al. 2011; Kobayashi et al. 2015; Macek et al. 2017; Baskaradoss 2018).

Across populations, individuals with lower oral health literacy are more likely to have poorer oral health status (Jamieson et al. 2013; Baskaradoss 2018) and are less likely to follow preventive oral health care recommendations (Parker and Jamieson 2010; Mejia et al. 2011) and to miss dental appointments (Holtzman et al. 2013). Whether a direct, causal relationship exists between oral health literacy and dental visits is not known, in part because low health literacy corresponds closely with other predictors of access to dental care, such as education, dental insurance, and income.

Quality of Oral Health Care

Transformation in the Quality Landscape

Over the past 20 years, many advances have been made across the public health landscape to improve the quality of programs and services. These advances have made their way to commercial and government programs focused on the development of quality measures for dentistry. Federal and state public health and delivery system programs are using quality measures to improve program performance. Such measures now are being used to drive *quality assurance*, as well as *quality improvement* processes. These steps support achievement of the Institute for Healthcare

Improvement's Triple Aim for Populations by applying integrated approaches to simultaneously improve the health of populations, enhance the experience of care for individuals, and reduce the per capita cost of health care (Berwick et al. 2008).

The 2000 Surgeon General's report on oral health noted the lack of performance measures for assessing the oral health care delivery system. More than a decade later, the National Academy of Sciences and the National Academy of Medicine (formerly the Institute of Medicine [IOM]) issued reports focused on oral health and highlighted persistent access barriers and disparities in care. In doing so, they also brought into sharper focus the need for quality measurement and identified the lack of quality measures as a primary barrier to improving the quality of oral health care (Institute of Medicine 2011; Institute of Medicine and National Research Council 2011). The IOM's report, *Leadership by Example: Coordinating Government Roles in Improving Health Care Quality*, noted that in "providing leadership to effect the needed changes in health care, the federal government should take full advantage of its unique position as a regulator, purchaser, health care provider, and sponsor of research, education, and training" (Institute of Medicine 2003, p. 6). Although Medicare, as a large public program, has the ability to drive market change, it has limited influence on dentistry because dental benefits are rarely provided through Medicare. Medicaid and CHIP, on the other hand, cover close to 40% of U.S. children and thus have the market power to effect change (Rudowitz et al. 2019).

In response to growing recognition of the need for dental quality measures, in 2009, the CHIP Reauthorization Act directed CMS and the Agency for Healthcare Research and Quality (AHRQ) to convene a representative group of stakeholders to develop health care measures for dentistry. CMS petitioned ADA to take a leadership role in this effort, which triggered the formation of the Dental Quality Alliance (DQA). DQA's mission is "to advance performance measurement as a means to improve oral health, patient care, and safety through a consensus-building process" (Dental Quality Alliance 2019).

DQA has since accepted the definition of quality set forth by IOM as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (Institute of Medicine 2001, p. 44). This definition addresses both individuals and populations, connects care delivery to outcomes, and is grounded in the best available knowledge. Thus, quality can be assessed at different levels within the care delivery system, including the clinician/practice level, facilities (for example, hospitals), Managed Care Organizations (MCO), and public insurance and public health programs. Currently, there are three adult and a dozen pediatric DQA quality measures related to oral health (Table). AHRQ's National Quality Measures Clearinghouse has identified five clinical quality and population health measure domains: access, structure, process, outcomes, and patient/population experience (Agency for Healthcare Research and Quality 2019). These domains form the framework for quality measurement across both the public health and health care delivery systems, including those for dentistry.

Given that dental public health and dental delivery systems operate different types of programs and services, measures and metrics developed for one type of program may not be suitable for another. In addition, measures developed for use at the plan level may not be suitable at the provider level. Several measures developed in recent years demonstrated this challenge to state program policymakers when they were tested in various dental environments (Dental Quality Alliance 2019).

Using Quality Measures to Improve Care

Over the past several years, DQA, educational institutions, and MCOs have developed dental quality measures for use by Medicaid and CHIP dental programs. Such efforts have led the way toward advancing value-based programming and value-based care. In the quest for value for the dental care dollar, both CMS and state Medicaid administrators are seeking to understand whether the Medicaid system enables the delivery of quality oral health/dental health care services to program beneficiaries and improved population health management through medical-dental integration. Measures that have been developed and used by Medicaid programs during the past decade typically assess *access* and specific *utilization of preventive services*.

Table. Dental Quality Alliance (DQA) Administrative claims-based measures

Measure Name	Description	Measure Domains
Pediatric Measures		
Utilization of Services	Percentage of all enrolled children under age 21 who received at least one dental service within the reporting year	Access/Process
Preventive Services for Children at Elevated Caries Risk	Percentage of all enrolled children who are at "elevated" risk (i.e., "moderate" or "high") who received a topical fluoride application and/or sealants within the reporting year	Related Health Care Delivery: Use of Services
Treatment Services	Percentage of all enrolled children who received a treatment service within the reporting year	Related Health Care Delivery: Use of Services
Oral Evaluation	Percentage of enrolled children under age 21 who received a comprehensive or periodic oral evaluation within the reporting year	Process
Topical Fluoride for Children at Elevated Caries Risk	Percentage of enrolled children aged 1–21 years who are at "elevated" risk (i.e., "moderate" or "high") who received at least 2 topical fluoride applications within the reporting year	Process
Sealant Receipt on Permanent 1st and 2nd Molars (by age 10 or by age 15)	Percentage of enrolled children who have received a sealant on permanent first molar by age 10 and percentage of enrolled children who have received a sealant on a permanent second molar by age 15 within the reporting year	Process
Care Continuity	Percentage of all children enrolled in two consecutive years who received a comprehensive or periodic oral evaluation in both years	Process
Usual Source of Services	Percentage of all children enrolled in two consecutive years who visited the same practice or clinical entity in both years	Access/Process
Ambulatory Care Sensitive Emergency Department Visits for Dental Caries in Children	Number of emergency department visits for caries-related reasons per 100,000 member months for all enrolled children	Outcome
Follow-Up after Emergency Department Visits for Dental Caries in Children	Percentage of ambulatory care sensitive emergency department (ED) visits for dental caries among children 0–20 years in the reporting period for which the member visited a dentist within (a) 7 days and (b) 30 days of the ED visit	Process
Per Member Per Month Cost of Clinical Services	Total amount that is paid on direct provision of care (reimbursed for clinical services) per member per month for all enrolled children during the reporting year	Related Health Care Delivery: Efficiency and Cost
Adult Measures		
Periodontal Evaluation in Adults with Periodontitis	Percentage of enrolled adults aged 30 years and older with history of periodontitis who received a comprehensive or periodic oral evaluation or a comprehensive periodontal evaluation within the reporting year	Related Health Care Delivery: Use of Services
Ongoing Care in Adults with Periodontitis	Percentage of enrolled adults aged 30 years and older with a history of periodontitis who received an oral prophylaxis OR scaling/root planing OR periodontal maintenance visit at least 2 times within the reporting year	Process
Topical Fluoride for Adults at Elevated Caries Risk	Percentage of enrolled adults aged 18 years and older who are at "elevated" risk (i.e., "moderate" or "high") who received at least 2 topical fluoride applications within the reporting year	Process

Source: American Dental Association. Dental Quality Alliance, 2022.

These measures help program administrators determine the degree to which program beneficiaries are receiving essential preventive dental services, whether health plans are promoting such quality services, and whether providers across their networks are centering care around primary prevention.

In 2020, CMS updated one of two oral health care measures within the Core Set of Children's Health Care Quality Measures for Medicaid and CHIP (CMS Child Core Set): receipt of sealants on first permanent molars replaced the former measure—dental sealants for children aged 6 to 9 years who are at elevated dental caries risk (SEAL-CH) (Centers for Medicare & Medicaid Services 2021a). The second measure —percentage of eligible children who received preventive dental services (PDENT-CH)—remained. While reporting of the Child Core Set measures currently is voluntary, it will become mandatory in 2024 (Center for Medicaid and CHIP Services 2020).

It should be noted, however, that dental program quality measurement continues to be hampered by limited infrastructure and capacity to effectively assess oral health status and the oral health care outcomes of beneficiaries. The current dental coding system, which does not account for patient-level oral health status and dental diagnostic information, is a primary contributor to this problem. Although other more advanced dental coding systems with diagnostic codes currently exist, the shift to such data systems has not yet been implemented at the dental care delivery level.

The move to Medicaid managed care and accountable care by state Medicaid dental programs has supported quality improvement across state Medicaid programs. In 2016, 68% of Medicaid beneficiaries were enrolled in comprehensive care programs, including some that provided dental benefits, and 9.7% of the total Medicaid population were enrolled in limited-benefit dental prepaid ambulatory health plans, including dental-only benefit plans (Medicaid and CHIP Payment and Access Commission 2021b). Within Medicaid managed care, a key lever for quality improvement is the requirement that states incorporate performance improvement projects (PIP) in their contracts with MCOs. A PIP is a quality improvement effort designed to address identified gaps in clinical or nonclinical aspects of care delivery, with the goal of achieving significant and sustained improvement through targeted interventions. To achieve this, MCOs must propose interventions and submit measurable objectives with metrics and adhere to strict timelines used by states to monitor performance and success. Such measures often are tied to financial incentives and disincentives. As such, the need for relevant, valid, and reliable oral health performance measures cannot be overstated.

As the current health care environment evolves, performance measures will be necessary to support plan and provider performance incentives, pay-for-performance programs, and population-based payments. The existing DQA measures provide a start. Monitoring their utility will be essential to ensure validity across all aspects of program measurement. From 2017 to 2019, CMS assisted three states under its Medicaid Innovation Accelerator Program to develop models to align payment with oral health care improvement goals. Such models will align payment with oral health care improvement goals (Centers for Medicare & Medicaid Services 2019b).

More recently, a move has emerged to identify and work with high-risk individuals with chronic conditions to measure the value of dental care based on the degree to which dental services may advance overall health and support medical care. These patients may seek dental care while still experiencing other critical health care gaps. Integrating medical screenings into dental visits provides the opportunity to identify high-risk medical patients and link them to care or programs that support and address SDoH. Measures for these types of programs are under development in some states. They do not yet exist at the national consensus level.

Chapter 2: Advances and Challenges

The oral health status of Americans, in general, has been improving since the 2000 Surgeon General's report on oral health (Rozier et al. 2017). Dental caries severity in the permanent teeth of children has declined to historically low levels, and long-standing inequalities in untreated caries appear to be narrowing. Declines in caries prevalence affecting children's permanent teeth have stabilized at a low level and likely will contribute to future reductions in caries experience in adults. Although

the prevalence of periodontal disease is high in adults, only a small percentage have severe forms of the disease. Tooth loss as a consequence of dental disease has declined markedly during the last half century and has been all but eliminated in high income groups.

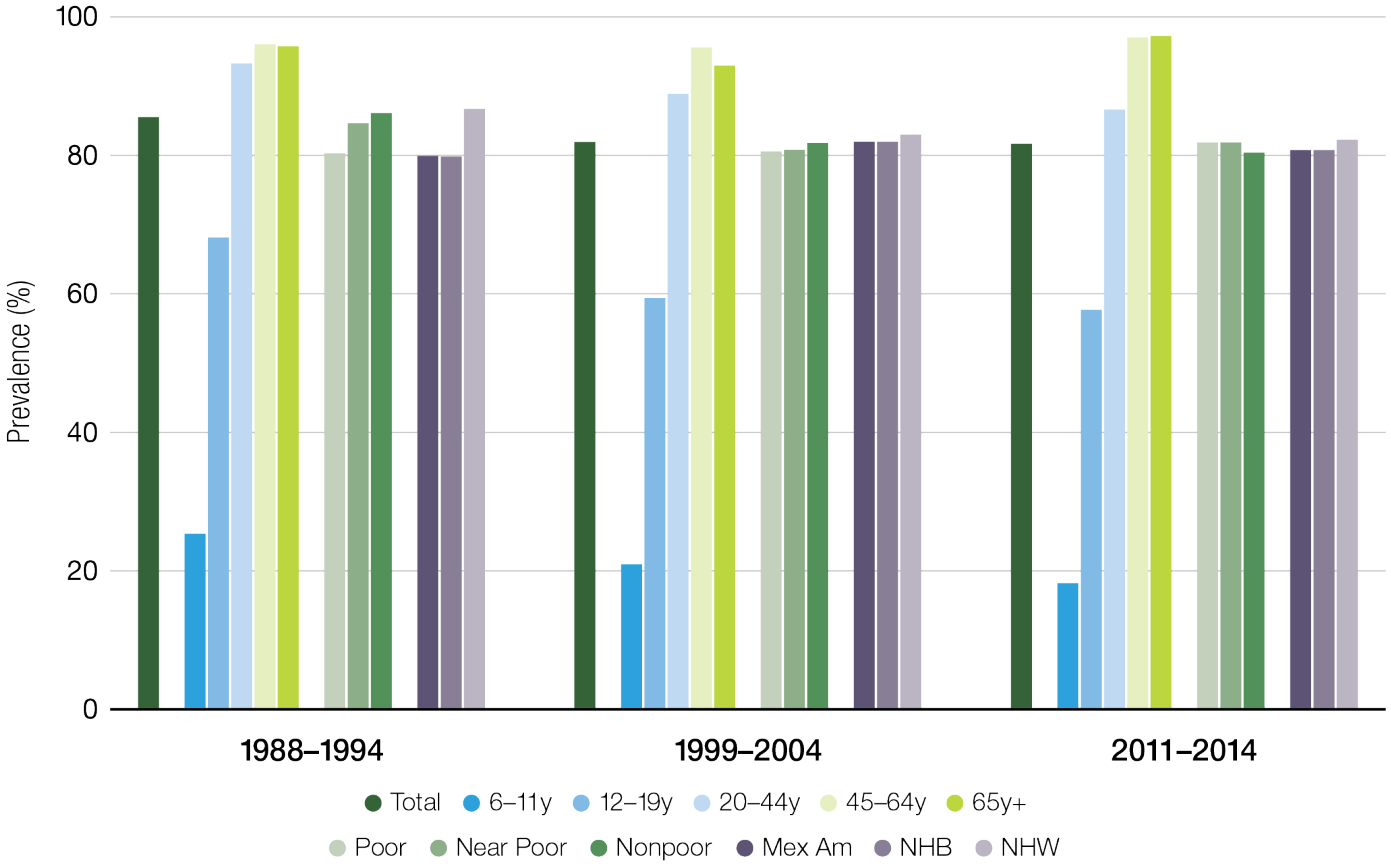
Although oral health is improving nationally, significant concerns persist. Dental caries, periodontal disease, and tooth loss remain significant public health concerns. As a nation, at least 4 out of 5 Americans aged 6 years and older have experienced tooth decay, irrespective of poverty or race/ethnicity status (Figure 10). The prevalence of dental caries increases as Americans age, and this has remained unchanged for the past 2 decades. But the overall prevalence of dental caries is starting to show a downward trend, especially among people younger than 45 years (Figure 10). However, most of this progress has only been realized for those living in households at 200% or higher of Federal Poverty Guidelines.

Overall, the prevalence of untreated dental caries in permanent teeth has not changed since the release of the 2000 report, with nearly 25% of all Americans aged 6 and older affected by untreated caries (Figure 11). Although untreated caries has declined for children, it has increased for working-age adults during this period. The prevalence of untreated caries is higher among working-age adults compared to children, adolescents, and older adults. Untreated caries among those living in poverty remains about twice that for those not living in poverty and disparities continue to persist by race/ethnicity status. These collective experiences clearly suggest that challenges persist in preventing dental caries in permanent teeth from occurring at the population level in the United States. Advances in reducing the loss of permanent teeth because of dental disease have been substantial. In general, tooth loss has been on the decline for all Americans in recent decades (Slade and Sanders 2017). When the Surgeon General's report on oral health was published, people aged 6 years and older had on average six teeth missing attributable to dental disease, whereas now that has been reduced by half (from nearly six, to about three mean teeth lost) (Figure 12). Among all age groups, improvements in tooth loss have affected older adults the most, decreasing from about 16 missing teeth to less than 11 missing teeth. Although the decreases in mean tooth loss are also occurring across all income levels, significant differences between those living in poverty and those who do not still exist. The complete loss of teeth (edentulism) still affects 18% of adults aged 65 years or older in 2009–2014, with those living in poverty twice as likely to be edentulous, compared to those not living in poverty (Dye et al. 2019). Additional information on advances and challenges influencing oral health status across the lifespan is provided in Sections 2 and 3 of this monograph.

