

revenues. The Head Start programs of the Administration for Children and Families (ACF) provide health education services and in some cases may pay for oral care services for enrolled low-income children 5 years old and younger.

Many organizations have activities that could be used to promote oral health, given appropriate collaboration. In this regard, studies of the federal oral health infrastructure have emphasized the need for federal programs to maximize partnerships within and beyond the federal government. A 1989 report recommended increasing the capacity of USDHHS agencies to direct dental expertise to programs that can affect oral health or dental care, and establishing a mechanism for coordinating programs and sharing expertise across agencies. The report recommended that a national advisory committee be established to assess opportunities, accomplishments, and needs (USDHHS 1989). A 1994 report determined that the collection and analysis of data related to oral health and dental care had not been maintained at a level consistent with analogous general health and health care data used for public program planning, development, and evaluation (SysteMetrics, Inc. 1994). Despite some progress, many of the recommendations of these reports have not been implemented; thus many of the deficiencies noted have not been fully addressed.

Table 9.2 presents the scope of services and activities supported by USDHHS agencies. It identifies each agency's principal activities in terms of the "essential public health services" conducted at federal, state, and local levels. The approximate fiscal year 2000 funding levels provide a sense of how the proportion of oral health programs varies across agencies.

Local public health departments, community health centers, nongovernmental organizations, dental schools, and volunteer groups are examples of entities that implement oral health programs in association with government agencies and the private sector. These collaborations are enhanced by state oral health programs as they direct and integrate public health services. Not every state health agency has an oral health program, however. Further, not all state oral health programs have sufficient resources to address oral health needs. For example, although 31 states and five territories currently have full-time state dental directors, in 20 states (including the District of Columbia), the state dental director positions are part time or vacant. Additionally, 21 states, with 67 million people, have two or fewer full-time equivalents staffing a state oral health program. In 25 states, fewer than 10 percent of the counties have oral health programs in their local health departments (ASTDD 1999).

The Association of State and Territorial Dental Directors (ASTDD) recently assessed the resources needed to achieve the objectives in Healthy People 2010. The study focused on the gaps in infrastructure and capacity of state oral health programs. Infrastructure consists of the systems, people, relationships, and resources that would enable state oral health programs to perform public health functions. Capacity describes the expertise and competence needed to enable the implementation of strategies. Box 7.3 describes the essential public health services for oral health in the areas of assessment, policy development, and assurance as noted in ASTDD's Guidelines for State and Territorial Oral Health Programs. In particular, states have high needs for oral health surveillance systems and staff with epi-

TABLE 9.2
Scope of essential public health services supported by agencies of the U.S. Department of Health and Human Services

	AHRQ	CDC	FDA	HRSA	IHS	NIH	HCFA	ACF
Monitor health status to identify and solve community health problems	X	X			X	X		
Diagnose and investigate community health problems		X		X	X			
Educate and empower people about health issues	X	X	X	X	X	X	X	X
Develop policies and plans that support individual and community efforts		X		X	X			X
Enforce laws and regulations that protect health and ensure safety			X				X	
Link people to personal health services; ensure provision of care when otherwise unavailable				X	X		X	X
Ensure a competent public health and personal health care workforce	X	X		X	X	X		
Evaluate effectiveness, accessibility, and quality of personal and population-based services	X	X		X	X		X	X
Conduct research for new insights and innovative solutions to health problems	X	X	X	X		X		
Oral health component (FY 2000) (\$ millions)	<1	<10	<3	<150	<80	<250	2000	<10
Total agency budget (FY 2000) (\$ billions)	>0.2	3.1	1.4	4.2	2.8	16	343	38
Oral health as proportion of agency budget	<0.5%	0.3%	0.2%	0.3%	3%	1.5%	<0.2%	<0.1%

Sources: Data from PHS Oral Health Coordinating Committee, personal communication, 2000, Public Health Functions Steering Committee 2000.

demologic and other public health expertise (ASTDD 2000). Similar gaps occur in many local public health departments that lack adequate oral health programs or appropriately trained personnel (USDHHS 2000).

Public health agencies at all levels have identified disparities in oral health and access to care, in terms of both population subgroups and geographical areas. In 1998, there were 1,036 dental Health Professional Shortage Areas (HPSAs), which required 3,984 dentists. Of 686 consolidated Community Health Center grantees, 385 (or 56 percent) provide dental services (J. Anderson, HRSA, personal communication, 1999).

Community Health Centers provide preventive and basic dental care to 1.2 million patients nationwide (HRSA 1998). Health Centers are located in medically underserved urban and rural areas and target low-income, migrant, homeless, and other disadvantaged populations. Individuals pay for dental services on a sliding fee scale adjusted by their ability to pay. Health Centers are a primary source of care for 2.84 million Medicaid-eligible individuals, who make up 33 percent of Health Center clients. An additional 3.55 million uninsured patients represent 41 percent of their clients (HRSA 1998). Health Centers that provide oral health care include it as part of an integrated primary care system. In addition, federal programs such as the National Health Service Corps offer scholarships and loan repayment opportunities to encourage newly licensed dentists to locate in underserved areas.

Areas of Overlap

The various components of oral health care work together in diagnosis, prevention, and treatment services. As mentioned above, dental and medical specialists work on teams treating patients with craniofacial birth defects. Oncologists, radiologists, otolaryngologists, plastic surgeons, and surgeons specializing in head and neck surgery similarly may partner with oral and maxillofacial surgeons and prosthodontists in treating oral and pharyngeal cancers and other tumors of the oral cavity and pharynx. Dentists also are active members of general oncology teams. They participate in the examination of patients about to undergo chemotherapy, radiation, or bone marrow transplantation, for example, to ensure that proven preventive measures are taken before treatment to minimize the effects of the therapy on the oral mucosa, salivary glands, and dentition.

Private medical and public health professionals often collaborate in implementing immunization

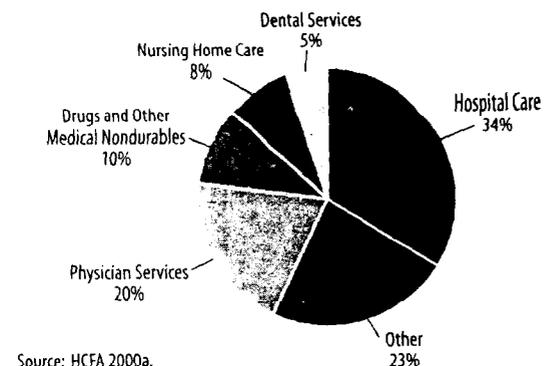
programs and other preventive strategies to reduce a specific disease or to change risk behaviors. Similarly, dental personnel in the private and public sectors cooperate in the implementation of mouthguard programs for sports injury prevention, statewide programs to apply sealants to the teeth of low-income children, and the promotion of oral health self-care behaviors. Private practitioners can deliver care that is paid for by public programs or can work as contractors to Migrant and Community Health Centers and local health departments, among others. Finally, all three components can work together to promote programs that address cross-cutting issues such as tobacco cessation and the prevention and control of HIV disease, oral and pharyngeal cancers, and early childhood caries.

EXPENDITURES FOR ORAL HEALTH CARE

The \$1.1 trillion spent in the United States on health care services in 1998 includes the cost of hospital care, physician and dental services, home health care, nursing home care, prescription drugs, medical equipment, private health insurance, public health activities, and research and represents an increase of 5.6 percent from 1997 (HCFA 2000b). Analysts project that this amount will double by 2007 to total more than \$2.1 trillion (HCFA 2000a).