Improvements in access to oral health care services have been observed steadily for the last 2 decades and have primarily helped children increase access to preventive and restorative care. State Medicaid and the Children's Health Insurance Program (CHIP) have substantially facilitated the use of dental services among poor and near-poor children and adolescents (Centers for Medicare & Medicaid Services 2020b). A near-doubling of the percentage of children with public dental insurance from 1996 to 2015 resulted in a 15-point increase to 88% in any dental coverage among all children (Ku et al. 2013; Steinmetz et al. 2014). For older adults aged 65 and older, modest increases in both public and private dental insurance coverage decreased the proportion uninsured from 68% to 62%, whereas the percentage of working-age adults aged 19 to 64 years with no dental insurance increased slightly from an estimated 33% to 35% (Nasseh and Vujicic 2016a).

Progress in expanding public coverage for youth, which has contributed to the decrease in the numbers of uninsured children, has also paralleled a considerable reduction in out-of-pocket dental expenditures for children (from mean of $155 to $100) and for adolescents (from mean of $444 to $418) between these two periods (Figure 13). However, with no change in dental insurance coverage for older adults, mean out-of-pocket expenses have continued to climb even after adjusting for inflation (2015 dollars) from $539 to $568. This mean out-of-pocket expenditure relationship observed for children and older adults persists for overall mean dental expenses as well. The mean reduction in total dental expenses for children was nearly $62 between these two periods ($438 to $376) whereas for older adults there was a mean increase in overall dental expenses to nearly $851 from $731, after adjusting for inflation (Figure 14). The ongoing lack of dental benefit/insurance coverage remains a persistent challenge and is a growing dental public

Figure 10. Percentage of individuals ages 6 and older with dental caries in permanent teeth by age group, poverty status, and race/ethnicity: United States, 1988–1994, 1999–2004, 2011–2014



Notes: Prevalence of dental caries (DMFT > 0). NHW = non-Hispanic White, NHB = non-Hispanic Black, Mex Am = Mexican American. FPG = Federal Poverty Guideline: < 100% FPG = poor; 100–199% FPG = near poor; and ≥ 200% FPG = nonpoor.

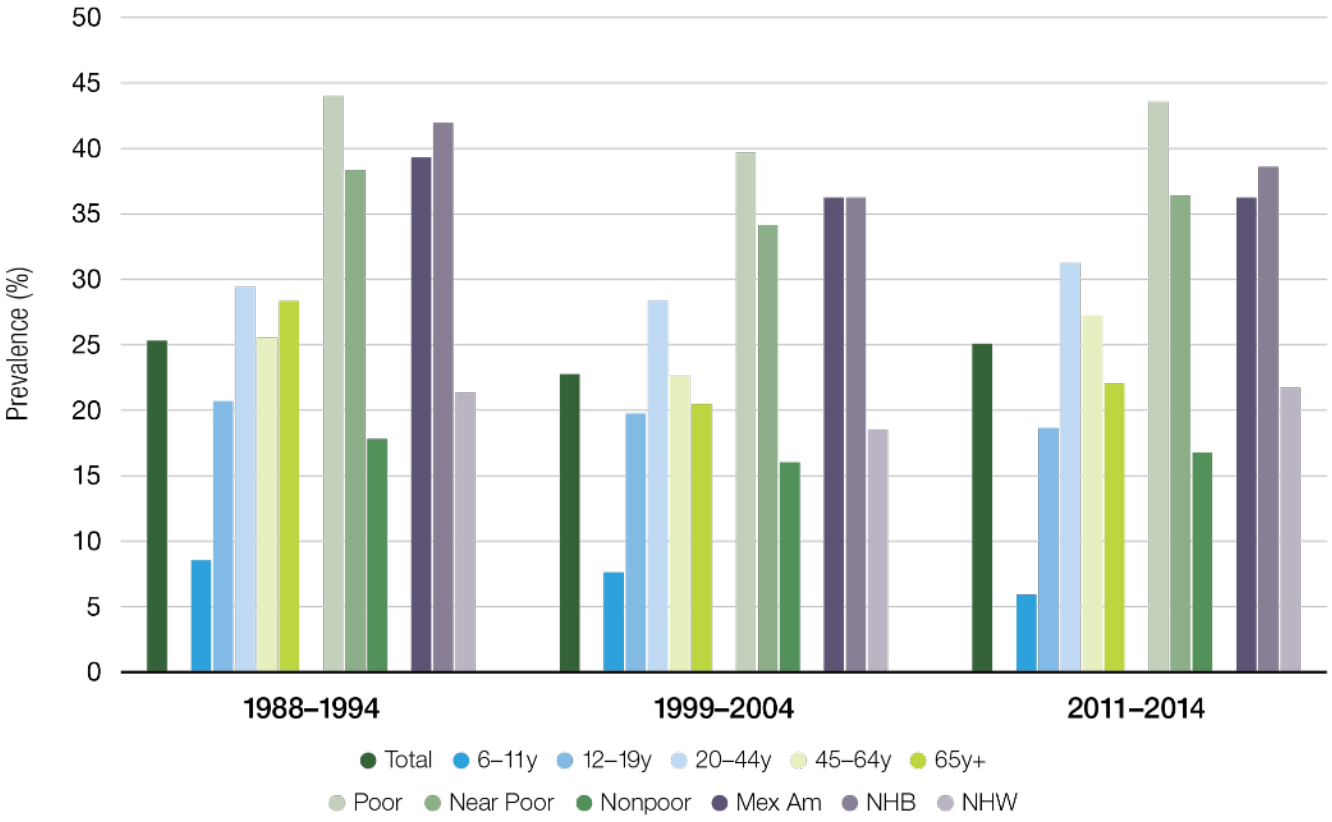
Source: CDC. National Health and Nutrition Examination Survey, public use data, 1988–1994,1999–2004, 2011–2014.

health problem. Because older adults are much more dependent on a fixed income, continual increases in out-of-pocket dental expenditures, along with increasing overall costs for dental care, will result in increasing deferred dental care when substantial improvements in tooth retention are occurring for an aging population that is increasing in numbers in the United States.

Social and Commercial Determinants of Health

Since 2000, emphasis on the role of social determinants of health (SDoH) (Figure 3) has increased substantially. Traditionally, risk factor identification for oral diseases, such as caries or periodontal disease, focused heavily on individual-level choices and behaviors such as oral hygiene behaviors, diet, and tobacco use. It is now widely accepted that SDoH need to be considered true risk factors with causal links to oral health outcomes. Risk factors generally are considered to be exposures that are statistically and causally related to a health outcome (Burt 2001). The result has been a growth in the epidemiological conceptualization of where health risk factors arise and an associated improvement in research methodology that supports the study of multilevel social determinants alongside lifestyle and biological risk factors.

Figure 11. Percentage of individuals ages 6 and older with untreated dental caries in permanent teeth by age group, poverty status, and race/ethnicity: United States, 1988–1994, 1999–2004, 2011–2014



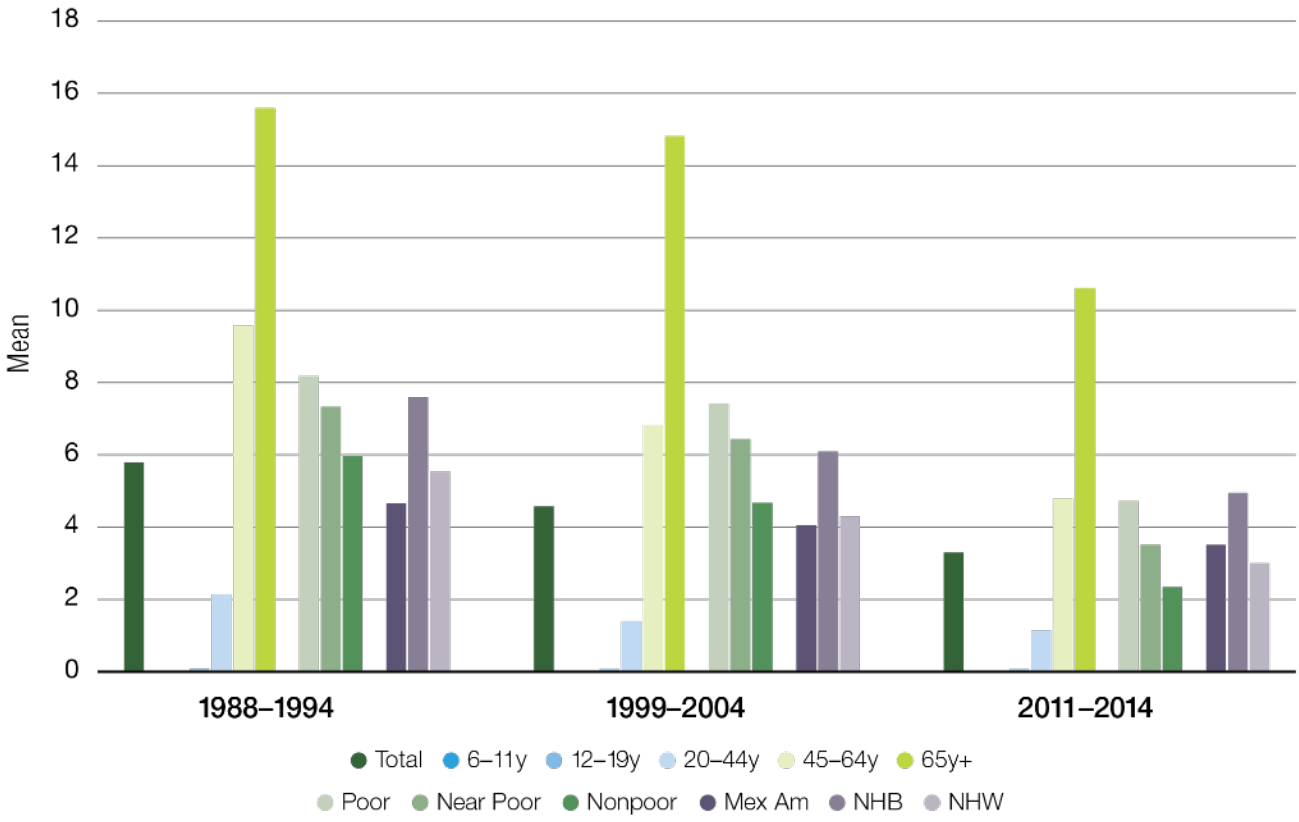
Notes: Prevalence of untreated dental caries (DT > 0). NHW = non-Hispanic White, NHB = non-Hispanic Black, Mex Am = Mexican American. FPG = Federal Poverty Guideline: < 100% FPG = poor; 100–199% FPG = near poor; and ≥ 200% FPG = nonpoor.

Source: CDC. National Health and Nutrition Examination Survey, public use data, 1988-1994,1999-2004, 2011-2014.

How does the world around us become part of our biology? Krieger (2001) provided insight into this by introducing a hierarchical, or multilevel, theory of causation. Her Ecosocial Theory provides a framework for analyzing how social factors across many levels (individual, family, community, and culture) can potentially influence health. A core concept of that theory is embodiment, "a concept referring to how we literally incorporate, biologically, the material and social world in which we live, from in utero to death; a corollary is that no aspect of human biology can be understood in the absence of knowledge of history and individual and societal ways of living" (Krieger, 2005 p. 352). Krieger described the pathways to embodiment as being structured by "(a) societal arrangements of power, property, and contingent patterns of production, consumption, and reproduction, and (b) constraints and possibilities of our biology, as shaped by human evolutionary history, its ecological context, and individual histories—that is, trajectories of biological and social development" (Krieger 2005 p. 352). The implication is that each individual's pathway to embodiment will result from dynamics related to the interactions of exposure, susceptibility, and resistance.

Several important developments emerged from this growing emphasis on social epidemiological methodologies for the study of oral health.

Figure 12. Mean number of missing permanent teeth due to dental disease among individuals ages 6 and older by age group, poverty status, and race/ethnicity: United States, 1988–1994, 1999–2004, 2011–2014



Notes: Mex Am = Mexican American, NHB = Non-Hispanic Black, NHW = Non-Hispanic White; per the Federal Poverty Guidelines (FPG), Poor = income <100% FPG, Near-poor = income 100–199% FPG, and Nonpoor = income ≥200% FPG.

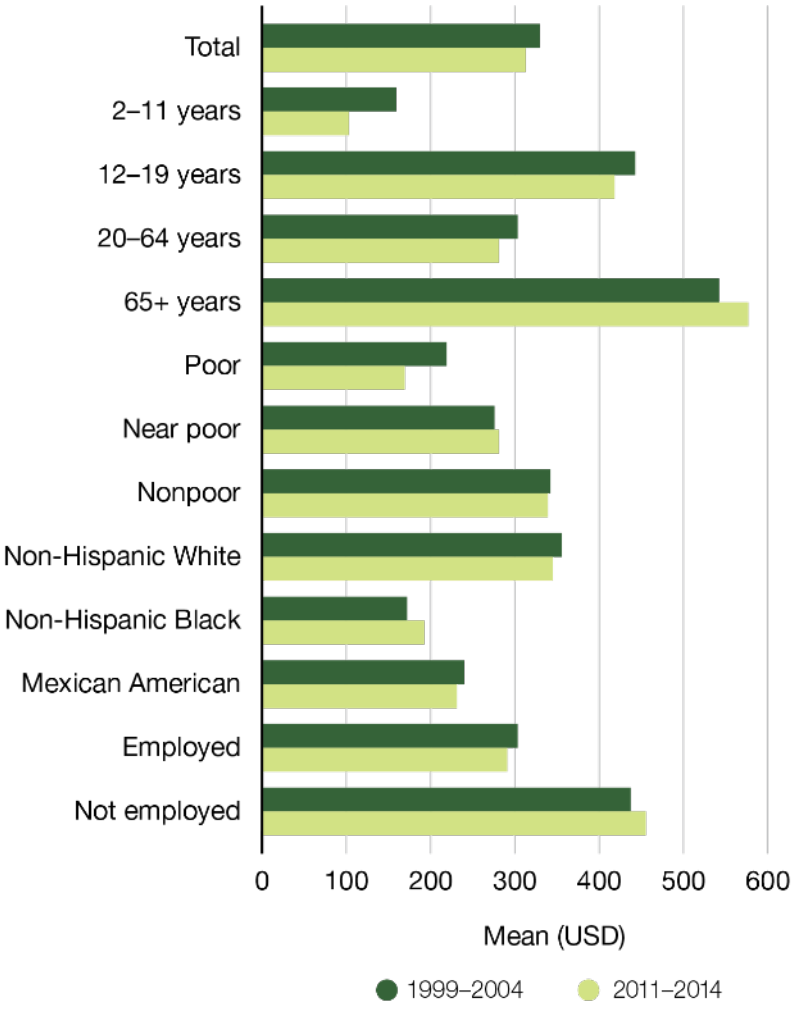
Source: CDC. National Health and Nutrition Examination Survey, public use data, 1988–1994,1999–2004, 2011–2014.

First, a large empirical literature emerged documenting the extent of the role of social factors in determining the oral health of populations. It became clear that ethnic minorities, lower income and education groups, and other vulnerable communities had greater oral disease liability (Evans and Kleinman 2000; Dye et al. 2007). These findings were consistently robust and demonstrated substantial effects on oral health. Consequently, additional efforts were made to understand the underlying mechanisms that could account for these effects. As a result, a wide variety of theoretical models and analytic frameworks have been developed for studying SDoH and the embodiment of the environment. Several of these approaches seem to have particular relevance to oral health.

The Life Course Approach

An earlier onset and faster progression of oral diseases, including tooth decay, tooth loss, and root caries, have been seen in ethnic minorities and among those with low education (Crimmins et al. 2009; Kim et al. 2012). Vulnerable groups tend to have poor access to routine preventive and reparative dental services and less access to fluoridated water, which can have lifelong effects on oral health and result in larger inequities among ethnic minority adults. In addition, chronic exposure to stress (for example, living in poverty) has been associated with altered physiological functioning, which may increase risk factors for oral diseases or faster progression of disease (Crimmins et al. 2009). Persons of disadvantaged social status report elevated levels of stress and may be more

Figure 13. Mean out-of-pocket dental expenditures per person in dollars (adjusted): United States, 1999–2004 and 2011–2014



Notes: Expenses adjusted to 2015 US Dollars (USD). **FPG** = Federal Poverty Guidleline: < 100% FPG = poor; 100–199% FPG = near poor; and ≥ 200% FPG = nonpoor. Employment calculated for people ages 16 years and older.