Expenditures for dental services in the United States in 1998 were \$53.8 billion, a 5.3 percent increase from 1997 and 4.7 percent of the total spent on health care that year (Table 9.3 and Figure 9.2). This figure is an undercount, however, because it represents only those costs associated with care delivered by dentists in practice settings. A generation earlier, in 1960, \$2 billion was spent on dental care, which represented 7.3 percent of that year's total

FIGURE 9.2
Dental services as a percentage of total U.S. health care expenditures by type of service, 1997



health care expenditures. During the 1970s, dental expenditures grew at approximately the same rate as personal health care expenditures, with both exceeding the growth of the economy overall. But starting in 1978, dental expenditures began to flatten and, until 1994, increased more slowly than expenditures for personal health care. Since 1994, dental expenditures have increased at a higher rate than personal health care expenditures (Levit et al. 1998).

Real per capita dental care expenditures (1995 dollars) are currently at about the level they were in the early 1980s, and in some years have declined (Figure 9.3) (ADA 1997b, Beazoglou et al. 1993, Beazoglou 1998). The American Dental Association estimated that \$174.12 was spent per capita in 1995 for dental services (ADA 1997b); HCFA estimated the same year's per capita consumer expenditures for dental services at \$164 (U.S. Bureau of the Census 1998).

The annual percentage change in fees for medical, physician, and dental services as measured by the Consumer Price Index (CPI) has generally exceeded that for the index as a whole (U.S. Bureau of Labor Statistics 1999) (Table 9.4 and Figure 9.4). Percentage changes in the dental CPI have generally

followed those for other medical services; since 1983, however, prices for dental services have increased at a rate faster than those for physician and all medical services. These trends signal different market forces for dental care services as compared to other health services.

In addition to dental care expenditures for services provided by dentists in practice settings, the full cost of oral health care in the United States must take into consideration the breadth of oral, dental, and craniofacial conditions for which services are provided in hospital and other institutional settings, often by nondentists. For example, the Healthcare Cost and Utilization Project (2000) estimated inpatient hospital charges for diseases of the mouth and disorders of the teeth and jaw to be \$451 million in 1996. Estimates for the management of severe early childhood caries range from \$1,500 to \$2,000, depending on whether hospitalization is necessary (Griffin et al. 2000, Kanellis et al. 2000). In Iowa the average cost of treating this condition in a hospital operating room was estimated to be \$2,578 (Damiano et al. 1996). In California, the lifetime cost per case for cleft lip/palate repair is estimated at \$101,000 (Waitzman et al. 1996).

TABLE 9.3
U.S. national health expenditures by source of funds and type of expenditure, 1998 (\$ billions)

	Total	Private					Government		
		All Private Funds	Consumer				Total	Federal	State and Local
			Total	Out of Pocket	Private Insurance	Other			
National health expenditures	1,149.1	626.4	574.6	199.5	375.0	51.8	522.7	376.9	145.8
Health services and supplies	1,113.7	613.4	574.6	199.5	375.0	38.8	500.4	360.4	140.0
Personal health care	1,019.3	574.5	536.5	199.5	337.0	37.9	444.9	343.6	101.3
Hospital care	382.8	149.9	130.9	12.8	118.0	19.1	232.9	187.4	45.5
Physician services	229.5	156.2	151.7	35.7	116.0	4.5	73.3	60.8	12.4
Dental services	53.8	51.5	51.3	25.8	25.5	0.2	2.3	1.3	1.0
Other professional services	66.6	52.4	47.4	27.2	20.2	5.0	14.2	11.2	3.0
Home health care	29.3	13.7	10.0	6.0	4.0	3.7	15.5	13.1	2.4
Drugs and other medical nondurables	121.9	103.1	103.1	55.4	47.8	—	18.8	10.7	8.1
Vision products and other medical durables	15.5	9.0	9.0	8.2	0.8	—	6.5	6.4	0.1
Nursing home care	87.8	34.8	33.2	28.5	4.7	1.6	53.0	35.4	17.7
Other personal health care	32.1	3.8	—	—	—	3.8	28.3	17.1	11.2
Program administration and net cost of private health insurance	57.7	38.9	38.0	—	38.0	0.9	18.8	12.6	6.2
Government public health activities	36.6	—	—	—	—	—	36.6	4.2	32.4
Research and construction	35.3	13.0	—	—	—	13.0	22.3	16.5	5.8
Research	19.9	1.6	—	—	—	1.6	18.3	15.5	2.8
Construction	15.5	11.5	—	—	—	11.5	4.0	1.0	3.0

Note: Research and development expenditures of drug companies and other manufacturers and providers of medical equipment and supplies are excluded from research expenditures, but are included in the expenditure class in which the product falls. Numbers may not add to totals because of rounding.
Source: HCFA 2000b.

FINANCING AND REIMBURSEMENT

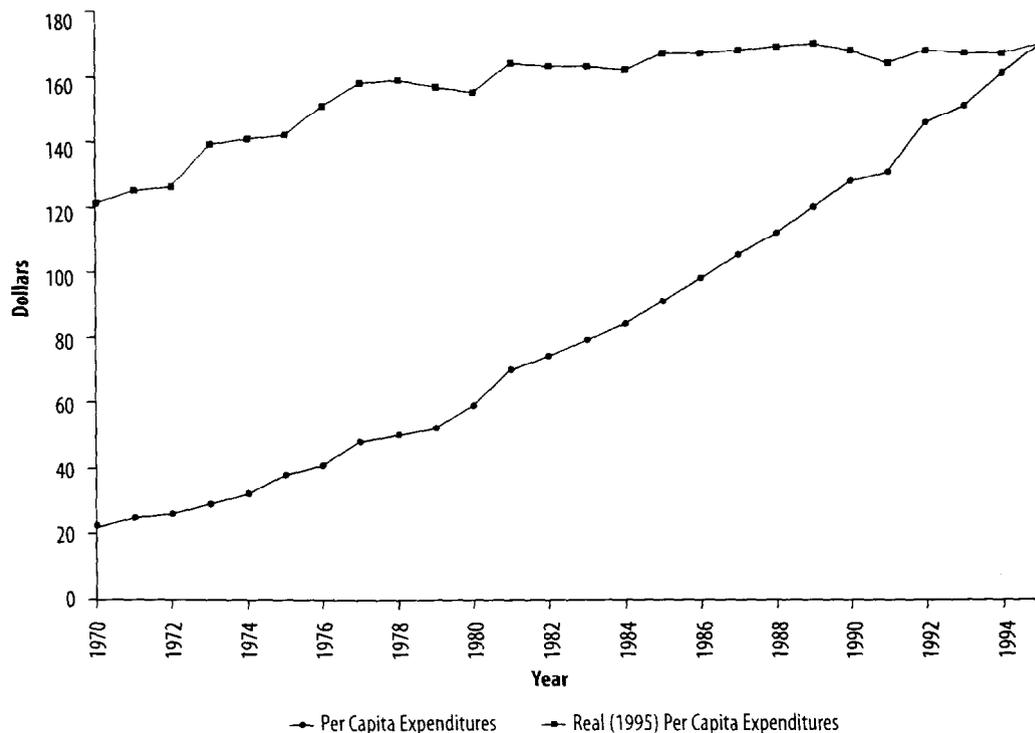
Dental care is financed principally through private sources, either as out-of-pocket payments made directly to the dentist or through employment-based dental insurance benefits. Since 1960, these two sources have financed over 93 percent of all dental expenditures (Figure 9.5). Table 9.5 shows the change in contributions for dental expenditures from 1970 to 1996. The proportion of dental expenditures that private dental insurance covers has increased over the past two decades. Dental insurance now contributes about 48 percent of dental expenditures, as compared to 50.1 percent contributed by medical insurance for physician services. In contrast, the percentage of out-of-pocket payments for dental services is over 3 times that for physician services (Figure 9.6). Sharp differences are also evident in terms of federal, state, and local government contributions to the cost of dental care as compared to physician services. Only 4.0 percent of dental care costs, or \$2.3 billion in 1998, is financed publicly (largely through federal-state Medicaid programs), compared to 32.2 percent for medical care. Few hospital dental services are reimbursed by Medicare, and state Medicaid programs may provide low reimbursement for dental

services. In contrast, public sources pay a large part of hospital costs for medical care.

Insurance

Insurance is a major determinant of dental utilization: 70.4 percent of individuals with private dental insurance reported seeing a dentist in the past year, compared to 50.8 percent of those without dental insurance (Bloom et al. 1992). Private dental care benefits are available to most full-time employees (59 percent) in medium-sized and large businesses. Fewer small businesses offer dental benefits. For the 22.6 million employees with employer-provided dental benefits, dental care may be offered as part of a comprehensive medical and dental plan or as a separate plan. Firms often offer employees a choice of medical plans as well as a separate dental plan that can accompany any medical plan. For employees with employer-provided dental benefits, 81 percent received care through fee-for-service plans, 11 percent from preferred provider organizations, and 8 percent from health maintenance organizations (HMOs) in 1998 (EBRI 1998).

FIGURE 9.3
Per capita dental expenditures in current and real (1995) dollars, United States, 1970 to 1995



Sources: U.S. Bureau of the Census 1998, U.S. Bureau of Labor Statistics 1999.

Provision of Oral Health Care

Most participants in employer dental plans receive benefits through a fee-for-service plan, which reimburses patients or providers after services are received. Such plans are commonly obtained through a commercial insurer, or are self-insured (the firm sets aside funds to meet expected charges), or are a combination of the two. Among self-insured plans is a type of dental plan called direct reimbursement, which enables patients to pay the dentist directly based on what they have been charged. The patients

are reimbursed by the plan based on their expenditures, up to a predetermined limit for total expenditures, but not according to the type of service they receive.

Dental insurance plans that reimburse dentists by type of service performed typically cover technical procedures but not counseling services, treatment planning, or disease management. Diagnostic and preventive care usually includes dental examinations, prophylaxes, sealants, and radiographs. Restorative

procedures may be limited to fillings, but may include crowns. Other services that may be covered include periodontal care, endodontic care, prosthetics, and oral surgery. Orthodontic care is covered less often by dental plans than are other procedures. In addition, most plans limit orthodontic coverage to dependent children and set maximum allowable payments. Dental implants, cosmetic procedures, and some preexisting conditions typically are not covered.

Dental insurance plans are similar to medical plans in defining the terms of payment on a fee-for-service basis. Typically, they may pay a percentage of the fee; they may pay up to a specified dollar amount using a table of allowances; they may require the patient to pay initial costs up to a fixed amount (a deductible); or they may pay a varying percentage of dental charges, based on a patient's past use of dental services. In all cases, the patient pays the difference. Copayments are a larger percentage of the total cost of dental care than is the case for medical care.

Dental coverage varies by race/ethnicity, income, and educational levels. Whites (41.8 percent), people with 13 years or more of education (51.4 percent), and families with annual incomes of \$35,000 or more (60.8 percent) have the highest percentage of insurance coverage in their demographic categories (Figure 9.7). Hispanic individuals have the lowest percentage of coverage

TABLE 9.4
Consumer Price Index for dental services, physician services, all medical care, and all items, United States, 1960 to 1997

	Dental	Physician	All Medical	All Items	Dental/ Physician	Dental/ All Medical	Dental/ All Items
1960	27.0	21.9	22.3	29.6	1.23	1.21	0.91
1961	27.1	22.4	22.9	29.9	1.21	1.18	0.91
1962	27.8	23.1	23.5	30.2	1.20	1.18	0.92
1963	28.6	23.6	24.1	30.6	1.21	1.19	0.93
1964	29.4	24.2	24.6	31.0	1.21	1.20	0.95
1965	30.3	25.1	25.2	31.5	1.21	1.20	0.96
1966	31.3	26.5	26.3	32.4	1.18	1.19	0.97
1967	32.8	28.4	28.2	33.4	1.15	1.16	0.98
1968	34.6	30.0	29.9	34.8	1.15	1.16	0.99
1969	37.1	32.1	31.9	36.7	1.16	1.16	1.01
1970	39.2	34.5	34.0	38.8	1.14	1.15	1.01
1971	41.7	36.9	36.1	40.5	1.13	1.16	1.03
1972	43.4	38.0	37.3	41.8	1.14	1.16	1.04
1973	44.8	39.3	38.8	44.4	1.14	1.15	1.01
1974	48.2	42.9	42.4	49.3	1.12	1.14	0.98
1975	53.2	48.1	47.5	53.8	1.11	1.12	0.99
1976	56.5	53.5	52.0	56.9	1.06	1.09	0.99
1977	60.8	58.5	57.0	60.6	1.04	1.07	1.00
1978	65.1	63.4	61.8	65.2	1.03	1.05	1.00
1979	70.5	69.2	67.5	72.6	1.02	1.04	0.97
1980	78.9	76.5	74.9	82.4	1.03	1.05	0.96
1981	86.5	84.9	82.9	90.9	1.02	1.04	0.95
1982	93.1	92.9	92.5	96.5	1.00	1.01	0.96
1983	99.4	100.1	100.6	99.6	0.99	0.99	1.00
1984	107.5	107.0	106.8	103.9	1.00	1.01	1.03
1985	114.2	113.3	113.5	107.6	1.01	1.01	1.06
1986	120.6	121.5	122.0	109.6	0.99	0.99	1.10
1987	128.8	130.4	130.1	113.6	0.99	0.99	1.13
1988	137.5	139.8	138.6	118.3	0.98	0.99	1.16
1989	146.0	150.1	149.2	124.0	0.97	0.98	1.18
1990	155.8	160.8	162.8	130.7	0.97	0.96	1.19
1991	167.4	170.5	177.0	136.2	0.98	0.95	1.23
1992	178.7	181.2	190.1	140.3	0.99	0.94	1.27
1993	188.1	191.3	201.4	144.5	0.98	0.93	1.30
1994	197.1	199.8	211.0	148.2	0.99	0.93	1.33
1995	206.8	208.8	220.5	152.4	0.99	0.94	1.36
1996	216.5	216.4	228.2	156.9	1.00	0.95	1.38
1997	226.6	222.9	234.6	160.5	1.02	0.97	1.41

Source: U.S. Bureau of Labor Statistics 1999.

TABLE 9.5
U.S. national expenditures on dental services, 1970 to 1996 (\$ millions)

	Total Dental Expenditures	Out-of-Pocket Payments	Private Health Insurance	Other Private Funds	Public Funds (Medicaid, etc.)
1970	4,669	4,240	212	0	217
1971	5,181	4,672	248	0	261
1972	5,516	4,934	292	0	290
1973	6,323	5,605	378	4	336
1974	7,076	6,130	550	7	389
1975	7,956	6,530	939	11	475
1976	8,972	6,965	1,486	15	506
1977	10,055	7,582	1,908	19	547
1978	10,957	7,918	2,504	22	512
1979	11,893	8,237	3,072	27	557
1980	13,323	8,833	3,811	27	652
1981	15,698	10,082	4,839	39	738
1982	16,953	10,547	5,737	43	626
1983	18,271	11,010	6,578	44	639
1984	19,833	11,578	7,613	51	591
1985	21,650	12,243	8,682	73	653
1986	23,108	12,658	9,677	81	693
1987	25,343	13,118	11,409	86	730
1988	27,460	13,845	12,758	94	763
1989	29,496	14,485	14,115	110	786
1990	31,566	15,389	15,134	124	919
1991	33,348	16,139	15,948	134	1,127
1992	37,013	17,782	17,686	143	1,402
1993	39,099	18,647	18,398	154	1,900
1994	41,665	19,727	19,798	167	1,974
1995	44,695	21,007	21,477	173	2,038
1996	47,551	22,116	23,166	183	2,086

Source: HCFA 2000b.