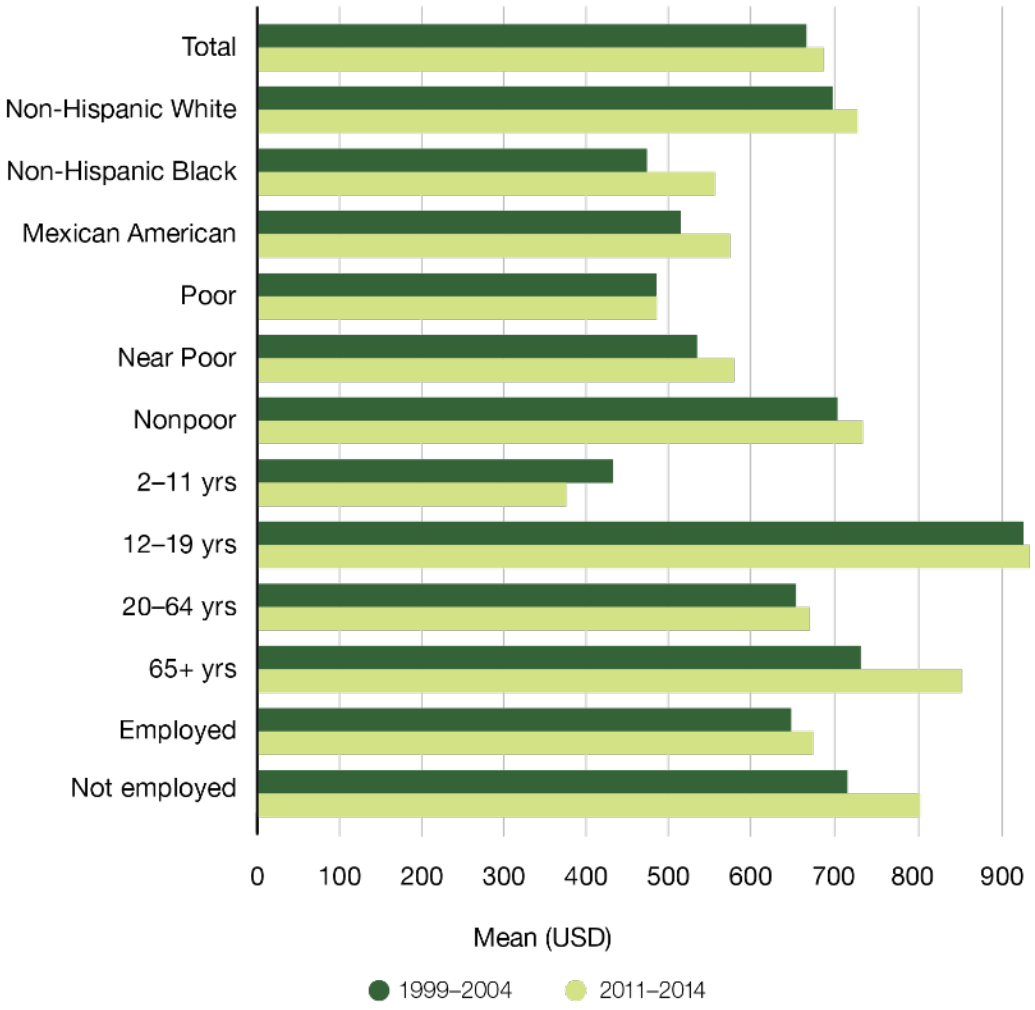
Source: Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey (MEPS), public use data, 1999–2004 and 2011–2014.

vulnerable to the negative effects of stressors, including increased disease vulnerability for many diseases (Williams and Jackson 2005).

The Access Effect

The largest disparities in access to dental care are related to income, race, and ethnicity (Vujicic and Nasseh 2014; Henshaw et al. 2018; Northridge et al. 2020). For example, low-income adults are less likely to have seen a dental provider within the past year compared to higher-income adults (Licata and Paradise 2012). One in five low-income adults reported that they had not had a dental visit in 5 years or more or had never had a visit (Licata and Paradise 2012). Not having regular access to dental services or an ongoing relationship with a dentist has long-term and cumulative effects on the oral health of low-income and racially diverse adults (Wu et al. 2011; Zhang et al. 2019). Deferral of care increases the need for advanced dental services, which require payments for services that are even less affordable to these already vulnerable populations, thereby leading to even greater disparities (Licata and Paradise 2012).

Figure 14. Mean total dental expenditures per person in dollars (adjusted): United States, 1999–2004 and 2011–2014



Notes: Expenses adjusted to 2015 US Dollars (USD). **FPG** = Federal Poverty Guidleline: < 100% FPG = poor; 100–199% FPG = near poor; and ≥ 200% FPG = nonpoor. Employment calculated for people ages 16 years and older.

Source: Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey (MEPS), public use data, 1999–2004 and 2011–2014.

Diminished Returns Theory

Given the current social structure and socioeconomic stratification, as well as existing biases in the labor market and education system, the same economic resources may generate larger health gains for White Americans than for individuals belonging to ethnic minorities (Assari 2018). This means that the protective effects of higher socioeconomic status are less for racial and ethnic minority groups than for Whites (Assari 2018). This could be the result of a reduced effect of education on employment and income. Conscious and unconscious bias also plays a role in employment, even among employees with the same education level, and leads to an increased chance of discrepancy in salary. Such structural and institutional-level barriers can result in health disparities (Assari 2018).

Culture/Acculturation Effect

Cultural factors play a significant role in oral health inequalities and lead to disparities. Living in a multicultural environment can affect the attitudes, beliefs, and knowledge of persons who are different from the mainstream population (Tiwari and Albino 2017).

The challenges of acculturating to the mainstream population can lead to distance from former sources of social support and cause emotional distress, which are linked to lower use of health services and poor oral health outcomes (Tiwari and Albino 2017). However, high acculturation is associated with higher education, preference for the English language, and social networks that potentially lead to greater utilization of dental services (Maupome et al. 2016; Macy et al. 2018).

Commercial Determinants Affecting Oral Health

Another important change in the past 2 decades is improved understanding of the conditions that lead to poor oral health, including the need that much greater attention should be paid to social and economic organization and the role of markets and industry as risk factors. Some commercial influences contribute to the persistent prevalence of oral disease. Population-level interventions are needed to address commercial determinants of oral health, income inequalities, health literacy, unhealthy eating habits, and more. For example, excise taxes on sugary beverages and other policy approaches to reduce sugar consumption have been associated with a reduction in new dental caries and lower dental treatment costs (Schwendicke et al. 2016), but these approaches remain underutilized as methods for shaping consumption and improving health and social outcomes (von Philipsborn et al. 2019).

Reducing two of the major risk factors for oral health—tobacco and excess alcohol consumption—remains a challenge for policymakers. In 2019, nearly 50.6 million U.S. adults used a tobacco product (34.1 million currently smoke) (Cornelius et al. 2020), and about 4.47 million middle and high school students used at least one tobacco product, including e-cigarettes (Cornelius et al. 2020; Gentzke et al. 2020). Every day in the United States, about 1,600 young people under the age of 18 years smoke their first cigarette (Substance Abuse and Mental Health Services Administration 2019). Moreover, e-cigarette use by adolescents and young adults increased at an alarming rate between 2018 and 2019 (Cullen et al. 2019; Wang et al. 2019), although it declined in 2020 (Gentzke et al. 2020). Alcohol use remains a challenge; in 2015, 66.7 million people in the United States reported binge drinking in the past month (U.S. Department of Health and Human Services 2016a). Additional information on tobacco and alcohol use is discussed in Section 5.

Vulnerable Populations and Oral Health Disparities/Inequities

Rural Populations

Although the 2000 Surgeon General's report on oral health noted the gravity of rural oral health disparities, its conclusion was limited by lack of sufficient data. Since then, the health outcomes of rural populations have been prioritized. The Health Resources and Services Administration (HRSA) released reports on oral health in rural communities in 2004 and 2018 (Barnett et al. 2018). These reports identified agency priorities for improving rural oral health, most notably provider recruitment and training, oral health literacy and education, and medical-dental integration. In 2013, the Federal Office of Rural Health Policy funded the development of a publicly available Rural Oral Health Toolkit to disseminate successful rural oral health care delivery models (NORC Walsh Center for Rural Health Analysis et al. 2013).

Geographic and socioeconomic factors continue to create rural oral health disparities. More than half of all uninsured rural adults live in states that did not expand Medicaid under the Affordable Care Act, thus restricting their access to insurance coverage (Foutz et al. 2017). Variations in Medicaid coverage for dental procedures also affect rural providers and patients more dramatically than those in urban settings (Fish-Parcham et al. 2019). Recruitment of dentists to rural areas is an ongoing challenge, with the vast majority of dental school graduates—even those originally from rural areas—choosing to practice in more urban locations (Vujicic et al. 2016b). Because rural dentists are, in general, older than the average practicing dentist, the sustainability of the rural dental workforce may be increasingly under threat in the coming decades (Doescher et al. 2009).

One of the largest innovations since 2000 with the potential to have an impact on rural residents has been the adoption of dental therapy in the United States to address ongoing rural dental workforce challenges. Dental therapists are members of a dental team who provide preventive and restorative dental care. Although dental therapists have practiced globally in rural areas since the early 20th century, it was only in 2003 that the first cohort of dental therapists began to treat Alaska Natives as part

of the Indian Health Service's (IHS) Community Health Aide Program. In 2009, Minnesota became the first state to pass legislation permitting dental therapists to practice statewide, with subsequent adoption by the predominantly rural states of Vermont and Maine (Koppelman et al. 2016b). As of 2019, eight states had passed dental therapy legislation that allows these professionals to practice independently (Grant 2019) and 12 states allowed dental therapy in some capacity. Research indicates that dental outcomes were equivalent or superior when dental teams included therapists (Wright et al. 2013). In spite of these advances, there are only about 100 dental therapists practicing across the country (Koppelman et al. 2016b). See Section 4 for more information on dental therapists.

Scalability of effective oral health prevention interventions in rural areas is a special challenge. Water fluoridation in small, rural communities is costlier than in cities; however, the estimated return on investment for community water fluoridation in communities of fewer than 5,000 people still approaches $30 per person (Griffin et al. 2001; O'Connell et al. 2016). Higher use of well water rather than community water sources further complicates efforts to provide this important preventive measure. Yet, prevention is especially important in rural areas because many patients face long travel times to reach a dentist in rural dental health professional shortage areas. Limited transportation options, especially for older rural dwellers, may further restrict access (Arcury et al. 2005).

Low-Income Populations

The 2000 report on oral health highlighted the disproportionate burden of dental caries borne by people living in poverty. Overall, income and economic status disparities in oral health persist. Cost continues to be the greatest barrier to accessing dental care. Dental cost as a percentage of total income is a metric that highlights how low-income families often are unable to access professional dental services. Halasa-Rappel and colleagues (2019) analyzed 2018 Medical Expenditure Panel Survey data and reported two associated and troubling findings. Among individuals living in poverty, 93% had unmet dental care needs, compared to 58% of those in the high-income group. They also reported that as a percentage of income, individuals living in poverty spend nearly 10 times more of their income for dental care, compared to high-income families (Halasa-Rappel et al. 2019).

Public health interventions intended to reduce disparities can inadvertently worsen them; however, working with community partners can improve implementation practices that can increase the likelihood of success and improved health outcomes of community participants. For example, population level interventions that depend on voluntary behavior change typically are adopted by the most advantaged. As health technologies advance, such as in the field of precision dentistry, economically advantaged groups are likely to benefit most from these potentially costly services, resulting in a widening of income disparities in oral health. For example, as technologies have improved treatment outcomes over the past 2 decades, increases in tooth retention have led to more affluent adults having more natural teeth retained compared to those living in poverty, but observed disparities in tooth retention by income status increased (Dye et al. 2019).

Decreasing health disparities depends in large part on programs and policies aimed at providing more equitable distribution of evidence-based, health-promoting interventions. Generally, this means programs that are not dependent on individual behavior change or compliance, such as community water fluoridation programs. Increasing the proportion of the population served by community water fluoridation not only benefits the entire population but disproportionally benefits economically vulnerable groups, producing a flatter socioeconomic gradient in dental caries among children (Slade et al. 1995; Riley et al. 1999; McLaren and Emery 2012; McLaren et al. 2016) and reducing the need for expensive dental treatment.

To redress such inequities, the federal Healthy People 2000 initiative introduced an overarching goal to reduce health disparities. Healthy People 2010 expanded this goal based on characteristics of race and ethnicity, geographic location, gender, sexual orientation, disability status, educational attainment, and family income. Healthy People 2020 retained elimination of health disparities as an overarching goal and added achieving health equity and improving the health of al groups. This has been further expanded for Healthy People 2030, where an overarching goal is to eliminate health disparities, achieve health equity, and attain health literacy to improve the health and well-being of all (U.S. Department of Health and Human Services 2020b).

Black or African American Populations

The gaps between the status of non-Hispanic Black populations relative to other racial groups remain similar to those reported in the 2000 Surgeon General's report on oral health. A comparison of the National Health and Nutrition Examination Survey (NHANES) data from 1999–2004 and 2011–2014 revealed that the racial disparities between non-Hispanic Black and White school-age children for untreated dental caries have broadly not improved but when race and poverty are both considered, the disparities for low-income non-Hispanic Blacks aged 6–11 become more pronounced but are nearly eliminated among more affluent youth (Dye et al. 2017). Non-Hispanic Black populations in the United States continue to experience greater morbidity from oral diseases than their counterparts of other racial groups (Henshaw et al. 2018). For low-income Blacks in the United States, the challenges of having adequate dental benefits and access to a workforce that is willing and available to meet their oral health needs is an ongoing challenge. That only 3.3% of U.S. dentists are Black is an important aspect to this challenge (Mertz et al. 2017).

As the number of older adults in the United States increases, it is important to note that there are persistent disparities between Black and White older adults, especially with regard to untreated dental caries (Centers for Disease Control and Prevention 2019). Continuing barriers to receiving needed dental care services for older adults include lack of dental coverage in Medicare and limited access to adult dental benefits through Medicaid (Friedman et al. 2014a). Because many individuals lose their employment-based dental insurance upon retirement, Manski and colleagues (2011) estimated that non-Hispanic Black retirees were three times more likely to stop using dental services than were their White counterparts, even after controlling for other factors, such as income and education.

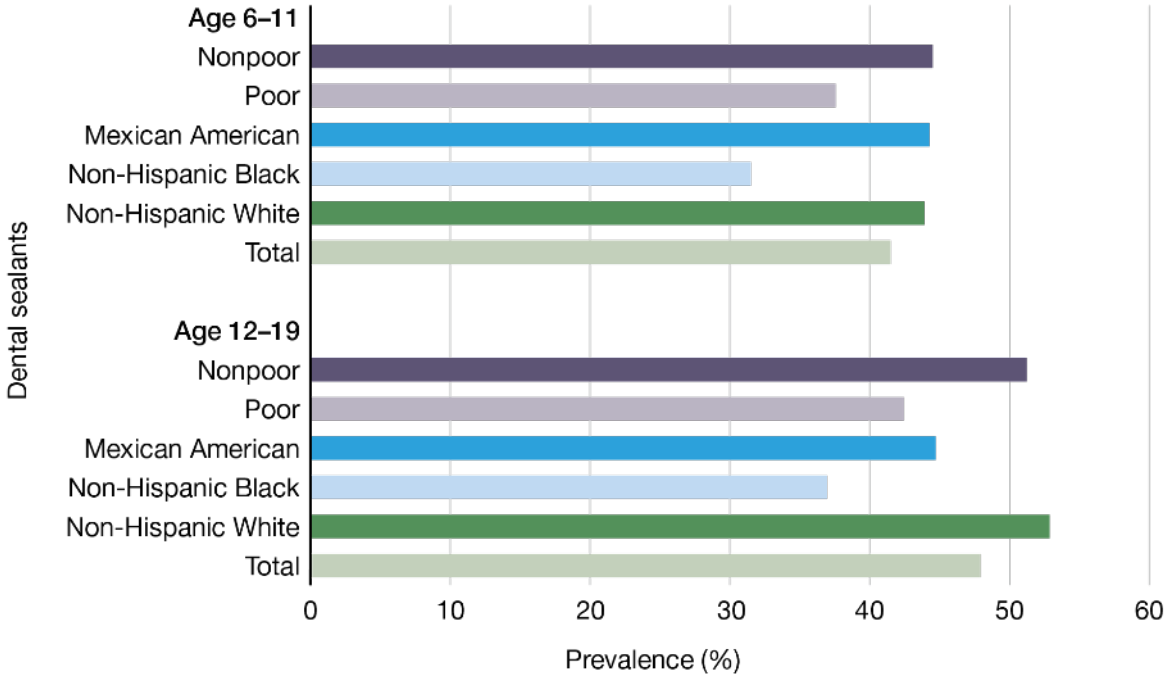
Effective promotion of oral health among non-Hispanic Blacks also requires an improved understanding of how social determinants function to influence oral health and access to care across cultures. Although living in poverty and disadvantaged neighborhoods, and having more exposure to chronic stressors (Sanders and Spencer 2004; Turrell et al. 2007; Finlayson et al. 2010; Braveman et al. 2011), can affect anyone living with those hardships, the interaction of these factors with race remains unclear. For example, among child populations where Medicaid and CHIP are available, the percentage of those who were uninsured varied in important ways across racial and ethnic groups. Among the insured, moreover, substantial differences exist between public and private insurance coverage. Among Black children, 49.1% had public insurance and 42.8% had private insurance, whereas for White children, 17.5% had public insurance and 76.2% had private insurance. Children with public insurance receive less dental care than those with private dental coverage. This often is attributed to lower reimbursement rates by Medicaid in most states, leading to a smaller number of dentists willing to provide services to Medicaid patients (Flores and Tomany-Korman 2008). These factors limit access to and utilization of regular dental services, especially preventive services (Edelstein and Chinn 2009; Pourat and Finocchio 2010). As a result, there are continuing disparities in access to important preventive services, such as dental sealants, between Black and White children (Figure 15) (Centers for Disease Control and Prevention 2019).