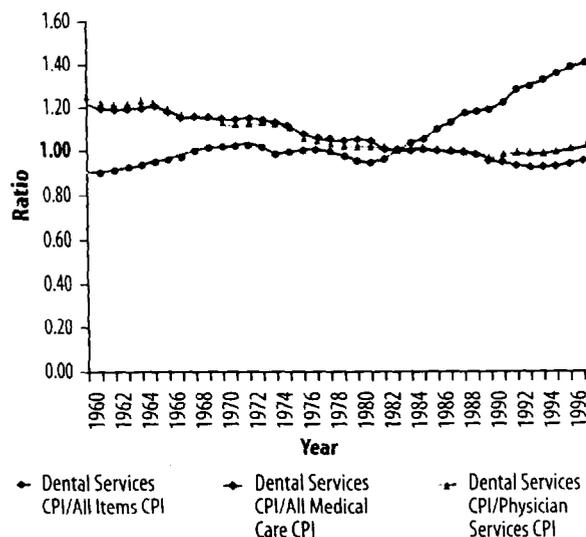
(29.7 percent), followed by blacks (32.4 percent), a pattern seen in medical insurance as well. Because private dental insurance is typically an employment-related benefit, some individuals lose their dental coverage when they retire. As a consequence, people 65 and older reported the lowest levels of coverage (NCHS 1992).

Although over 14 percent of children under 18 have no form of private or public medical insurance, more than twice that many, 23 million children, have no dental insurance (Vargas et al. 2000). Over 15 percent of persons 18 and older have no form of medical insurance, but 3 times as many, over 85 million persons, have no form of dental insurance (NCHS 2000).

The Changing Market

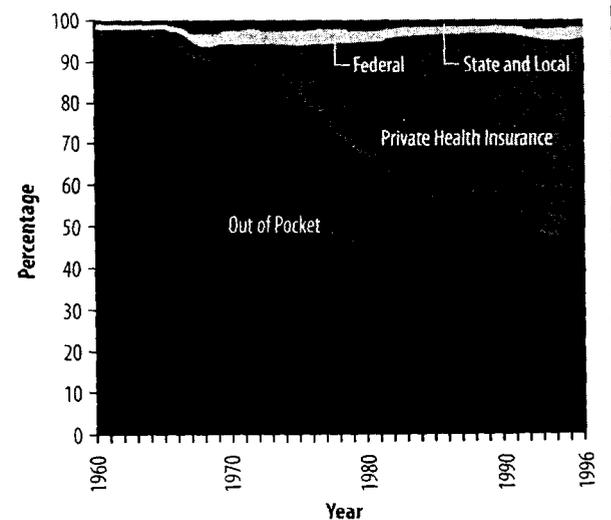
Increasingly, private dental insurance plans are entering into contractual agreements with dentists. The purpose of these agreements is to shift some or all of the financial risk to the clinician, the beneficiary, or both. These alternative

FIGURE 9.4
Ratio of dental services CPI to physician services CPI, all medical care CPI, and all items CPI, 1960 to 1997



Source: U.S. Bureau of Labor Statistics 1999.

FIGURE 9.5
Percentage of total U.S. dental expenditures by source and year, 1960 to 1996



Sources: HCFA 2000b, U.S. Bureau of the Census 1998, U.S. Bureau of Labor Statistics 1999.

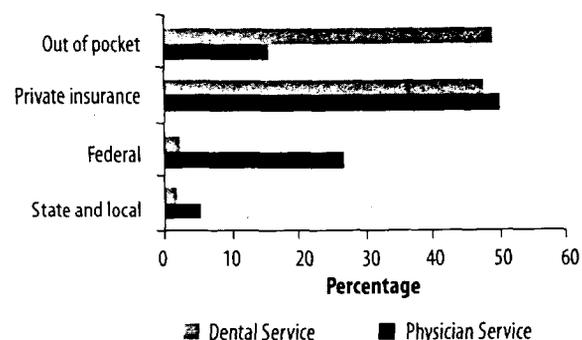
reimbursement systems have been labeled “managed dental care.” As defined by the Physician Payment Review Commission (1997), managed care is “any system of health services payment or delivery arrangements where the health plan attempts to control or coordinate use of health services by its enrolled members in order to contain health expenditures, improve quality, or both.”

In dentistry the primary alternative reimbursement systems in place are the dental health mainte-

nance organization, dental preferred provider organization (PPO), and dental referral network. Between 1995 and 1996, dental HMO enrollment grew 17.7 percent; it grew another 8.6 percent between 1996 and 1997, for a total enrollment of approximately 26.5 million people. Dental PPO enrollment grew 30.9 percent in 1996 and 32.6 percent in 1997 to a total of about 24.5 million people (Table 9.6). Dental indemnity increased by 10.1 percent in 1996 and 2.6 percent in 1997 to about 90.6 million persons (NADP 1998). By comparison, the Health Care Financing Administration reported an increased shift of employers and employees from indemnity to managed care health plans, in the past several years. According to HCFA, 86 percent of all insured workers were covered by managed care health plans in 1998, an increase of 54 percent over 1993 (HCFA 2000b).

The rapid changes in the health care environment have emphasized the development of performance measures that can be used by both public and private purchasers of care, consumers, and health care professionals. Specifically, health care quality oversight has focused on the collection and use of data that provide the basis for assessing and monitoring care delivery performance. These performance

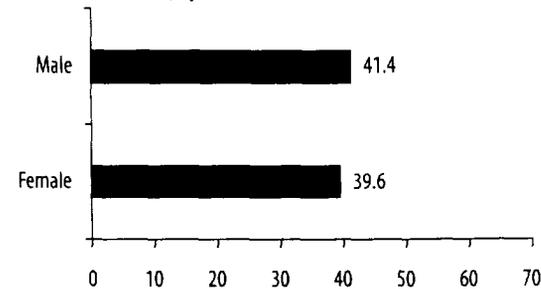
FIGURE 9.6
Source of funds for dental and physician services, United States, 1997



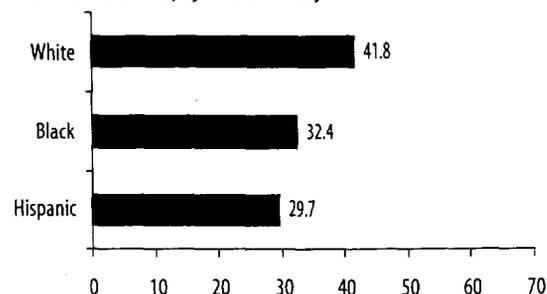
Source: York et al. 1995.

FIGURE 9.7
Dental insurance coverage, United States, 1989

Percentage of persons aged 2 and older who are covered by private dental insurance, by sex

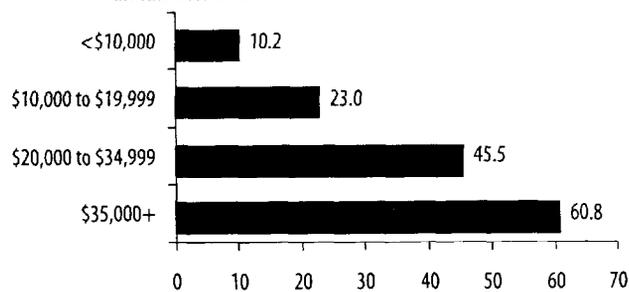


Percentage of persons aged 2 and older who are covered by private dental insurance, by race/ethnicity

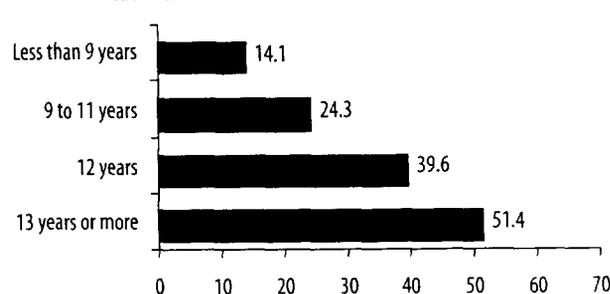


Sources: ADA 1997b, NCHS 1992.

Percentage of families with private dental insurance with an annual income of



Percentage of persons with private dental insurance with an education level of



or outcome measures require development and testing to determine their reliability and validity, and depend on enhanced data collection and information systems for their application. An example of performance measures is the Health Plan Employer Data and Information Set (HEDIS), a set of standardized measures developed by the National Committee for Quality Assurance. Recently, pediatric oral health measures have been reviewed and additional measures proposed for HEDIS consideration (Crall et al. 1999). A framework for the development of outcome measures for oral health care has been proposed along four dimensions: biologic, clinical, psychosocial, and economic. This schema is designed for potential use by patients, health care providers, purchasers of care, and the public (Bader and Ismail 1999). Efforts are needed to proceed with the development and testing of reliable and valid outcome measures in all four dimensions for oral health care and their incorporation into practice and programs.

Federal and State Programs

Medicaid

The Medicaid program, established as Title XIX of the Social Security Amendments of 1965, was designed to provide health care for all indigent and medically indigent persons, with funding shared between federal and state governments. Although states differ in eligibility rules and expenditures for services provided, amendments to the Medicaid program instituted in 1968 required all states to include dental care for individuals under 21 years of age as part of the Early and Periodic Screening, Diagnostic, and Treatment (EPSDT) service. In addition, the Omnibus Budget Reconciliation Act of 1989 required the provision of all medically needed dental services for EPSDT beneficiaries beyond what is covered under the state's Medicaid plan. Medicaid funds

dental care for low-income individuals and persons with disabilities at usual and customary fees, or the Medicaid fee schedule rate, whichever is lower. Although some states have increased their medical reimbursement to 80 percent of usual and customary fees, the norm is 47 percent (Colby 1994).

In 1998, total governmental outlays for dental services were \$2.3 billion (\$1.3 billion federal, \$1.0 billion state and local). Of this total, \$2.0 billion represented dental Medicaid expenditures, which is approximately 1.25 percent of the \$159.6 billion designated for all Medicaid personal health care expenditures, a proportion that is much lower than it was in the early years of the Medicaid program (HCFA 2000b). Some states have tightened their eligibility requirements and have reduced the range of covered dental services for adults. States have not been able to meet the mandatory components of the EPSDT dental program, partly because of low levels of reimbursement to providers and difficulties regarding access to care for eligible enrollees.

Eligibility for Medicaid, as with any form of insurance coverage, does not ensure receipt of adequate dental care. A 1996 report by the USDHHS Inspector General estimated that 80.3 percent of eligible infants, children, and youth up to 20 years of age, for whom disease levels are known to be high (see Chapter 4), did not receive preventive dental services (USDHHS 1996). The report stated that the reasons were complex and included the following factors: few dentists see Medicaid patients, Medicaid families give dental services low priority, and the youngest patients are the least likely to obtain care.

The State Children's Health Insurance Program

Legislation passed by Congress in 1997 created the State Children's Health Insurance Program, which provides billions of dollars to states (supplemented by required state contributions) to extend coverage for health care to uninsured children. For a child to be eligible, family income may be as high as twice the federal poverty level, exceeding eligibility for Medicaid. The states must cover immunizations and well-child care within specified program requirements, but are otherwise free to decide how the money is spent. By midsummer 1999, only 1.3 million of the 10 million uninsured children had been enrolled in SCHIP, with some states using the funds to expand Medicaid coverage and

TABLE 9.6
Estimated number of dental plan members and annual percentage change by market sector and year, United States, 1995 to 1997

	Number of Members			Percentage Change 1995 to 1996	Percentage Change 1996 to 1997
	Year End 1995	Year End 1996	Year End 1997		
Dental HMO	20,697,452	24,359,434	26,457,650	17.7	8.6
Dental PPO	14,085,181	18,442,216	24,460,062	30.9	32.6
Dental referral	1,920,330	5,033,866	5,453,264	162.1	8.3
Dental indemnity	80,255,346	88,323,803	90,640,826	10.1	2.6
Total/average	116,958,309	136,159,319	147,011,802	16.4	8.0

Source: Data from NADP 1998.

others designing new programs that may or may not include dental care (see Chapter 10 for more details).

Medicare

Dental services covered under the Medicare program are limited. Unlike Medicaid, Medicare (Title XVIII of the Social Security Amendments of 1965) is financed totally by the federal government; it was originally designed to provide physician and hospital services for all persons 65 and older, rich and poor alike. Medicare is split into hospital insurance (Part A) and physicians' services (Part B), the latter being a voluntary supplemental insurance program paid for by the individual.

Medicare was not designed to insure routine dental care. Rather, as an exception to the statutory exclusion from Medicare of dental services, it covers dental services needed by hospitalized patients with specific conditions. These include dental services in connection with jaw fractures or with preparation of patients for radiation in cases of oral and pharyngeal cancers or as part of a comprehensive workup prior to renal transplant surgery (Table 9.7). Total Medicare payments for dental services in 1998 were \$0.1 billion (HCFA 2000b).

Recently, the Institute of Medicine (IOM) was asked to study the short- and long-term benefits and costs to the Medicare program of extending coverage to include "medically necessary dental care" to beneficiaries for a limited number of conditions. In the Medicare program, the term "medically necessary dental services" is used narrowly to mean care that occurs as the direct result of an underlying medical condition or its treatment or that has a direct effect

on such a condition. Under this definition, care for serious periodontal disease would not be "medically necessary" unless, for example, it threatened the health of someone with leukemia or was caused by the disease or its treatment (and could otherwise be health threatening if untreated). The IOM report noted that such a restrictive definition may suggest that "periodontal or other tooth-related infections are somehow different from infections elsewhere" and "imply that the mouth can be isolated from the rest of the body, notions neither scientifically based nor constructive for individual or public health."

The IOM committee concluded that it is reasonable for Medicare to cover both tooth-preserving care and extractions for patients undergoing radiation for oral and pharyngeal cancers, and a dental examination, cleaning of teeth, and treatment of acute infections of the teeth or gingiva for a leukemia patient prior to chemotherapy. The report suggested that further study would enable recommendations to be made—on a condition-by-condition basis—for coverage of effective dental services needed in conjunction with surgery, chemotherapy, and radiation for other conditions (Field et al. 1999).

FACTORS AFFECTING THE CAPACITY TO MEET ORAL HEALTH NEEDS

The nation's capacity to provide care that is accessible and acceptable to address the oral health needs and wants of Americans in the next century is challenged by numerous factors. Among them are concerns about a declining dentist-to-population ratio, an inequitable distribution of oral health care providers, a low number of underrepresented minorities

TABLE 9.7
Current Medicare coverage for dental services

Clinical Condition	Covered Service	Part A (hospital)	Part B (physician)
Underlying medical condition and clinical status require hospitalization for dental care	Inpatient hospital services only	X	
Severity of dental procedure requires hospitalization for dental care	Inpatient hospital services only	X	
Any oral condition for which nondental services are covered	All dental services if incident to and an integral part of covered procedure or service		X
Neoplastic jaw disease	Extractions prior to radiation		X
Renal transplant surgery	Oral/dental examination on an inpatient basis	X (if dentist is on staff at hospital where service is provided)	X (outpatient payment for physicians only)

Source: HCFA 2000b.

applying to dental schools, the effects of the cost of dental education and graduation debt on decisions to pursue a career in dentistry, the type and location of practice upon graduation, current and expected shortages in personnel for dental school faculties and oral health research, and an evolving curriculum with an ever-expanding knowledge base.