Hispanic Populations

Hispanic Americans, especially those of lower socioeconomic status, continue to experience a high burden of oral disease and challenges with low dental utilization and access to culturally competent dental care. Based on National Health Interview Survey data, the proportion of Hispanic children without dental visits in the past year declined between 2000 and 2014 (Larson et al. 2016). However, dental coverage is more variable for adults than for children and dental care continues to pose a significant cost for many adults who report more financial barriers to obtaining dental services than other types of health services (Vujicic et al. 2016a).

Statistics from more current NHANES cycles revealed that young Hispanic children (aged 2–8 years) had higher prevalence of untreated decay in primary teeth and greater dental caries experience compared to other racial and ethnic groups (Satcher and Nottingham 2017). An important advancement since 2000 has been the development of more recent national data available for Hispanic adults aged 18 to 74 years for 2008–2011 (Beck et al. 2014). These data allow reporting on oral health status for different Hispanic subgroups, unavailable since the 1982–1984 Hispanic Health and Nutrition

Figure 15. Percentage of youth ages 6–19 with dental sealants by age group, poverty status, and race/ethnicity: United States, 2011–2016



Note: **FPG** = Federal Poverty Guidleline: < 100% FPG = poor; 100–199% FPG = near poor; and ≥ 200% FPG = nonpoor.
Source: Centers for Disease Control and Prevention (2019).

Examination Survey, which included Mexican Americans, Cubans, and Puerto Ricans (Ismail and Szpunar 1990). Baseline data from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) provide a new national dataset that can support exploring diversity across Hispanic population groups in an attempt to better understand the connection between oral health and other diseases. For example, among all ethnic Hispanic subgroups, half have some form of periodontitis (mild, moderate, or severe), but more than a third of Cubans and Central Americans have the highest prevalence of moderate periodontitis among all subgroups (Jiménez et al. 2014). The HCHS/SOL enables accounting for traditional oral health risk factors, as well as other important cultural factors.

Acculturation, education, language barriers, transportation deficiencies, ethnic identity, and lack of dental insurance remain significant factors affecting dental utilization among Hispanic adults (Stewart et al. 2002; Eke et al. 2011; Strouse et al. 2013; Velez et al. 2017; Silveira et al. 2020). In addition, the lack of an ongoing relationship with a dentist, lack of available transportation, and difficulty getting time off from work for dental visits are more common barriers among Hispanic communities (Kim et al. 2012; Vujicic and Nasseh 2014). Hispanic dentists remain largely underrepresented among dentists nationwide and, like other minority dentists, Hispanic dentists tend to practice in communities with a large proportion of minorities (Mertz et al. 2016a).

American Indian and Alaska Native Populations

In 2010, IHS implemented an ongoing oral health surveillance system designed to monitor trends in oral health among the American Indian and Alaska Native (AI/AN) population served by IHS and tribal programs. Since the implementation of the surveillance program, oral health data have been obtained from four different age groups: preschool children (2010, 2014, and 2018–2019), elementary school children (2011–2012 and 2016–2017), adolescents (2012–2013), and adults (2015). The IHS Oral Health Surveillance Plan provides detailed

information regarding past, present, and future-planned oral health surveys of the AI/AN communities (Indian Health Service 2015).

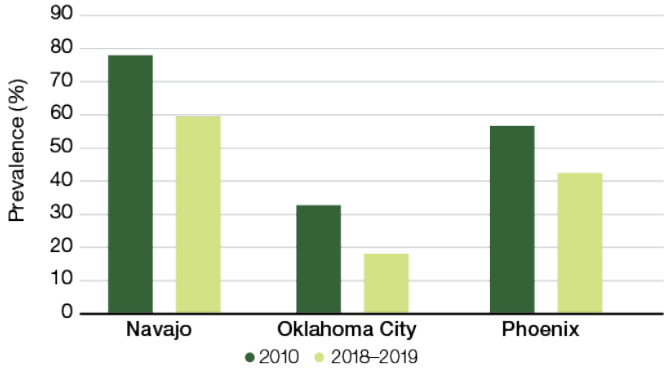
The IHS Division of Oral Health has conducted seven surveys since the launch of the original oral health surveillance plan in 2010 (Indian Health Service 2021a). Each survey used the Basic Screening Survey instrument (Association of State and Territorial Dental Directors 2021) as the tool to conduct community-based, clinic-based, and school-based surveys. Survey results are available as IHS Data Briefs on the IHS Division of Oral Health website (Indian Health Service 2021b). However, despite the fact that more recent data from the IHS surveillance system appear to be showing improvements in the oral health of some AI/AN preschool children (Figures 16 and 17), these children continue to suffer disproportionately from common oral diseases (Phipps et al. 2019).

The relative geographic isolation of many tribal populations may limit access to dental care. AI/AN patients also face difficulties in receiving routine and preventive dental care as a result of other reasons, such as the chronic shortage of dentists within IHS (Batliner 2016). The IHS struggles to attract physicians and dentists to rural and geographically isolated locations. The dentist-to-population ratio exceeds 1:5,000 in AI/AN communities (Mertz et al. 2017), compared to an average of 1:1,600 for the entire U.S. population (Munson and Vujicic 2018). In addition, dental services provided through IHS often are underfunded, resulting in a need to concentrate on providing basic emergency care services, with restorative and preventive care provided primarily to children. As a result, availability of adult restorative care may be compromised (Soeng and Chinitz 2010).

Sexual and Gender Minorities

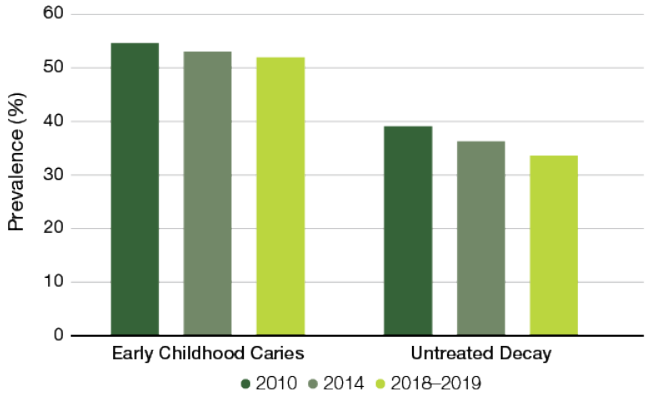
Sexual and gender minority populations (SGM) likely constitute groups at higher risk for oral diseases and oral health inequities by virtue of their lower access to care and lower levels of social influence (Schwartz et al. 2019). The National Institutes of Health established an SGM Research Office to expand the knowledge base related to SGM health and well-being and to advance SGM-related research (National Institutes of Health 2020). However, to date, research related to the oral health of this group is extremely limited. In the 2000 Surgeon General's report on oral health, attention was drawn to the lack of

Figure 16. Change in percentage of American Indian/Alaska Native (AI/AN) children ages 1–5 with early childhood caries (ECC) by select Indian Health Service areas between 2010 and 2018–2019



Source: Phipps and Ricks (2015); Phipps et al. (2019).

Figure 17. Percentage of American Indian/Alaska Native (AI/AN) children ages 1–5 with early childhood caries (ECC) and untreated dental caries in 2010, 2014, and 2018–2019



Note: Information surveyed from 53 IHS service units.
Source: Phipps and Ricks (2015); Phipps et al. (2019).

information on lesbian, gay, bisexual, transgender, queer, and other populations. Little has changed in the intervening 2 decades. The only current report is from Schwartz and colleagues (2019), which noted that "subjective measures of oral health were worse among gay, lesbian, and bisexual adults versus heterosexual adults" (Schwartz et al. 2019, p. 18).

Oral Health for those with Special Health Care Needs

Although access to dental care services and achieving and maintaining good oral health is a challenge for many people, this is especially the case for individuals with disabilities and complex medical conditions (Institute of Medicine and National Research Council 2011). In the

past 20 years, the population of individuals with special health care needs (SHCN) has increased at the same time that many more are residing in community living arrangements. One in five children have SHCNs (Chi 2018a). Lewis (2009) responding to the 2000 report on oral health, reported that dental care was the most frequently cited health care need among children with SHCNs. As a result, dentists are increasingly called upon to provide dental care services in their offices for people with complex conditions. This often requires close consultation and collaboration with others on the patient's health care team. It also may present challenges for dental professionals without the in-depth training required to care for the wide variety of physical, medical, and cognitive conditions that these patients present. Currently, the population with the highest per-visit expenditures in dental offices is the elderly population. This also is the group most likely to have disabilities and complex health care conditions (Wall et al. 2013). See Sections 2A and 3B for more information on these special needs populations.

Training of oral health providers in providing clinical dental services for patients with complex health conditions remains distressingly inadequate (Furlini et al. 2018) and accreditation requirements for predoctoral dental education programs require that graduates only be competent to assess the needs of individuals with special needs (Commission on Dental Accreditation 2018). Unfortunately, the number of people with special needs or complex health conditions continues to grow in absolute terms and as a percentage of the population (Institute of Medicine 2007; Okoro et al. 2018; Child and Adolescent Health Measurement Initiative 2020). Moreover, those with the most complex conditions are more likely to be isolated in facilities providing specialized health care. Finally, payment systems typically do not recognize complexity and as a result, dental care is still paid through one-size-fits-all reimbursement mechanisms (set procedure or visit fees with no modifiers). Understandably, all these factors disincentivize dentists and worsen the disparities experienced by many individuals living with complex health conditions.

Social Determinants and Health Policy

Many oral diseases, such as dental caries and periodontal disease, share common risk factors with other chronic disorders, including diabetes, obesity, and cardiovascular disease. These risk factors include tobacco and alcohol use and an unhealthy diet. Increasing awareness of the presence of common risk factors across multiple chronic diseases could help to coalesce powerful health advocacy groups. Combining the voices speaking for both oral diseases and related chronic diseases would provide a stronger lever for advancing health promotion messages and for advocating for health policy change (Watt and Sheiham 2012).

The realization that oral health fits into a broader health agenda already has enabled changes in health promotion and service delivery. It now is seen as appropriate for oral health advocates to focus on high-level policy changes, such as those aimed at reducing consumption of foods and beverages with added sugars (Navia 1994). Moving oral health promotion and service delivery to new venues, such as medical offices, schools, and community services sites, also has been stimulated by these changes.

Health-related policy and social marketing aimed at social and commercial determinants have had an impact on population-level health behaviors. In terms of dietary risk factors, added sugar intake decreased for both men and women across all age groups between 2001–2004 and 2007–2010 (Millen et al. 2016). Nonetheless, most Americans continue to exceed the U.S. Dietary Guidelines' recommendation to limit added sugar intake to less than 10% of calories per day (U.S. Department of Health and Human Services 2016b).

Use of conventional, or combustible cigarettes has declined during the past several decades among all age groups including youth and young adults in the United States (U.S. Department of Health and Human Services 2014). Although federal restrictions on where smoking can occur have not been enacted, many state and community laws prohibit smoking in workplaces, restaurants, and bars. Nevertheless, 39% of the U.S. population remains uncovered by comprehensive smokefree indoor air policies (American Nonsmokers' Rights Foundation 2021). Rising state excise taxes on cigarette sales also have reduced per capita consumption of cigarettes.

Since the first Surgeon General's report on smoking and health in 1964, there have been 34 different reports related to tobacco use, including the most recent report in 2020

on smoking cessation. A 2012 Cochrane Collaboration systematic review on interventions for tobacco cessation in the dental setting suggested that behavioral interventions for tobacco cessation conducted by oral health professionals and incorporating an oral examination component in the dental office or community setting may increase tobacco abstinence rates both among people who smoke cigarettes and those who use smokeless tobacco (Carr and Ebbert 2012).

Understanding of policy approaches for reducing tobacco use, alcohol misuse, and added sugar consumption has greatly improved. Excise taxes, which raise the price of taxed products, are highly effective in reducing consumption of tobacco products, alcohol, and sugary beverages (Bloomberg et al. 2019). Their impact tends to be stronger among the less affluent and youth, suggesting that these groups would receive the greatest health benefits. Increasing taxes on these three products should not only improve health and reduce costs but also improve market efficiency. Such taxes are justified by the large and growing health and economic costs they impose on users, such as smoking-related illnesses or alcohol-related automobile accidents, as well as economic arguments regarding fiscal efficiency.

The introduction of the human papillomavirus (HPV) vaccine also is critical because it will provide some protection against oropharyngeal and other cancers (Chaturvedi et al. 2008; Chaturvedi et al. 2011). Although the incidence of oropharyngeal cancers has decreased, this has not been the case for HPV-positive oropharyngeal cancers. Thus, the HPV vaccine has the potential to be a key public health intervention and may have an equity effect among men and women if HPV vaccination programs can be provided in a broad-based manner similar to other mandatory vaccines. According to the National Immunization Survey-Teen, rates of HPV vaccine initiation are higher among adolescents living in poverty than among higher-income groups (Bednarczyk et al. 2013). More information on HPV and oral health is found in Sections 2B and 3A.

The federal Earned Income Tax Credit and Child Tax Credit are broader policy developments that redistribute income to low-income families with children. Along with rises in the minimum wage, these policies may alleviate the magnitude of income-related inequalities in oral health. In this way, contemporary understanding of what determines health—namely that structural factors play a stronger role than individual factors—is a fundamental change in the current policy and health research environment that should not be ignored. It also is an area where evidence of the effects of interventions is developing (Waters et al. 2008; Bambra et al. 2009; Cochrane Public Health 2015).

The Food and Beverage Industry

Policy and population-level initiatives are being employed to begin to address commercial determinants of poor oral health. Cost is a powerful tool to modify behavior. For example, states impose different levels of excise tax on the sale of cigarettes and their impact on consumption is well established. Whether these efforts affect smoking-related diseases is less clear. Sanders and Slade (2013) examined state cigarette excise tax and its associations with per capita consumption, exposure to secondhand smoke, and chronic periodontitis in U.S. nonsmokers. They found that for each additional 10 cents in excise tax, cigarette sales would decrease by 0.74 packs per person per month and the adjusted odds of moderate or severe periodontitis by 22%. These authors found that the odds of periodontitis for those exposed to secondhand smoke were elevated, suggesting that a cigarette excise tax also could protect nonsmokers against periodontitis.

More recently, taxes on sugar-sweetened beverages have been implemented in a number of countries and localities, yet no analysis has been published about their effect on dental caries (Schwendicke et al. 2016). Nevertheless, simulation studies suggest that such a tax could reduce tooth decay and its associated economic burdens and that improvements would be most concentrated in younger age groups (Sowa et al. 2018; Jevdjevic et al. 2019)

Financing Dental Care

Dental spending has increased substantially in the past 2 decades. Much of this increase comes from increased access to public programs, in particular Medicaid, with smaller shares coming from private dental insurance and out-of-pocket spending. For example, in 2018, 10% of national dental spending was financed by public programs, and 40% was paid out of pocket by patients. Another 46% was financed by private dental insurance

(See Section 4, Figure 3). In 2000, only 4% was financed by public programs, 44% through out-of-pocket payments, and 50% from private dental insurance. The shifts in the mix of dental care financing have been occurring gradually, driven largely by changes in dental care utilization patterns (Vujicic 2015b; American Dental Association 2020g).

Among adults 65 years and older, retirement often brings a loss of employment-based medical and dental insurance. After reaching age 65, older adults typically transition from employment-based medical insurance to Medicare. Because Medicare includes only limited coverage for dental care, an estimated 1 in 3 older adults have any dental insurance with the majority having some private dental insurance and a few enrolled in Medicaid (Nasseh and Vujicic 2016a; Yarbrough and Vujicic 2019). Consequently, older adults relying on Medicare for health insurance incur substantial out-of-pocket expenses for dental services. More than 40% of dental expenses are paid out of pocket, compared to only 9% of medical expenses for Medicare-enrolled older adults (Kreider et al. 2015). As a result, many adults fail to receive needed dental care. Fewer than half of Medicare beneficiaries (49%) had a dental visit within the past 12 months. For some ethnic groups, utilization rates for Medicare beneficiaries were even lower. Only 29% of Blacks and 35% of Hispanics aged 65 years and older had a dental visit in the past 12 months. Other older adult groups also had low utilization rates—only 30% of low-income and 41% of rural residents sought dental care in the previous 12 months. This is particularly concerning because older adults are at higher risk for periodontal disease and oral cancer, both of which have a worse prognosis if diagnosis and treatment are delayed (Medicaid and CHIP Payment and Access Commission 2020).

Current public insurance programs are struggling to provide coverage for many. This is primarily attributable to the expanding number of Americans eligible for public assistance. These numbers are growing, and states are challenged to keep up with the demand. Although federal law restricts routine dental care for Medicare beneficiaries, many Medicare enrollees more recently have begun to access preventive dental services under Medicare Advantage (MA) programs. These programs offer seniors dental services as incentives to plan selection (Freed 2021). In most MA plans, dental care is limited to preventive and simple restorative services.

Public Dental Insurance

Use of dental care services across population groups has steadily increased since 2000. Among Medicaid and CHIP beneficiaries, children enrolled in the Early and Periodic, Screening, Diagnostic, and Treatment program under Medicaid or CHIP were reported to have increased utilization of any dental service from 6.3 million in fiscal year (FY) 2000 to 19.6 million in FY 2019 (Centers for Medicare & Medicaid Services 2021b). Population growth and changing demographics across the United States have driven changes in Medicaid program policy, administration, and eligibility across states and have accounted for much of this increase. Medicaid expansion implemented in many states as a result of the Affordable Care Act (ACA) has led to steady increases in both pediatric and adult Medicaid enrollment since 2010. Similar enrollment increases have been observed across states with CHIP. Between 2013 and 2018, nonexpansion states observed only a 10.2% increase in Medicaid enrollment, compared to a 35.9% increase in expansion states during the same period (Medicaid and CHIP Payment and Access Commission 2020).

Since 2010, many states have combined their CHIP and Medicaid programs. This shift in program administration provides greater access to a wider range of dental benefits because Medicaid policy is less restrictive than CHIP. In 2017, only 13 states operated a separate CHIP program, compared to nearly all states in 2000 (Medicaid and CHIP Payment and Access Commission 2017). Increased enrollment of children in Medicaid can improve access to care and reduce untreated disease. However, the structure of dental coverage for children in the ACA has presented new challenges for implementation. These structural barriers include complex benefit designs, lack of affordability protections in some plans, and no mandate to purchase dental coverage (Snyder et al. 2014). The ACA does not require dental insurance for adults and the result has been negligible improvement in dental coverage

among working-age adults. Nearly 2.5 times as many adults have medical insurance, compared to dental insurance (Kreider et al. 2015).

For adults, dental benefits are not mandated under federal law, although many state Medicaid agencies have expanded dental policies and benefits during the past 2 decades. This increase in access to dental care came about because of increases in enrollment through Medicaid expansion and the advancement of Medicaid dental policy for adults (Medicaid/Medicare/CHIP Services Dental Association 2019a; 2019b). Current status of dental Medicaid benefit expansion is shown in Figure 18. In 2017, more than half of state Medicaid dental programs reported including preventive and restorative oral health care services for adults: comprehensive oral examination (33 states), dental cleaning (33 states), and amalgam and composite fillings (32 and 31 states, respectively). Thirty states covered upper and lower dentures, 24 states covered root canal treatment for adults, and 31 states covered scaling and root planing and scaling services for pregnant women 21 years and older (Medicaid/Medicare/CHIP Services Dental Association 2019a).

Although the national average is 38% of dentists participating in Medicaid or CHIP to provide services for children, there is considerable variation across states. For example, the participation rate in Iowa is 85.5%, with greater than 70% participation in Alabama, Michigan, Montana, North Dakota, and Vermont. On the low end, with participation rates below 16%, were California, Maine, and New Hampshire. Factors that are associated with participation include dental provider gender and age, with participating providers more likely to be younger or female (American Dental Association 2020h). However, other factors, such as state poverty level, the number of health professional shortage areas within a state, and a state's decision to not participate in the Medicaid expansion of the ACA, are associated with lower rates of dentist participation in Medicaid and CHIP (American Dental Association 2020g).

Still, there has been much improvement with regard to dental providers enrolled in Medicaid and CHIP since the early 2000s. According to the most recent data, 38% of general and pediatric dentists participate as Medicaid or CHIP providers. It is important to note that simple participation rates do not fully measure the availability of dental services for the Medicaid beneficiaries because they do not include billing rates or patients treated (Warder and Edelstein 2017).

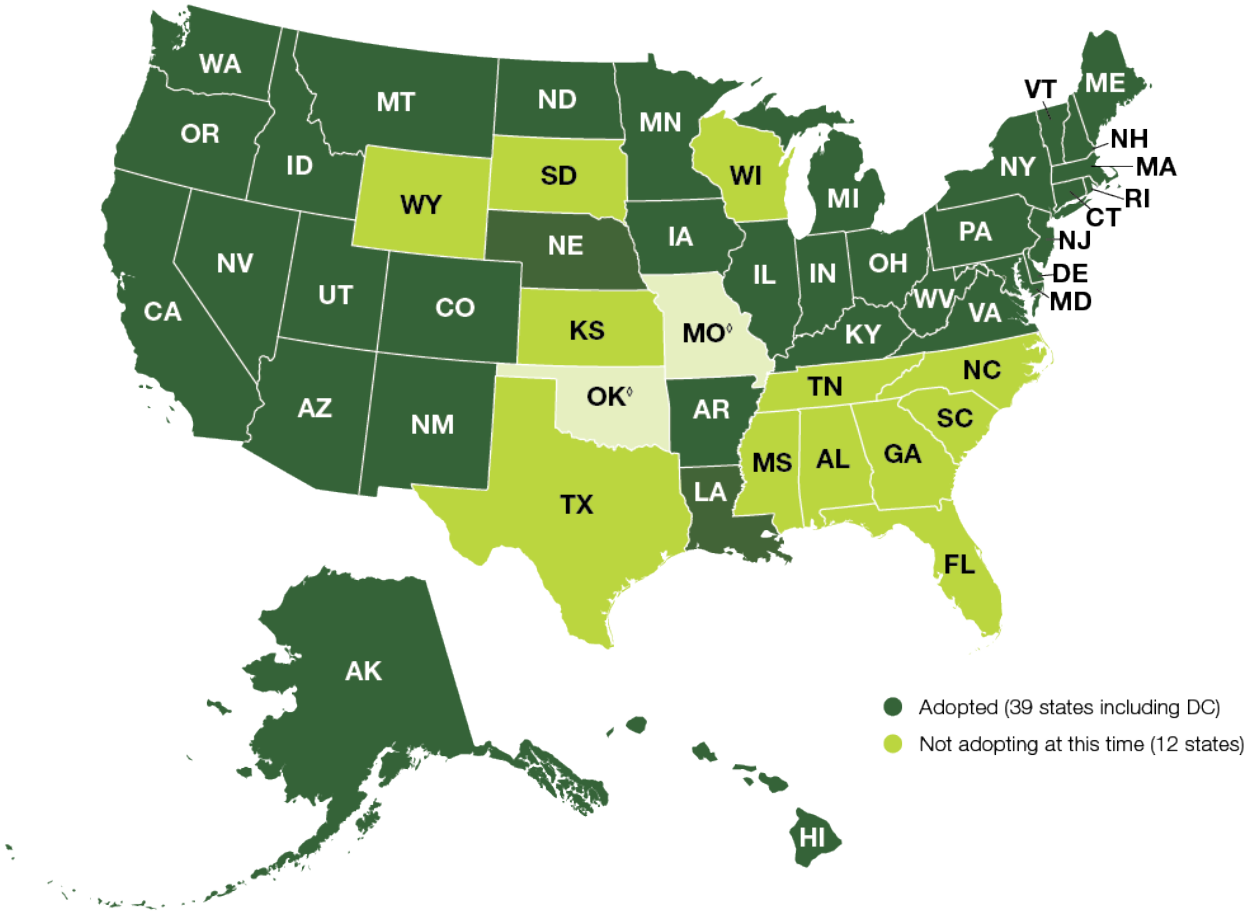
Other Governmental Activities Supporting the Dental Health Care System

Over the past 2 decades, HRSA, in collaboration with the Centers for Medicare & Medicaid Services (CMS), has continued to support and expand dental care access for low-income Americans. The HRSA Health Center Program (HCP) has supported health centers with Section 330 grant funding, whereas CMS and state Medicaid agencies cover fees associated with the delivery of health care services (110th United States Congress 2008). In 2011, CMS established a federal regulation allowing Federally Qualified Health Centers to contract with private dental offices for the delivery of dental care services. In so doing, a new pathway was cleared in which health center dental program infrastructure and capacity could expand so that patients could more easily access dental care services in their communities. As a result of this regulation, many health centers across the United States have been able to significantly increase their capacity to meet the dental needs of their patients.

Nearly 93% of HRSA's Health Center Program grantees provide preventive dental services either onsite or by paid referral. Between 2001 and 2020, HRSA-funded health centers increased the number of dental visits from 3.2 million to more than 11.3 million and the number of dental patients from 1.4 million to nearly 5.2 million (Health Resources and Services Administration 2021b). In FY 2016, 420 health center program grantees received nearly $156 million to expand oral health services as part of the FY 2016 Oral Health Service Expansion awards (Health Resources and Services Administration 2016).

More recently, in 2019 HRSA awarded more than $85 million to 298 health centers to expand their oral health service capacity through new infrastructure enhancements (Health Resources and Services Administration 2019b). These investments are the first by HRSA to focus solely on oral health infrastructure and will enable HRSA-funded health centers to provide new, or enhance existing, oral health services.

Figure 18. Status of Medicaid expansion decisions by state: United States, 2020



Notes: Current status for each state is based on Kaiser Family Foundation tracking and analysis of state activity.
◊ Expansion is adopted but not yet implemented in MO and OK.
Source: Kaiser Family Foundation (2021).

Provision of Oral Health Care in Nontraditional Settings

Fragmented care delivery continues to characterize much of the U.S. health care system. The resulting lack of access to care for many, as well as poor coordination among health care providers, exacerbates poor health outcomes and contributes to health disparities (Wasserman et al. 2019). Moreover, dental delivery systems and regulatory environments still emphasize and provide disproportional support for surgical interventions provided in high-cost surgical suites (Suga et al. 2014). One result is that the understanding and adoption of evidence-based prevention and conservative management approaches to dental caries management have been slow over the last 2 decades. This lag in adopting or advocating for effective but minimally invasive prevention interventions, such as silver diamine fluoride or fluoride varnish, limits the provision of dental services in nontraditional settings (care provided outside a traditional dental office) by public health dental hygienists, dental therapists, or others who may be more available than dentists.

Care delivery outside of traditional dental care facilities continues to be problematic. The need for adequate equipment, such as a dental operatory and patient safeguards such as infection control and privacy, often

creates financial and logistical barriers to providing care for some patients. The most important population in this regard is the institutionalized elderly or disabled, who often have limited or no mobility and may have significant oral health treatment needs. Although regular dental care delivered onsite would be possible for many, few long-term care facilities currently provide such care. In states where dental practice regulations permit care delivery by dental hygienists or other expanded-function professionals, some opportunity exists for onsite care.

Supply of Dental Services

In the past 20 years, several successful initiatives have been established to bridge the artificial separation between oral health and overall health by addressing the oral health knowledge gap in medical education, training medical personnel to look for oral disease and provide oral hygiene and dietary counseling, and engaging them in interprofessional practice. The Smiles for Life National Oral Health Curriculum, launched in 2005, covers oral health across the lifespan and is a free, open-access resource that provides continuing education credit for both medical and dental professionals (Society of Teachers of Family Medicine 2021). The curriculum, which is endorsed by 20 professional organizations, has more than 100,000 registered users. As of April 2021, more than 400,000 courses had been accessed for continuing education credit (Society of Teachers of Family Medicine 2021).

Medicaid pays medical providers in all 50 states and the District of Columbia for child oral health services, including fluoride varnish application (Pew Charitable Trusts 2011; Clark et al. 2014). The MORE Care program (DentaQuest) specifically trains rural primary care practices in primary and secondary oral health preventive services and provides technical assistance to integrate the work of medical teams and their oral health counterparts. Some of these programs also train general dentists who have not previously treated young children to start offering early childhood examinations and preventive services, particularly in rural areas where pediatric dentists are scarce (Colorado Department of Public Health and Environment 2020). Integration of oral hygiene counseling, dietary advice, and fluoride varnish application fits nicely into the well-child primary care conducted by rural family physicians, physician assistants, and nurse practitioners, provided the necessary additional time is built into their schedules or other clinical staff are trained to help.

Medical Settings

Better integration of dental and medical care could lead to more people receiving preventive dental services. Efforts to improve integration of medicine and dentistry have been slow to develop since 2000. Although interest has grown in the role that nondental health care providers and settings could play in improving oral health, dental care delivery within medical settings requires providers to have knowledge beyond what traditionally has been provided in their training. In response to this need, oral health curricular content in medical, nurse practitioner, and physician assistant programs has increased, and some family medicine residency programs have begun requiring rotations in dental clinics for resident physicians. However, the impact of increased curricular exposure on practice and patient outcomes remains unclear, especially in the absence of interoperable electronic health records, common referral processes, and insurance coverage (Dwiel et al. 2019).

The specific role of frontline medical providers in delivering dental care is still not well defined. However, it has become common for pediatric medical providers to apply fluoride varnish to children's teeth, a service that is recommended by the U.S. Preventive Services Task Force and universally reimbursed by Medicaid, as well as by most private insurers. Dental hygienist-led screening and preventive treatments, such as dental prophylaxis, have been successfully integrated into the pediatric primary care setting, including in the Colorado Medical-Dental Integration Project (Braun and Cusick 2016). Similar care models have been proposed for adult populations, although lack of insurance coverage for adults is a barrier to expanding equivalent services. Additional information on medical-dental integration is provided in Section 4.

Community Settings

Efforts to improve population health and reduce inequities, particularly for chronic diseases such as those often experienced by low-income and other vulnerable populations, can be enhanced through integration of community-based preventive service with professionally delivered clinical services as well as efforts aimed at increasing family-level engagement and empowerment

(Dietz et al. 2015). Delivery of clinical preventive services, long a focus of U.S. dental care, can be highly effective in addressing the chronic oral diseases of caries and periodontal disease. However, delivery of these services is largely dependent on access to routine dental care. Furthermore, financing for dental prevention is weighted toward the clinical interventions that focus on individual patient encounters with dental professionals. Community-based prevention programs, a foundation of public health, occur outside of the clinical care delivery system (e.g., water fluoridation, school-based programs, health-promoting policies). As such they do not rely on access to dental offices and generally reach a broader population and fill in gaps in access to prevention services, particularly for those individuals who do not regularly seek care in dental offices.

Sometimes overlooked is the important role of individual behaviors as contributors to oral disease prevention. As Dietz and others (2015) note, motivation and a supportive family environment are critical for developing and maintaining healthy behaviors and should be considered part of an integrated health care system. For example, community-level programs that reinforce the importance of appropriate self-care, such as toothbrushing with fluoride toothpaste and reduction of risky behaviors such as smoking, can provide broad benefits for population oral health.

Full integration across all levels of the health system will likely lead to optimal benefit for population health and reduction in oral health inequities. This requires that public and private policymakers at all levels (local, state, and national) create the environment that allows for maximum access to prevention services as well as access to health-promoting food and other conditions. Assuring that prevention efforts will benefit the broadest number of individuals and have maximum impact on population health generally depends on the degree to which prevention services are delivered at all levels. Coordination and integration can be especially important to ensure that low-income and other vulnerable populations receive the benefit of prevention interventions. As dental care delivery continues to evolve into more complex multi-provider systems of care and these systems integrate with primary medical care, new opportunities will arise for integration of clinical services with community programs.

Quality of Oral Health Care

The Triple Aim of health care articulated by Berwick and colleagues (2008)—improving the health of populations, improving patient experience with care, and reducing costs—laid the foundation for the value proposition in health care. A value-based system drives improvement based on outcomes relative to resource use and focuses particularly on those outcomes that are most important to patients (Porter 2010). Access, structure, and process measures that are associated with improved outcomes are useful tools for assessing and improving quality of care. Current oral health care performance measures fall largely in the process of care domain (Righolt et al. 2019). Ultimately, however, the true markers of success are whether patient and population outcomes have improved. Although several endeavors are beginning to identify tools to assess outcomes (Liu et al. 2016; FDI World Dental Federation 2018; Mittal et al. 2019), there are continued challenges in implementing data collection systems and infrastructure to aggregate clinical data from each patient encounter to ultimately achieve a population-level learning health system (Institute of Medicine 2013a).