Numbers of Dental Personnel

The ratio of dentists to the total population is declining: in 1996, there were approximately 58.4 professionally active dentists per 100,000 people in the United States, down from 59.1 in 1990. The current ratio equates to one dentist for every 1,700 people (HRSA 1999). The dentist-to-population ratio is a very crude measure of dental care capacity, because it does not consider dentist productivity (affected by hours worked, use of auxiliary personnel, and mix of services provided) or location of practices relative to underserved populations; there is no agreement on the number that is optimal. Nevertheless, this ratio does indicate trends. By 2020 the dentist-to-population ratio is expected to drop to 53.7 per 100,000 (Figure 9.8). Moreover, it appears that the absolute number of active dentists will decline after 2000. In part, this drop reflects the retirement of older dentists (estimated to range from 2,500 to over 4,300 per year between 1996 and 2021 (HRSA 1999) with insufficient numbers of new graduates (estimated at about 4,000 per year) replacing them (ADA 1999). In comparison, the ratio of active physicians to population has been increasing; it was 251.6 per 100,000 in 1997, up from 226.1 in 1990 (HRSA 1999). The trend in the reduction of the dentist-to-population ratio and the absolute number of dentists

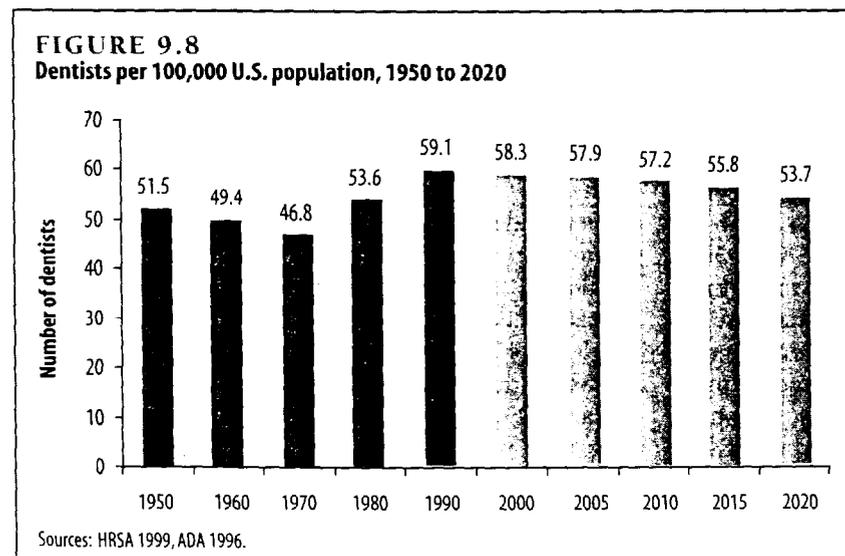
implies a shortage of dentists in the future. This trend may, however, be offset by innovation in dental practice. However, if the impact of future technology changes is similar to that produced by changes over the past 20 to 30 years, it will not substantially affect the projections.

The entering supply of dentists and dental hygienists depends on the number of graduates from dental and dental hygiene schools. The number of applicants to dental schools almost doubled between 1989 and 1997. However, the number of applicants declined by 4 percent in 1998, with further declines of 8 to 10 percent expected for 1999 and 2000. Based on the sharp decline that has occurred in the number of individuals taking the Dental Admissions Test, similar declines may continue into the early 2000s. During the 1989-97 time period, dental school first-year enrollment increased only about 9 percent. Little further growth in enrollment is anticipated because the current infrastructure in dental education has limited ability to expand, coupled with the declines occurring in dental school applicants. Along with concerns about a possible shortage of dentists, there is concern that the pool of qualified applicants may not be sufficient to supply a dental workforce that meets the needs of society, as well as the needs of dental education and research.

In contrast, the number of dental hygiene programs and students has increased almost 18 percent since 1990. The number of first-year dental hygiene students currently stands at 6,000, more than recovering from the 15 percent decline that occurred in these programs during the late 1970s through the mid-1980s. The last 4 years has seen a steady 11 percent growth in dental hygiene positions.

The numbers of dentists and sites of health pro-

profession education programs have been influenced by government policies and social factors. During the late 1950s an emerging shortage of health care providers (including dentists) was expected arising from the "baby boom" that began in the late 1940s. Beginning in the early 1960s, the federal government supported an expansion in the number of medical and dental schools and in class sizes. By the mid-1970s, the number of dental schools had grown from 47 to 60. First-year enrollments grew from 3,612 to 6,301. By the mid-1970s, a possible oversupply of physicians and



dentists became a concern. Government support for all health profession education was substantially reduced. Through the 1980s, dental schools reduced their enrollment by 37 percent. By 1993, six dental schools, all affiliated with private universities, had closed.

Following the growth in dental school enrollments that has occurred since 1989, the 1998-99 first-year enrollment stood at 4,268 in 55 dental schools located in 33 states, the Commonwealth of Puerto Rico, and the District of Columbia. One more dental school (at Northwestern University) is scheduled to close in 2001. One is scheduled to open in 2001, at the University of Nevada at Las Vegas (ADA 1996). Total dental school enrollment in 1998-99 was 17,033 students, down from a peak of 22,842 in 1980-81.

Sex and Racial/Ethnic Composition of Dental Personnel

The number and percentage of women in the dental and medical professions have continued to increase. Thirty years ago, women represented 1.3 percent of first-year enrollment in dental schools. By 1988, that proportion had risen to 35.7 percent, a level that has been relatively constant over the past 10 years. Recent trends indicate that the proportion of women in dentistry will continue to increase: by 2000, more than 26,000 women will be active practitioners; this is almost twice the number in 1990 (HRSA 1993, 1999). However, data from 1990 show that the proportion of dentists who were women (9.5 percent) was smaller than the proportion of female physicians (17.0 percent), female pharmacists (28.9 percent), and female optometrists (14.6 percent). The percentage change in the numbers of first professional degrees conferred to women by health field of study and race/ethnicity from 1981 through 1990 shows that although dentistry is second lowest (next to allopathic medicine), the percentage changes for Hispanic women and American Indian/Alaska Native (AIAN) women in dentistry were among the highest (46.7 percent and 500.0 percent, respectively), even though the actual numbers were low (HRSA 1993).

The participation of racial and ethnic minorities in dentistry does not mirror the dramatic increase in the entrance of women into the profession in the course of a single generation. The demographic profile of the U.S. population is changing rapidly, and is likely to continue to do so, with continued increases in racial and ethnic minority groups in comparison to whites. However, these trends and projections are not reflected in the dental or medical workforce.

The overall percentage of minority students has increased significantly, to the point that, in 1998, a little over 34 percent of the first-year students were members of a minority group. This overall percentage is up from 13 percent in 1980. However, the primary increase has come among Asian/Pacific Islander students, increasing from about 5 percent of enrollment in 1980 to almost 25 percent in 1998. At the same time, the proportion of black/African American, Hispanic/Latino, and American Indian students, together, has shown only a small percentage point increase since 1980, from about 7.5 percent to nearly 10 percent. The percentage of first-year enrollment in 1998 for black/African American students was 4.4 percent. It was 4.9 percent for Hispanic/Latino students and 0.4 percent for American Indians. These percentages for black/African American, Hispanic/Latino, and American Indian students are far less than their percentages in the U.S. population. In addition, a specific look at black dental school graduates during the 1980s and 1990s showed that although the number of black female graduates had increased, the increase was insufficient to offset the decline in black male graduates (HRSA 1993).

In 1996, African Americans made up 12.0 percent of the general population, but only 2.2 percent of active dentists (Brown and Lazar 1999). Similarly underrepresented were Hispanics, who accounted for 10.7 percent of the population, but only 2.8 percent of active dentists. The Hispanic population is the fastest-growing segment of the population and by 2002 will exceed the number of blacks (U.S. Bureau of the Census 2000). American Indians, 0.7 percent of the population, represented only 0.2 percent of active dentists. Table 9.8 shows the 1996 dentist-to-population ratios by race/ethnicity of the dentist.