Several areas offer promise for improving the quality of care, including the development of new dental diagnostic codes and clinical practice guidelines. Yet the adoption is slow in the majority of clinical practice settings. National metrics on oral health status, such as those within the federal Healthy People initiative and the CMS Child Core Set, offer promise for informing better oral health policy. However, at present, new policy initiatives aimed at improving access and prevention are not evident.

Oral Health Literacy

Interest in oral health literacy has increased substantially during the past 2 decades. Research on the relationship between health literacy and oral health shows that low levels of health literacy are correlated with poor oral health knowledge (Hom et al. 2012; Horowitz et al. 2013; Macek et al. 2017), suboptimal oral health behaviors such as limited use of preventive care (White et al. 2008; Bennett et al. 2009; Henderson et al. 2018), and negative oral health outcomes (Vann et al. 2010; Batista et al. 2017).

Ensuring that individuals understand what their medical and dental plans cover is important because out-of-pocket costs can discourage the use of dental services (Vujicic et al. 2016a). Many coverage options are now available. For example, some dental benefits are embedded in medical plans (Cousart et al. 2015). Dental services covered by commercial insurers and state Medicaid programs vary greatly (Willink et al. 2016), and their explanations of benefits can be confusing.

Informed consent is another essential aspect of patient care that requires participation among patients and providers. A patient's signature on a consent form, however, does not guarantee complete understanding of the risks, benefits, and alternatives associated with the proposed treatment (Kinnersley et al. 2013). A study of consent forms used for dental care indicated that the average American adult would have difficulty understanding most of them (Glick et al. 2010), suggesting that considerably more work is needed to ensure that all patients fully understand their options for dental treatment. Patients with low health literacy are less likely to understand to what they are consenting, although understanding of the consent process is poor regardless of literacy skills and may lead to unnecessary refusal of treatment (Aldoory et al. 2014). One study demonstrated the effectiveness of a simple teach-back technique to ensure comprehension of informed consent procedures for low health-literate populations (Sudore et al. 2006).

Effective communication is a patient safety issue. The medical community has long recognized the importance of health literacy in developing providers' skills for communicating effectively with patients to ensure safety. An Institute of Medicine (IOM) white paper describes 10 desirable attributes of a health-literate health care organization (Brach et al. 2012). These include preparing the workforce to be health literate, using health literacy strategies in interpersonal communications, and confirming understanding of health information at all points of contact. The Joint Commission initiated a public policy initiative in 2001 to address issues that could affect health care providers' delivery of safe, high-quality health care. In 2007, it launched a new perspective on the initiative, with a framework that highlighted health literacy as a way to protect patient safety. The framework has three components: (1) making effective communication an organizational priority to protect the safety of patients, (2) incorporating strategies to address patients' communication needs across the care continuum, and (3) pursuing policy changes that promote improved practitioner–patient communications (The Joint Commission 2007).

A culture of patient safety in dentistry involves not only making oral health information clear and accessible but also contextualizing that information in patients' lives. Dental providers who use effective communication techniques contribute to greater oral health literacy—the patients' ability to understand and act upon the information provided to improve their oral health (Horowitz et al. 2012; Maybury et al. 2013). Yet some studies show that dental providers continue to need support in using evidence-based communication practices with their patients (Rozier et al. 2011; Tseng et al. 2020). Furthermore, evidence suggests that dental and dental hygiene students graduate without the skills necessary to meet the literacy needs of their patients (Bress 2013; McKenzie 2014). Consequently, the Commission on Dental Accreditation (CODA) recently suggested a revision to its standards to include health literacy to help ensure that dental students are able to effectively communicate with their patients. Although CODA Accreditation Standards for Dental Hygiene Education include a standard that requires oral and written communication be included in the general education content, and another standard that requires graduates to have an understanding of how cultural influences can affect delivery of care, there are none specific to health literacy (Commission on Dental Accreditation 2018).

Educating the professional dental community about health literacy remains a major challenge. Environmental scans of health center dental clinics in Maryland showed that current practices related to oral health literacy lacked consistency (Horowitz et al. 2014). Prioritizing health literacy as a means to protect patient safety in dentistry starts with the dental education system and training future providers how to effectively communicate interpersonally with patients. Continued learning opportunities after graduation also may improve patient safety, as well as patient and population oral health status, and contribute to decreased disparities. Recent calls for required continuing education on health literacy and cultural competency for all dental providers is one

approach that may help to improve the use of effective communication techniques (Rozier et al. 2011; Bress 2013; McKenzie 2014).

In the only reported population-based study linking oral health literacy and attitudes toward population-level oral health promotion strategies, Curiel and colleagues (2019) showed that an increase of one standard deviation in health literacy scores predicted a 12% increase for support of community water fluoridation. There is evidence that health literacy may contribute to sociodemographic differences in oral health behavior. For example, Bennett and colleagues (2009) found that health literacy significantly mediated education disparities related to utilization of dental care among older adults.

In reviewing oral health literacy measurement, Dickson-Swift and colleagues (2014) identified 14 different measures used in 32 studies. However, the majority of investigators relied on one of two measures—the Rapid Estimation of Adult Health Literacy in Dentistry or the Test of Functional Health Literacy in Dentistry. There is a need for development and assessment of improved methods to measure oral health literacy across diverse populations. In addition, the mechanisms through which health literacy influences oral health in general and how health literacy might differ across social subgroups need to be clarified (Jones et al. 2016), because such understanding is required to appropriately target literacy interventions.

In 2010, health literacy became the focus of both national legislative efforts and federal agency research after the ACA was signed into law. The ACA emphasized the need to increase health literacy among the general public, especially for those with lower income and/or education levels (HealthCare.gov 2021). In addition, the Plain Writing Act of 2010 mandated that federal documents designed for public audiences (e.g., Medicaid applications) be written in plain language. The law specified that each federal agency should train employees in the use of plain language, create and maintain a plain writing section on the agency's website, and establish a process to oversee agency compliance (111th United States Congress 2010).

Two federal agencies also contributed to the national focus on health literacy. In 2010, the Agency for Healthcare Research and Quality published the first edition of the Health Literacy Universal Precautions Toolkit. A second edition was released in 2015 (Brega et al. 2015). The aim of the toolkit is to guide primary care providers in implementing system-wide changes to improve communication with, and support for, patients of all health literacy levels. In an earlier effort, in 2004, the National Institute of Dental and Craniofacial Research convened a workshop aimed at promoting the national oral health literacy research agenda. The workshop—which targeted researchers in oral health, cognition, adult education, and communications—served to educate the research community about the need to expand understanding of oral health literacy (National Institute of Dental and Craniofacial Research 2005).

More recently, the Healthy People 2030 national initiative increased attention to health literacy by making "increase the health literacy of the population" one of its overarching goals. The initiative also includes new definitions of health literacy that address both personal and organizational health literacy. Personal health literacy is defined as "the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others." The definition of organizational health literacy, which aligns with the U.S. Department of Health and Human Services' National Action Plan to Improve Health Literacy (U.S. Department of Health and Human Services 2010b), is "the degree to which organizations equitably enable individuals to find, understand, and use information and services to inform health-related decisions and actions for themselves and others" (U.S. Department of Health and Human Services 2020c).

Professional organizations also took a greater interest in health literacy as a public health concern. In 2010, the Oral Health Section of the American Public Health Association developed the policy "Health Literacy: Confronting a National Public Health Problem" (American Public Health Association 2010). The policy statement was broad; it urged Congress to require government documents to be written in plain language and urged federal and state agencies to increase health literacy among children in grades K–12 and train health providers in the use of recommended communication techniques. The American Dental Association (ADA)

established a National Advisory Committee on Health Literacy in Dentistry, part of the ADA's Council on Advocacy for Access and Prevention (formerly called the Council on Access, Prevention, and Interprofessional Relations). The committee developed a long-range plan that included providing education on health literacy at the ADA annual session, analyzing ADA's written patient materials to ensure they are written in plain language, and conducting surveys of their members' and dental students' use of recommended communication techniques (Rozier et al. 2011; Podschun 2012).

In 2013, the IOM Roundtable on Health Literacy published the proceedings of a workshop on oral health literacy (Institute of Medicine 2013b). Interestingly, when the roundtable was established in 2006, its membership included no dentists. In 2019, however, two dentists were active members and most of the roundtable's workshops now include a focus on oral health.

In 2000, oral health literacy was barely on the radar screen. Since that time, numerous instruments for measuring oral health literacy have been developed and investigators have pursued research aimed at understanding the link between health literacy and oral health. Health literacy has become a national priority, receiving attention from federal agencies, foundations, and professional organizations.

Oral Health and Quality of Life

Measures of oral health-related quality of life have been used in national surveys and as an outcome measure in clinical trials. In the case of population-based oral health surveys, the most widely used instrument has been the shortened version of the Oral Health Impact Profile (OHIP-14) (Slade 1997). The data from these studies have shed useful insights into the varying impacts of oral diseases and their treatment at the population level (Locker and Quinonez 2009; Benn et al. 2015; Parker et al. 2016; Zusman et al. 2016; Tsakos et al. 2017; Torppa-Saarinen et al. 2018; Masood et al. 2019). Developments during the past 20 years have enabled movement toward patient- and population-centered outcomes for several oral conditions and their treatments. These advancements align with the World Health Organization's conceptualization of health as more than the absence of disease, but a state of physical, mental, and social well-being (World Health Organization 1946). For example, pediatric oral health-related quality-of-life measures have been used to gauge the social impact of such conditions as early childhood dental caries (Tinanoff et al. 2019). Oral health-related quality-of-life measures have been used to assess the impact of dental care at the individual level, such as endodontic treatment (Neelakantan et al. 2019), implant-supported overdentures (Sharka et al. 2019), or orthodontic treatment (Ferrando-Magraner et al. 2019), as well as the impact of policies and programs at the population or community levels (Ha et al. 2012; Burgette et al. 2017; Ho et al. 2019; Seo and Kim 2019; Tomazoni et al. 2019).

Oral Health Surveillance for Population Health Planning

Public health surveillance provides data and information on the burden and distribution of disease and other health-related conditions. This information helps to monitor interventions and disease control measures that have been implemented to improve health, set public health goals, and assess for emerging conditions that might pose a threat to public health. In the past 2 decades, rapid advances in information technology have transformed our ability to use data for decision making, ushering in new fields of interest in health informatics, particularly in public health informatics (Groseclose and Buckeridge 2017).

Public health practitioners utilizing these informatics tools can have an important impact on the health and well-being of populations at local, state, and national levels (Friede et al. 1995; McNabb et al. 2006). Although the application of health informatics is substantially advanced in medicine and health care, it remains in an early stage of development in dentistry and oral health care. This presents several challenges. Many oral health surveillance activities in the United States are dependent on active surveillance measures, which are resource intense and are often periodic. Active surveillance also requires a substantial commitment to maintain the infrastructure. On the other hand, an ongoing passive surveillance system using informatics concepts can potentially provide more consistent and timely oral health data about population health for many important planning purposes. Such systems require greater

functionality within dental electronic health records than exist today. Nevertheless, enhanced investments in oral health monitoring and surveillance activities, including in dental public health informatics, could facilitate the evaluation of interventions and disease control measures and could lead to evidence-based approaches that improve oral health and reduce health disparities.

The goal of surveillance programs is to provide essential data for program planning and support efforts that lead to improved population health and decreased oral health inequities. The Association of State and Territorial Directors cautions that, to meet those goals, data collection alone is insufficient. Features that support an effective surveillance system include collection of standardized and actionable health information, rapid analysis and dissemination of findings, and buy-in from policymakers when policy solutions are indicated (Phipps et al. 2013).

Oral Health and National Security

The military continues to face challenges in meeting recruitment goals and military readiness because of oral health-related issues. Today, fewer than 1% of potential Air Force recruits are rejected because of extremely severe dental conditions. However, among new recruits entering the Air Force, nearly all have some level of unmet dental treatment needs, and about a quarter (23%) suffer from serious oral conditions that prevent them from deploying (Irwin 2019a).

In the deployed environment, disease and nonbattle injuries (DNBI) accounted for the majority (75%) of all casualties (Zouris et al. 2008). Of DNBIs, 15–22% were dental-related emergencies (Dunn 2004). During Operation Iraqi Freedom, nearly 17% of deployed members required acute dental care while deployed. In FY 2018, 20% of dental visits during deployment were emergency related (Irwin 2019b). These dental emergencies can risk a deployed unit's ability to complete a mission and require costly and dangerous medical evacuations by ground convoy, helicopter, and/or fixed-wing aircraft. In FY 2017, nearly one-fifth (18%) of all medevacs were the result of dental emergencies in locations where dental teams were not deployed, and each medevac cost an average of nearly $100,000.

Meeting recruitment goals for dental professionals is another challenge, with recruitment of oral and maxillofacial surgeons a particular challenge. Specifically, between FY 2012 and 2016, the Navy was not able to recruit additional oral and maxillofacial surgeons (U.S. Government Accountability Office 2018). Instead, the Navy maintained high levels of dental readiness by training the necessary oral and maxillofacial surgeons through in-house training programs fully accredited by CODA. Continued focus on recruiting and/or training the necessary numbers and types of oral health providers will be needed to maintain high levels of readiness.

The services, in turn, are reevaluating the number and specialty mix of uniformed providers needed to support the warfighting mission (Philpott 2019). This will include some reduction in total numbers of providers as those positions are transferred to warfighter roles to meet the Secretary of Defense's priorities. The intention is to use purchased care to handle the potential reduction in access to military facilities. It is unclear how this might affect dental wellness.

Over the past 20 years, the U.S. Navy has made significant progress integrating dental and medical care. The dental technician rating merged with hospital corpsman. Consequently, all active-duty enlisted personnel with assignments primarily related to dental care receive more advanced medical skills training and acquire greater understanding of how dental health relates to overall health and well-being. Additional training in oral health issues is now provided for the hospital corpsman. This allows greater flexibility and utilization of medical enlisted personnel and a broadening of individual career opportunities (U.S. Department of the Navy 2005).

The U.S. Air Force has made significant progress in improving the dental readiness of airmen over the past 2 decades. In 2001, nearly half (45%) of airmen had a dental readiness classification (DRC) of either DRC 2 or DRC 3 for oral health conditions that required treatment. By 2018, just 22% of the force had any current dental treatment needs. Similarly, over the last 2 decades, the percentage of airmen classified as high risk for caries has decreased 50% (from 11% in 2001 to 5.6% in 2017) (Schindler et al. 2021). Today, more than 95% of active-duty airmen are DRC 1 or 2 and dentally ready to deploy.

Tobacco smoking among airmen also declined substantially during this period—from 22% in 2001 to just 8.9% in 2017—a 60% reduction (Schindler et al. 2021). Although the prevalence of smoking historically has been higher in the military than in the general U.S. population, overall the prevalence of smoking today is actually lower among airmen (8.9%) than among the civilian population (14%) (Creamer et al. 2019). A key contributing factor to the decline in smoking includes intervention efforts of Air Force dentists through free smoking cessation programs for airmen. Air Force Dental Service (AFDS) providers are being trained to provide tobacco cessation counseling and related pharmacotherapy to tobacco and e-cigarette users. E-cigarette use is highly prevalent among youth and young adults, some of whom are beginning to enter the Air Force. Data from an ongoing Air Force public health assessment revealed that among all airmen, the prevalence of e-cigarette/vaping product use had risen from 5% to nearly 8% since October 2017. Studies indicate that e-cigarette use among young populations may increase the risk of using combustible and other types of tobacco products (Soneji et al. 2017). In the coming years, vaping/tobacco cessation interventions to aid cessation of tobacco use, including vaping products, by AFDS providers may be key to preventing an increase in overall tobacco use among airmen. In addition, the Air Force Dental Corps have developed certified tobacco treatment specialists who provide training to dental providers to improve access to smoking cessation treatments.

Chapter 3: Promising New Directions

Social Determinants of Health and Commercial Determinants of Health

Watt and colleagues (2014) argued that the social determinants of oral health disparities were the same as those associated with other health disparities, such as those related to diabetes and cardiovascular disease, and that improving social and economic conditions supported improvements in health generally, including oral health. For example, by improving someone's income and education, or by providing broader income supports and access to education for a population, it is reasonable to assume that improvements in diet and reductions in stress would occur. In turn, these improvements could be expected to reduce risks related to a broad array of diseases, including dental caries, periodontal disease, prediabetes, diabetes, metabolic syndrome, and hypertension.

Many of the social and commercial determinants of health are structural in nature. Alleviating the inequities they create will require interventions that focus not only on individual behavior and biological determinants of oral health but also on social and commercial determinants (Sabbah et al. 2009). This means that there is potential to mitigate inequities in oral health with large-scale policy changes that alter the structural determinants of health. These policy changes, including regulations supporting such issues as income security and food security, are politically challenging. However, these conversations are becoming more prevalent in societal and political discourse today.

Vulnerable Populations and Oral Health Disparities

Policy changes advanced by the Affordable Care Act (ACA) include promotion of the patient-centered medical home (PCMH) (Agency for Healthcare Research and Quality 2018). The PCMH emphasizes comprehensive and coordinated patient-centered care, accessible services, quality, and safety. However, dentistry has not yet become a significant partner in this initiative. As Wasserman and colleagues (2019) note, although the impact of the PCMH has not yet been empirically demonstrated, the increased emphasis of the PCMH on primary care, prevention, and community-based service delivery holds promise. Incorporating oral health services is a logical next step in the development of this initiative.

Rural Populations

Well-documented disparities in rural oral health outcomes have led to inquiry and innovation. Integration of oral health into primary care, interprofessional practice, teledentistry, school-based oral health services, and the addition of dental therapists to the dental professional workforce provide opportunities to reduce oral health disparities among rural populations (National Advisory Committee on Rural Health and Human Services 2018).

Integrating oral health into primary care is particularly important because primary care medical providers—particularly family medicine physicians and pediatricians—are widely distributed across the United States, including rural areas where they offer preventive care, early diagnosis of disease, and prompt referral when subspecialty care is indicated. Primary care medical providers, therefore, are well-positioned to work with dentists to comanage diseases with known oral-systemic connections, such as diabetes and periodontitis.

As rural areas acquire increased Internet bandwidth, telemedicine and teledentistry are becoming viable methods for delivering expertise to rural areas, saving patients the time and expense of travel, and expanding available services. In response, some states are modifying health care providers' scope of practice to accommodate virtual doctor-patient interactions. The Federal Office of Rural Health Policy, operating under the Health Resources and Services Administration, has more than doubled its budget since 2016 and provided substantial grant funding for teledentistry and mobile dentistry initiatives. These teledentistry models, such as California's virtual dental home, may expand access to dental care in remote and underserved areas, with the understanding that effective payment models and mechanisms for timely referral for more intensive dental needs will need to be developed (Glassman et al. 2014).

Opportunities to expand access and improve the rural dental safety net are being explored and developed. Because most professional practice policies are implemented at the state level, these include changes in state law related to scope of practice and the oral health workforce. An example of coalition building to advocate for change in state law to improve oral health is the Foundation for Health Leadership and Innovation, North Carolina Oral Health Collaborative. This collaboration brings together a diverse group of stakeholders focused on improving access to oral health care in rural areas and among populations with high oral health disparities (Box 2). Other states are amending their state practice acts to improve population health, including Pennsylvania, which now certifies public health dental hygiene practitioners to provide care in a variety of public health settings without the supervision or prior authorization of a dentist.

Expansion of dental therapy is another promising model, given the evidence of improvements in dental outcomes in rural areas where dental therapists practice (Koppelman et al. 2016b). Minnesota authorized a dental therapist program in 2009, and other states now have similar pending legislation regarding dental therapists. The original goal for developing this new category of oral health provider was to fill the unmet needs of rural and underserved children (Nash and Nagel 2005; Friedman and Mathu-Muju 2014b), but there is evidence that they also are helping to meet the needs of the rural elderly (Fish-Parcham et al. 2019), particularly those in extended-care facilities. Both school-based programs for children and extended-care facilities for the elderly exemplify population-based approaches to improving access to care by meeting people where they live, work, and play.

Program evaluations in Alaska and Minnesota found that the clinical care provided by therapists was clinically competent, appropriate, and provided in safe ways. An evaluation of the Alaska program by Chi and colleagues (2018b) found that villages that employed therapists had increases in access to dental services and prevention services and less need for extractions and treatment under general anesthesia. The success of these programs speaks to the potential of this model to benefit vulnerable rural populations in varied geographic settings.

Programs intended to recruit and train rural dentists also have the potential to create major improvements in rural access. Several dental schools have developed programs to incentivize dentists to practice in rural communities, including the University of Washington's RIDE program, the University of Minnesota's Rural Dental Scholars program, and the University of Mississippi's Rural Dentists Scholarship program. The National Health Service Corps (NHSC) scholarship and loan repayment programs support almost 500 rural dentists, although the number of dental providers in the program has not increased as substantially as that of other clinicians supported by the NHSC (Pathman and Konrad 2012). National rural primary care training programs—such as the HRSA-funded academic unit, Rural Primary Care Research, Education, and Practice—may serve as models for future rural oral health expansion (Rural Primary Care 2019).

Box 2. How can diverse groups of stakeholders collaborate to improve access to oral health care in their state?

The North Carolina Oral Health Collaborative (NCOHC), a program of the Foundation for Health Leadership & Innovation, was established in 2013 to increase access and equity in oral health care for North Carolina's most vulnerable populations. Policy advocacy is a major activity for NCOHC. By bringing together community organizations, professional societies, health providers, academics, and legislators, NCOHC leverages diverse perspectives for the development of evidence-based policy reforms. In 2020, NCOHC influenced a regulatory rules change that allows dental hygienists to provide preventive services (cleanings, x-rays, sealants, fluoride applications, screening) in high-need settings without a prior examination by a dentist. This change increases direct access, builds a culture of community-based dentistry, and brings care to people where they are.

In 2021, NCOHC and its key stakeholders drafted and introduced legislation in the North Carolina General Assembly to codify teledentistry in the state's Dental Practice Act. To support this pending change, NCOHC provided financial support to Federally Qualified Health Centers and local health departments for implementation of teledentistry.

NCOHC recently completed a 2-year community capacity building mini-grant initiative. Grants were awarded to seven organizations working with populations with high oral health disparities. Activities included NCOHC-organized events and trainings and focus group meetings to discuss local oral health needs. One of the goals was to develop the 2019–2024 North Carolina oral health change agenda, which was completed and published in 2019.

There now are more than 1300 partners and organizations in NCOHC. Current and former funders include the Blue Cross Blue Shield of North Carolina Foundation, The Duke Endowment, the Kate B. Reynolds Charitable Trust, and the CareQuest Institute for Oral Health (formerly the DentaQuest Partnership for Oral Health Advancement).

As already discussed, the existing rural primary medical care workforce could provide a substantial resource for improving rural oral health. Nationally, delivery of preventive oral health services within pediatric practices occurs at lower rates in rural communities (Geiger et al. 2019). Because of higher rates of primary medical—rather than dental—utilization, the primary medical care setting can serve as an access point for oral health screening, treatment, and referral (Davis et al. 2010; Caldwell et al. 2017). Several states with large rural populations have implemented integrated practice models, often focused on pediatric populations. In these models, such as North Carolina's Into the Mouths of Babes program (Pahel et al. 2011) and the Colorado Medical-Dental Integration Project (Braun and Cusick 2016), families receive preventive oral health care services and screening within the primary care setting (Blackburn et al. 2017).There are 4,500 rural health clinics widely distributed across the nation delivering primary medical care, but they currently are not required to provide preventive dental services. Adding dental services to the scope of care in these clinics would significantly expand the dental safety net (American Dental Education Association 2018) while efficiently leveraging existing resources and personnel.

Shifting the distribution of dentists from urban areas to rural communities is a longer term solution to improve rural access to oral health care. The task of producing more rural dentists is similar to that of producing rural physicians; both depend on a complex combination of admission preferences, curriculum, mentorship, personal lifestyle choices, and incentives (McFarland et al. 2010; Vujicic et al. 2016b). Dental schools could increase the use of a strategy that some medical schools have successfully implemented by creating rural tracks designed to attract, admit, and mentor students who are interested in rural practice and by creating residency programs targeted to the skills required for rural practice (Downey et al. 2010; WWAMI Rural Health Research Center 2012; Deutchman 2013; Suphanchaimat et al. 2016).

Low-Income Populations

Community water fluoridation achieved wide success in the mid-20th century for primary prevention of dental caries (Carstairs 2015). In the 21st century, community

water fluoridation has again captured national public health interest, this time for its effects in reducing socioeconomic disparities in dental caries. Not only does water fluoridation confer a protective effect beyond that offered by other sources of fluoride (Slade et al. 2018), it can especially benefit children in low-income families (Sanders et al. 2019). A study compared levels of dental caries in two groups of children: those living in counties where at least 75% of the population received optimally fluoridated drinking water, versus those in counties with a lower percentage of the population with fluoridated drinking water (Sanders et al. 2019). Findings showed that living in a predominantly fluoridated county reduced the magnitude of income disparities in dental caries. The findings are important from a health policy perspective. Efforts to expand population coverage of community water fluoridation that intentionally target counties with high concentrations of families with lower income could yield greater benefits in reducing both dental caries and income disparities in dental caries.

Black or African American Populations

In 2017, 21.2% of non-Hispanic Blacks in the United States lived below the poverty line—the highest of any racial group (Semega et al. 2018a). The median household income of non-Hispanic Blacks in 2017 was $40,258, the lowest of any racial group (Semega et al. 2018b). Thus, the substantial number of non-Hispanic Blacks potentially at risk for oral diseases by income and social pathways alone requires approaches that are geared more towards health equity. Health systems in the United States are starting to incorporate social determinants into health assessment protocols to learn more about which of these may be more influential to health (Gottlieb et al. 2014). In addition, health systems and organizations focused on both disease prevention and care provision are beginning to prioritize oral health through integrated care models and value-based care models (Solomon and Kanter 2018).

Hispanic Populations

Access to new datasets related to Hispanic population health has enabled new research. The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) dataset has several affiliated ancillary studies that explore specific topics in greater depth and have potential to further clarify the role of cultural factors in oral health. The HCHS/SOL has a sociocultural ancillary study with a subset of participants (Gallo et al. 2014) that included more validated cultural measures for a range of psychological stressors and resources than what was available in the main study. Several oral health analyses are underway that will advance the field's understanding of cultural factors among Hispanics in the United States. Advances in genomic studies related to the oral health status of adult Hispanics have been made in recent years, and HCHS/SOL data have been used in genome-wide association studies (GWAS) (Conomos et al. 2016). To date, published HCHS/SOL GWAS studies have focused on temporomandibular disorders (Sanders et al. 2017a), dental caries (Morrison et al. 2015), and chronic periodontitis (Sanders et al. 2017b). This new series of studies based on HCHS/SOL data will advance identification of the biologic/genetic factors associated with oral diseases for Hispanic Americans.

Level of acculturation and the influence of other cultural factors among Hispanic Americans are now being studied in greater depth to advance understanding of their relationships to oral health status and practices. For instance, familism, or *familismo*, is a core cultural concept that describes the importance of immediate and extended family in Latino families (Stein et al. 2014). Exploratory research is emerging on the role of *familismo* in an oral health context (Maupome et al. 2016). In the HCHS/SOL dataset, cultural factors related to ethnic identity (measured by a sense of belongingness) and acculturation were associated with oral health-related quality of life, although overall there were inconsistent patterns of association in adjusted models (Silveira et al. 2020).

American Indian and Alaska Native Populations

New dental care delivery technologies, such as teledentistry, can especially benefit remote-living American Indian and Alaska Native (AI/AN) populations (Glassman et al. 2012). Legislative approaches that address social determinants of health (SDoH) also are being developed. A bipartisan bill, the Social Determinants Accelerator Act of 2019 (H.R. 4004) (116th United States Congress 2019), was introduced in the U.S. House of Representatives (Luthi 2019) and although it was specifically related to Native Americans, it had the potential to benefit many population groups. The legislation would provide technical assistance to local, state, and tribal governments to develop innovative

approaches to provide services and improve outcomes (116th United States Congress 2019). A new framework encompassing SDoH in dental education emphasizes a need for reframing the current teaching structure to include health inequities, population health and diversity, and cultural competence (Tiwari and Palatta 2019).

The Indian Health Service (IHS) Loan Repayment Program is available to fund IHS clinicians to repay their eligible health profession education loans in exchange for an initial 2-year service commitment to practice in health facilities serving AI/AN communities. Opportunities are based on Indian health program facilities with the greatest staffing needs in specific health profession disciplines (Indian Health Service 2021c).

The IHS Scholarship Program provides qualified AI/AN health profession students an opportunity to establish an educational foundation for each stage of their preprofessional careers. Since IHS began providing scholarship support to AI/AN students to pursue health profession careers in 1978, the program has grown to support, educate, and place health care professionals within medically underserved Native American health programs throughout the continental United States and Alaska. Today, nearly 7,000 AI/AN students have received scholarship awards, and many have committed to serving their professional careers at IHS.

Oral Health for Those with Special Health Care Needs

There is a growing realization that dental services delivered in the community provide better dental access for vulnerable populations than do traditional brick-and-mortar dental care delivery systems. These services include using mobile and portable equipment, telehealth-connected teams to involve outside dentists, and allied oral health personnel applying aspects of modern prevention science, including minimally invasive treatment techniques. There is growing interest in integration of oral health activities into general health, educational, and social service settings. The integration of general health and oral health care systems will drive incentives to create better oral health for individuals with special needs or complex health conditions. The movement from volume to value will have particular impact on oral health care for this population.

Financing Dental Care

With flexibility built into the current system through Medicaid waivers and the capacity for value-added programs implemented by contracted dental health plans, we may see new initiatives aimed at providing better and more comprehensive oral health through Medicaid and Children's Health Insurance Programs. Moving toward value-based care, where providers are given incentives to improve the oral health of a population, may help to improve dental coverage gaps and increase access, especially for low-income and ethnic minority patients (Riley et al. 2019). There are other policy options available to expand dental insurance for working-age and older adults. Potential options include providing dental coverage for these adults as a mandatory benefit within Medicaid and Medicare, as well as considering dental care services for adults as essential services under the ACA.

Dental Care Delivery Models

Accountable Care Organizations (ACO) are promising models for furthering integrated oral health care. ACOs provide comprehensive medical services through a model that offers incentives for both cost reduction and quality, generally through a capitated mechanism with incentive bonuses for meeting baseline quality measures. ACOs have proliferated since the adoption of the pioneer Medicare ACOs in 2012 (Pham et al. 2014), based on systems developed in 2009 by Blue Cross Blue Shield in Massachusetts. Ten percent of Americans currently receive their care through an ACO utilizing both public and private insurance contracts (Muhlestein et al. 2018).

ACOs represent a seismic shift away from fee-for-service reimbursement in medicine. Given the emphasis on quality of care and the responsibility of the ACO for all member costs, ACOs may be incentivized to pursue innovative models of dental care if they result in cost savings or improved outcomes. Although promising, only about one-fourth of Medicaid ACOs and one-tenth of contract ACOs nationwide were responsible for dental costs and quality in 2015 (Colla et al. 2016). Even when oral health is included in ACO coverage responsibilities, dental care is most often reimbursed with conventional fee-for-service payments to contracted dental providers external to the ACO. A notable exception to this is Oregon's Medicaid ACO, which offers dental providers a

per-member per-month (PMPM) fee that is carved out of the global PMPM budget for ACO enrollees (Atchison et al. 2018).

Clinical innovation under the ACO umbrella lags even further—in 2015, only 4% of ACOs had integrated dental clinicians into their care teams. ACOs that have introduced oral health quality measures have been limited to process rather than outcome measures, and those in effect have only been applied to pediatric populations. For example, a quality measure used by the Massachusetts Medicaid ACO is the percent of beneficiaries under age 21 receiving an annual dental visit, and the Oregon Medicaid ACO provides bonuses for increased dental sealant rates among beneficiaries aged 6 to 14 years.

Addressing these concerns—by increasing the numbers of ACOs, fine-tuning reimbursement options, and offering incentives for clinical innovation—could make ACOs a valuable addition to dental care.

Oral Health Literacy

Improving the health literacy of the U.S. population holds great promise to improving utilization and choice of dental care, leading to better oral health outcomes. The foundational skills underlying health literacy, such as reading and math, are typically developed in the context of regular schooling. Consequently, it is likely that health literacy skills of any group will correspond with the overall quality of their education system. Implementing educational strategies shown to effectively enhance reading, numeracy, and verbal communication skills can help individuals better manage their oral health. Incorporating real-world, oral health-related tasks into educational efforts might be particularly valuable, increasing both underlying health literacy skills and oral health knowledge at the same time. A focus on real-world needs often is implemented in adult basic education (Murphy et al. 1996) and could be extended to other levels of the educational system.