As has been shown in Chapter 4 and elsewhere in this report, oral health problems disproportionately affect disadvantaged populations among underrepresented minority groups. This disparity will not be ameliorated through technology improvements or increases in clinical productivity. Moreover, recent data show that underrepresented racial and ethnic minority dentists are more likely to provide care to minority populations. In 1996, black dentists reported that 61.8 percent of their patients were black, and Hispanic dentists reported that Hispanic patients made up 45.4 percent of their practice; 76.6 percent of white dentists' patients were white (Brown and Lazar 1999). A recent study of the role of black and Hispanic physicians in the provision of care for underserved populations demonstrated that these physicians practiced in communities with a higher percentage of their racial or ethnic group (Komaromy

et al. 1996). Also, black physicians saw more Medicaid patients, and Hispanic physicians more uninsured patients, than other physicians. If this pattern of treatment of Medicaid patients and the uninsured is similar for dentists, the underrepresentation of minority dentists may also contribute to the unmet needs of minority patients. This issue warrants further research.

Regarding the importance of reaching parity in the dental profession, the American Association of Dental Schools comments, "The production of underrepresented minority [URM] dentists is totally out of synch with projected U.S. demographics. The U.S. population is expected to increase by 60 percent, reaching 394 million by 2050. At that time, nearly half (48 percent) of the population will be constituted from racial and ethnic minority groups. Strategic measures are needed to increase the number of URM dental graduates that will improve access to care for minorities throughout the nation" (AADS 1999).

Recruitment and retention of underrepresented minorities and women into the health professions will continue to be a challenge in the coming years. Activities such as enrichment programs in science and mathematics for grades K-12 and precollege are designed to increase the interest and capacity of all students, including women and underrepresented minorities, in health professions and science careers. These efforts will require careful design, implementation, and evaluation.

Student Indebtedness and Its Effects

The American Association of Dental Schools reports that in 1998 graduates of dental schools had incurred, on average, over \$84,000 in educational debt (G. Luke, AADS, personal communication, 1999). Average debt ranged from \$71,000 for graduates of public schools to \$98,000 for private/state-related schools and \$108,000 for private schools. This was over 14 percent more than the educational debt of graduating medical students. Specialty education

may result in additional debt. Setting up an office involves additional costs. In the end the burden of debts to be repaid is a driving force in decision making for many new graduates regarding career direction and practice site.

Fewer dentists establish practices in low-income communities. The National Health Service Corps (NHSC) was created in 1970 as a program of the U.S. Public Health Service to provide financial assistance to health professionals who agree to locate in a Health Professional Shortage Area (HPSA). The NHSC offers programs for both students and clinicians, including scholarships, loan repayment programs, and rotations in Community Health Centers. Currently, there are approximately 2,526 clinicians, including 306 dental care providers, delivering care to more than 4.6 million people through these programs. Only about 6 percent of the dental need is currently being met in the approved 1,198 dental HPSAs with a population of 25.9 million. It is estimated that an additional 4,873 dental care providers are needed to meet the current demand. In fiscal year (FY) 1999 the NHSC provided 139 new and continuing dental loan repayment awards, valued at \$9 million. In FY 1998, there were 308 dental NHSC scholars, a 40 percent increase since 1994. Outreach and program development are critical to foster growth and create opportunities for placing dentists in underserved areas, where the needs are great.

In addition to the NHSC, the Indian Health Service operates a loan repayment program to identify health professionals who will practice full-time at an IHS facility or approved tribally managed site in exchange for repayment of their eligible health professions educational loans. Funding for this program has remained level for the past 8 years, in spite of the fact that student debt has nearly doubled during that time.

Primary care dental residency programs supported by Health Professions Training Funds also play a role in meeting the oral health care needs of the nation. An evaluation performed for the USDHHS

TABLE 9.8
U.S. dentist-to-population ratios by race/ethnicity of the dentist, 1996

	Total	Black	Hispanic	Asian/Pacific Islander	American Indian	White
U.S. population	265,189,000	31,933,000	28,092,000	9,181,000	1,954,000	194,029,000
Active dentists	154,900	5,201	5,178	10,693	194	133,634
Number of dentists per 100,000 population	58.4	16.3	18.4	116.5	9.9	68.9
Number of people per dentist	1:1,712	1:6,140	1:5,425	1:859	1:10,072	1:1,452

Source: HRSA 1999.

found that 87 percent of General Dentistry trainees remain in primary care practice and over 30 percent of General Dentistry program graduates receiving federal support over the last 4 years entered practice in underserved communities.

The issue of indebtedness not only is an important consideration for the graduate in deciding where to practice, but also has become an obstacle to college students contemplating a career in dentistry and other health professions. Moreover, it can affect the choices graduates make about whether they will pursue careers in academia or research. The National Institutes of Health created three loan repayment programs to attract health care professionals to research in its facilities. In addition, innovative loan repayment incentives, such as awarding "extramural" loan repayment to researchers working in dental education institutes, have been proposed to overcome the current critical shortage of dental faculty/researchers.

Personnel Needs for Faculty and Clinical Research

The education and training of dentists and allied dental health personnel are essential to the country's capacity to meet its oral health needs. Dental education institutions and their allied academic health centers play a critical role in providing the infrastructure for oral, dental, and craniofacial research and continuing education for dental professionals. A task force report on the future of dental school faculty shows that the number of faculty vacancies in the clinical sciences has more than doubled in recent years, rising from 139 in 1992-93 to more than 300 in 1999 (AADS 1999). The task force projects that retirements will rapidly increase in the coming decade given the average age of the faculty (47 percent of all faculty members are aged 50 and older, and 19 percent are 61 and older). Kennedy (1990) estimated that dental institutions need at least 208 to 218 new faculty members each year, based on a faculty turnover rate of approximately 33 percent every 5 years.

Curriculum Needs

New technologies such as telehealth, bioinformatics, and virtual reality, as well as databases specifying human, animal, and microbial genomes, are altering public awareness, attitudes, and behavior regarding health issues. The new knowledge and tools available are also changing dramatically how health care pro-

professionals are taught, how they learn, how they practice, and how they retain clinical practices.

These developments, along with new paradigms for the treatment of oral, dental, and craniofacial diseases and disorders, have led to several recent studies of oral health professional education and curricula (Field 1995). A 1995 Institute of Medicine study on the future of dental education called for greater integration and collaboration of dental schools with the parent university and academic health center, a commitment to research programs and the building of research capacity, and an enrichment of the curriculum to incorporate new scientific knowledge and its transformation into clinical applications. The report's first strategic policy principle affirmed that "oral health is an integral part of total health, and oral health care is an integral part of comprehensive health care, including primary care." Ideally, curricula for all health professional schools should reflect this principle by integrating knowledge and management of oral and medical health and disease.

Work is beginning on revisions to educational materials necessitated by these advances in research and technology. Initial steps are being taken to increase emphasis on interdisciplinary training, clinical research, and orientation to cultural competency in health professional education. The National Coalition for Health Professional Education in Genetics is promoting the incorporation of genetics, genomics, and proteomics into predoctoral programs to prepare future health professionals to integrate genetics into practice. Other developments that need to be addressed include HIV disease and other emerging and reemerging infectious diseases, increased understanding of gender health issues, management of chronic pain, and the growing numbers of aging baby boomers and older Americans with complex and chronic health problems. For example, instruction on the special needs of individuals whose oral health is compromised by systemic diseases or disease treatments and on the heightened quality-of-life expectations of young and middle-aged adults should be incorporated into the curricula. In addition, in Area Health Education Centers in some states, health profession students work together to care for patients in underserved, rural, or disadvantaged populations.