Quality of Oral Health Care

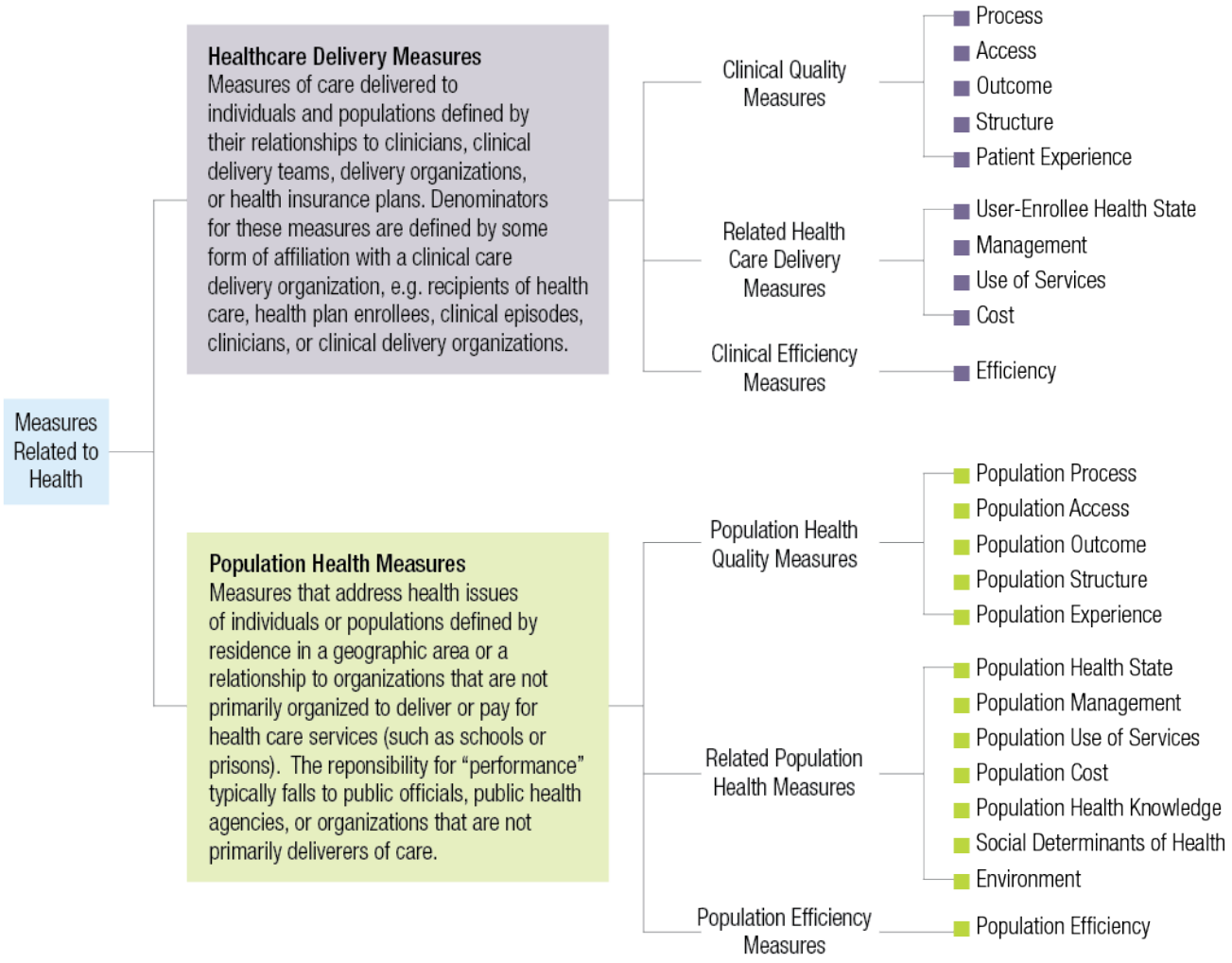
Quality oral health care delivery is advancing on several fronts. There is increased emphasis on the importance of full integration of medical and dental care as integral to a vision of Berwick's Triple Aim, which deploys new patient-centered quality metrics for improved planning and evaluation, better surveillance of population health, and reduced health care costs. Support for integration came from the Institute of Medicine report (2011) that recommended integration of oral health in planning, programming, policies, and research in all U.S. Department of Health and Human Services agencies and programs.

A necessary condition for integration is an interoperable electronic health record (EHR) capable of rapidly updating a patient's clinical status in a way that is accessible to members of the medical and dental teams. Jones and colleagues (2017) provided several examples of organizations that offer promising integration models. These include the U.S. Department of Veterans Affairs (VA), Kaiser Permanente (Permanente Dental Associates), HealthPartners, PACE programs, and some Federally Qualified Health Centers. A highly adaptable model that is not dependent on a unique health care delivery infrastructure is the DentaQuest Medical Oral Expanded Care program (CareQuest Institute for Oral Health 2021), which is both flexible and scalable. These models provide important guidance for others with interest in creating integrated health care.

Another innovation improving EHR effectiveness was motivated by state Medicaid policy requiring use of dental diagnostic codes (ICD-10 codes), now mandated in several states (American Dental Association 2015b). Requirements for diagnostic codes in private insurance are still evolving. Diagnostic codes are central to medical records and provide the foundation for assessing quality of care. As their use in dentistry increases, benefits for care integration and advancement toward the Triple Aim's goals will be supported.

A focus on population health outcomes requires attention to nonclinical determinants of health, as well as clinical determinants. The relevance of SDoH, such as poverty status, is explicitly recognized in the National Quality Measures Clearinghouse framework (Figure 19). Section 1115 of the Social Security Act promotes experimental or demonstration projects likely to forward the objectives of the Medicaid program. Population health outcomes and value are measured separately from health care treatment outcomes. Recognizing this, some states are successfully gaining approval for Centers for Medicare & Medicaid Services' 1115 demonstration projects to address the

Figure 19. National Quality Measures Clearinghouse (NQMC) domain framework



Source: Agency for Healthcare Research and Quality (2019).

SDoH as a pathway to realizing improved outcomes. The North Carolina Department of Health and Human Services is piloting a comprehensive program that targets such social determinants as housing instability, transportation barriers, and food insecurity (North Carolina Department of Health and Human Services 2018). Florida obtained a waiver to pilot the provision of housing support services for adult Medicaid beneficiaries with severe mental illness and substance use disorders who are homeless or at risk for homelessness (Florida Agency for Health Care Administration 2016).

Evidence-based dental practice initiatives aimed at improving the quality of care have grown steadily in recent years. Professional organizations are leading the way in developing clinical practice guidelines aimed at bringing the best evidence into the hands of clinicians in ways that facilitate application in routine clinical practice. The American Dental Association is a leader in this area, having supported development of a number of important guidelines related to prevention, conservative dental caries management, and appropriate antibiotic use, among others. See Section 4, Table 8 for more information.

Oral Health and Public Health Emergencies Planning

Public health emergencies can arise at any time from natural or man-made disasters and could have a serious impact on a community's oral health. Although the magnitude and severity of the impact on oral health can vary greatly, these emergencies often affect the more vulnerable, who already experience poor oral health and who are dependent, to the greatest extent, on the health care safety net. In the United States, preparing for these disasters requires substantial planning, investment, and ongoing discourse at federal, state, and local levels.

Preparedness can take many forms, ranging from addressing financial loss to providing health care (Kim-Farley 2017). A key barrier to health care preparedness typically is a lack of coordination across the spectrum of public health and health care communities and disciplines (Markenson et al. 2005). An example of a community overcoming numerous coordination barriers to include oral health care in emergency preparedness and response is Fulton County, Georgia, where the county health department includes oral health providers in planning for and responding to public health emergencies (Box 3).

The COVID-19 pandemic has revealed the necessity of having health care infrastructure and policy preparedness plans in place to successfully cope with widespread infectious illness across the country. Pandemics reveal inequities in health care access and availability that increase already existing health disparities in vulnerable communities and populations. Just as the HIV/AIDS epidemic forever changed infection control standards and guidelines in dentistry to prevent the spread of bloodborne pathogens (Kohn et al. 2003), COVID-19 may change infection control practices to control the spread of respiratory diseases among dental health care workers and patients. Many dental procedures generate large amounts of droplets and aerosols, which have been shown to be capable of carrying the coronavirus implicated in COVID-19 (Anderson et al. 2020; Ge et al. 2020). Most dental care facilities have not been designed to practice using airborne precautions, and few dental health care workers had prior experience with respirators before the onset of the pandemic. Clinical recommendations and guidelines are rapidly changing to address the new reality, and there is a strong possibility that long-term standards will establish administrative and engineering controls for aerosols. The increasing frequency of disease outbreaks attributable to viruses in recent years suggests that reduction and control of aerosols and droplets may become a permanent practice in the provision of oral health care.

Oral Health and National Security

A promising new direction in military oral health care is being adopted by the Veterans Health Administration, U.S. Coast Guard, and U.S. Department of Defense (DoD). It includes the modernization and integration of EHRs, which will allow service members to maintain the same record when transitioning care from DoD to VA. This will give health care providers a full picture of a patient's history since their start of active duty and will help identify those at increased risk for other issues, such as opioid addiction (U.S. Department of Veterans Affairs 2018).

To facilitate global continuity of care for service members by leveraging telecommunication and information technologies and collaborating with colleagues from the other services and the Defense Health Agency, the Navy is developing and testing a dental virtual health infrastructure (U.S. Department of the Navy 2019).

The Army is exploring incorporation of advanced information technology, such as voice recognition dictation, dental diagnostic coding, and electronic dental records, which could improve efficiency and quality of patient care by allowing rapid creation of a searchable dental record. Advances in nanotechnology could expand the use of salivary diagnostics beyond disease testing to real-time biometric monitoring of soldiers' physiologic function and hydration status (National Institutes of Health 2010).

The greatest impact on soldier wellness and readiness, however, would be accomplished with new methods to prevent or diagnose the root cause of more than half of all dental treatment needs and dental emergencies—dental caries. New technologies that allow for reliable and valid caries detection by nondental personnel would be of great value for screening, particularly in areas where dental professionals are not readily available. This would facilitate triage and referral for prevention or disease management interventions. An antiplaque peptide

Box 3. How does a community include oral health care in emergency preparedness and response?

Hurricanes and other emergency events can create serious challenges to receiving oral health care, particularly for vulnerable individuals. Including oral health professionals in planning for and responding to emergencies has created opportunities to improve access to care for residents of Fulton County, Georgia, and neighboring counties. While assessing the immediate health needs of persons moved to a temporary shelter during a hurricane, a dentist member of the local unit of the Medical Reserve Corps noticed that the health intake questionnaire did not include questions about oral pain or dental problems. Moreover, the membership of the local unit included physicians, nurses, pharmacists, and veterinarians but almost no dentists. Recognizing that dentists, with their advanced knowledge of oral health in the context of overall heath, could play an important role in emergency preparedness and response, the Fulton County Board of Health began recruiting dentists in 2019 to join their local Medical Reserve Corps. During the COVID-19 pandemic in 2020–2021, an additional group of 40 oral surgeons and dentists quickly stepped forward to join the Medical Reserve Corps to develop protocols for swab tests, administer diagnostic tests, and provide vaccinations. In another example of the county's response to an emergency that threatened access to oral health care in an adjacent county, Fulton County and Clayton County entered into a co-location of services agreement. When the Clayton County dental facility had to be closed because of mold, its staff relocated to a dental facility already operating in Fulton County. In the first 6 months of operation, 300 at-risk children from Clayton County received oral health services at the Fulton County facility. This collaboration marks the first time that two districts in Georgia have operated under a co-location of services agreement.

developed by the Army Institute for Surgical Research has demonstrated efficacy against biofilm-producing microorganisms and was recently incorporated into a chewing gum formulation to determine if it can prevent dental caries (Al-Ghananeem et al. 2017). The restoration of deeply cavitated carious lesions using minimally invasive treatment techniques and bioactive materials has the potential to preserve tooth structure, extend the retention and function of soldiers' natural dentition, and possibly help to manage urgent care needs in remote environments (Zhang et al. 2012; Schwendicke 2018; Aro et al. 2019; Pappa et al. 2019).

Chapter 4: Summary

There are several issues that influence oral health beyond the clinical realm in which dentists and their patients typically interact. By considering broad epidemiological, systemic, and policy perspectives and examining the best available data, it can be more clear where oral health is improving and where there is a continued need for concern and action (Box 4).

Many improvements in oral health have occurred in the past 2 decades. The prevalence of major oral diseases is declining. Access to care for low-income children has improved remarkably as a result of Medicaid and Children's Health Insurance Program reform and, more recently, for low-income adults through Medicaid expansion under the Affordable Care Act. Despite ongoing improvements in oral health, poor oral health continues to be highly prevalent and remains a major concern for many Americans. For example, since the release of the last Surgeon General's report on oral health in 2000, the current patchwork of dental care financing continues to create major gaps in access to affordable dental care for many vulnerable groups. These same groups tend to suffer disproportionate levels of dental disease, with little hope of obtaining needed care. Having large segments of society suffer from persistent untreated oral disease creates economic and societal costs that harm individuals, families, communities, and national security.

A new understanding has emerged that the causes of poor oral health are the result of complex interactions of determinants from many levels, including socioeconomic conditions and the food and beverage industries' targeting of vulnerable populations with sugary or low-nutrition food items. The result is unacceptable disparities in oral health among population groups. Although these distal health determinants have previously been recognized in some form or another, they are now identified in the conceptually, empirically, and policy unifying language of the social and commercial determinants of health.

Box 4. Key summary messages for the Effect of Oral Health on the Community, Overall Well-Being, and the Economy

- Good oral health supports overall health and well-being of individuals, families, communities, and the nation.
- Based on economic and social factors, some groups experience more disease and more barriers to care than the general population; the result is unacceptable, but reversible, inequities in oral health.
- Commercial interests play a dual role in affecting oral health, providing excellent products that support oral health, as well as products, such as tobacco and sugar-sweetened foods and beverages, that are detrimental to oral health.
- Lack of access to regular dental care can result in ineffective and expensive overuse of emergency departments.
- Poor oral health reduces the economic productivity of society by limiting participation in the workforce, as well as by increasing health care costs.
- Untreated oral disease can postpone entry to military service or delay deployment of troops to active duty, thus jeopardizing the nation's military readiness.
- Natural disasters, the emergence of novel pathogens, such as COVID-19, and other large-scale emergencies underscore the need for public-private partnerships that plan and ensure the continued delivery of essential oral health care in times of crisis.

Call to Action:

- Policy changes are needed to reduce inequities in oral health status and care, ensuring that all Americans can enjoy the benefits of good oral health.

Lack of access to dental care continues to be a barrier to good oral health, especially among poor and rural communities, and has led to the increased use of emergency departments and urgent care facilities that can only provide palliative, not comprehensive, care.

As a consequence of these developments, policy reform is urgently needed to resolve the structural barriers that allow oral disease and oral disease inequities to persist. This requires that attention be directed toward social and commercial determinants that discourage healthy behavior and nutritional choices and fail to guarantee access to care for all. The benefits of these reforms will more than justify the costs. However, these policy actions will be politically challenging because they are embedded in larger debates about social and economic organization and will require us to engage in highly sensitive conversations about the ways in which historical, and still broadly based, biases create structural racism even in social and health care systems that are intended to support the well-being of all.

Fortunately, compared to 20 years ago, there is better understanding of where remedies are needed. Improved models of disease etiology have identified many new targets for public health and public policy interventions. Increased understanding of the importance of social determinants of health and the common risk factor approach provides a strong rationale for more upstream solutions. There is a broadening consensus that health care practices and patient outcomes would benefit from greater dental and medical integration. The technology infrastructure also is available to support that integration. The growing emphasis on quality metrics and value-based payments is prompting more emphasis on evidence-based practices, health literacy, patient-centered care, and population health outcomes. There also is compelling evidence that was not available 20 years ago that oral health conditions in the population have an economic cost in terms of employability and lost school days.

Looking forward, it is clear that a variety of stakeholders have important roles to play. Policymakers should understand the importance of oral health to individuals, families, and communities and recognize its importance in overall well-being. Significant human suffering and economic costs arise from dental policy neglect. All health care professionals should understand that oral health IS health and that they each have a vital role to play in

helping individuals stay healthy. Alongside dental associations and other professional and advocacy groups, all health professions should have the opportunity to advance health promotion and oral health policy.

There is no question that high-quality dental services are routinely delivered in dental offices every day to a majority of Americans. However, significant numbers of Americans are unable to access this care. Approaches that include care outside of the dental office—in places such as nursing homes, schools, and community health centers—should be considered to ensure full access to everyone with oral health care needs. Further, providers and educators must communicate to members of their communities an understanding of the value of oral health and provide incentives for engaging in the healthy behaviors that will help to avoid chronic diseases or to assist in managing them. Most importantly, dentists, other oral health and health care professionals, insurers, and legislators need to understand that healthy behaviors are best achieved by improving social and living conditions and providing equal opportunity to live a good life. None of this is easy, but all of it is necessary to achieve a just and equitable system of health care that provides for everyone's needs, including the experience of good oral health.

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