The HIV/AIDS Dental Reimbursement program assists dental education programs in meeting the HIV/AIDS community's significant need for oral health care services. This program trains dental students and residents in the care and treatment of those living with this chronic disease. A federal-

institutional partnership provides funds to dental education institutions to partially reimburse for the costs of providing oral health care services to people living with HIV and AIDS.

As the health professional curriculum evolves, so must efforts in K-12 education and beyond to improve the public's health literacy. Efforts directed toward improving science and health knowledge and attitudes and at implementing health-promoting practices have begun; these can contribute to an enhanced partnership between patients and their health care providers.

Taking Care of Those Most in Need

The capacity to care for those most in need requires not only an adequate number of individuals to provide the care, but also an equitable distribution of providers to ensure the availability of care. In addition, sufficient financial resources must be available to support the delivery of and reimbursement for care provided to those most in need. Attention must also be given to a quality of care that ensures that the services provided fulfill the needs and functional requirements of the patients. Although the proportion of the population that uses dental services continues to increase, disparities remain (see Chapter 4).

A recent review of the literature related to access to care has identified many of the factors associated with these disparities. The lack of dental insurance emerged as a highly significant factor (Isman and Isman 1997). A series of reports demonstrates that privately insured individuals of all ages are more likely to get dental care when they need it than are the uninsured (Bloom et al. 1997, Cohen et al. 1997, Simpson et al. 1997). Lack of insurance was found to be an even more significant barrier to gaining primary care access for children than either poverty or minority status (Newacheck et al. 1997).

Once access to care has been established, there is greater likelihood that individuals will adopt preventive practices. Although a causal relationship has not been established, Wagener et al. (1992) found that brushing with a fluoride dentifrice and using dietary fluoride supplements were more frequent among preschool children who had had a dental visit in the past year than among those who had not. In contrast, as discussed in Chapter 4, one of the most common reasons cited by individuals in all income and education groups for not having made a dental visit was that they did not perceive that they had a problem. This implies a lack of awareness that attaining and maintaining good oral health and preventing disease

require not only self-care but also professional oral health care.

Federal and state statistics show strong and consistent racial and ethnic disparities among U.S. children in disease occurrence and severity, untreated dental disease, access to dental care, and use of preventive services (see Chapter 4). Vulnerable child populations as well as the elderly, individuals with disabilities, people with HIV, migrant workers, and homeless persons pose an additional set of challenges. These populations require health care providers sensitive to cultural and social issues who are capable of addressing complex problems that demand integrated dental and medical care. The oral, dental, and craniofacial and medical care curricula are vital in preparing dental and other health care providers to coordinate and integrate care for these individuals.

The issues of oral health and the underserved have been addressed in a policy paper, *Oral Health for All: Policy for Available, Accessible and Acceptable Care* (Warren 1999). This report makes recommendations regarding financial barriers to care, integration of oral health services into health care delivery, capacity to meet oral health needs, cultural competency of health care providers, and education and oral professional practice requirements to meet the oral health care needs of underserved populations.

A survey of dental care reported that more than half of the responding private practice dentists provided some charitable care to low-income populations in 1996 (ADA 1998b). Although access-to-care dental programs for low-income populations are supported by many dental societies, this generosity falls well short of meeting the needs of these populations, which also require community-based programs (Waldman 1999) (see Chapter 7). Programs such as Community and Migrant Health Centers serve hard-to-reach populations. In 1996, more than half of such centers provided dental services, serving more than 1 million people (J. Anderson, personal communication, 1999).

TWENTY-FIRST CENTURY CHALLENGES: WHAT LIES AHEAD?

The United States is witnessing unprecedented changes in demography, patterns of disease and disorders, and the nature of health care. The imperative to keep abreast of advances in science and technology is already evident in dentistry and medicine, aided by access to multiple information

systems. In addition to the Internet and continuing dental education, the new century will see continued growth in imaging systems, computer-assisted technology, teledentistry and telemedicine, improved diagnostics and therapeutics, and new biomaterials and other biotechnology products. Genetic information will play an increasing role in assessing a patient's risk for disease and in planning treatments.

Although some information is available on the effectiveness, cost-effectiveness, and outcomes associated with health care treatment, further research will be needed to determine "best practices"—which treatments work for which patients, under what circumstances, and at what cost. Treatment planning will incorporate outcome measures and patient preferences. Systematic reviews of the existing literature will help promote an evidence-based approach to dental and medical care. In addition, comprehensive diagnostic and treatment codes, as well as a process by which new technologies can be incorporated appropriately, will be needed.

The dental profession has been at the forefront of efforts to prevent disease and enhance general health and the quality of life. Efforts such as community water fluoridation, over-the-counter fluoride products, and dental sealants represent a preventive orientation that has been associated with the dental profession for half a century. Dentistry is continuing to be responsive to the ever-rising expectations of patients. Increases in the provision of fee-for-service cosmetic dentistry, adult orthodontics, and dental implants are among the trends already in evidence and expected to grow.

As the knowledge base regarding the relationships between oral health and general health increases, so too will the need for greater coordination of dental and medical services. Efforts to improve cardiac care, for example, may include treatment of periodontal diseases. Prenatal care may come to include a dental evaluation and treatment to reduce the risk of preterm, low-birth-weight deliveries. Regular oral examinations and periodontal treatment for diabetic patients may become an important component in disease control. Partnerships will need to be expanded and new ones created among the private dental, medical, and public health components.

A challenge facing the health professions will be to expand community-based disease prevention and personal oral health care to meet the needs of populations. Questions of access and barriers to care must be addressed and satisfactory solutions found to ensure that there is care for all who seek it.

The extent to which these predicted structural, organizational, and thematic changes will affect the nation's capacity and commitment to provide oral health care is not certain. The nation's health promotion and disease prevention objectives, which include oral health objectives, serve as a critical guide. How successful a changed care system will be in addressing the oral health needs and wants of the nation can be measured in several ways. These include reductions in health disparities in the population, decreases in the overall incidence and prevalence rates of diseases for the entire population, improved functional status, lower costs, reduced mortality rates, and enhanced health and quality of life.

FINDINGS

- Dental, medical, and public health delivery systems each provide services that affect oral and craniofacial health in the U.S. population. Clinical oral health care is predominantly provided by a private practice dental workforce.

- Expenditures for dental services alone made up 4.7 percent of the nation's health expenditures in 1998—\$53.8 billion out of \$1.1 trillion. These expenditures underestimate the true costs to the nation, however, because data are unavailable to determine the extent of expenditures and services provided for craniofacial health care by other health providers and institutions.

- The public health infrastructure for oral health is insufficient to address the needs of disadvantaged groups, and the integration of oral and general health programs is lacking.

- Expansion of community-based disease prevention and lowering of barriers to personal oral health care are needed to meet the needs of the population.

- Insurance coverage for dental care is increasing but still lags behind medical insurance. For every child under 18 years old without medical insurance, there are at least two children without dental insurance; for every adult 18 years or older without medical insurance, there are three without dental insurance.

- Eligibility for Medicaid does not ensure enrollment, and enrollment does not ensure that individuals obtain needed care. Barriers include patient and caregiver understanding of the value and importance of oral health to general health, low reimbursement rates, and administrative burdens for both patient and provider.

- A narrow definition of "medically necessary dental care" currently limits oral health services for many insured persons, particularly the elderly.
- The dentist-to-population ratio is declining, creating concern as to the capability of the dental workforce to meet the emerging demands of society and provide required services efficiently.
- An estimated 25 million individuals reside in areas lacking adequate dental care services, as defined by Health Professional Shortage Area (HPSA) criteria.
- Educational debt has increased, affecting both career choices and practice location.
- Disparities exist in the oral health profession workforce and career paths. The number of under-represented minorities in the oral health professions is disproportionate to their distribution in the population at large.
- Current and projected demand for dental school faculty positions and research scientists is not being met. A crisis in the number of faculty and researchers threatens the quality of dental education; oral, dental, and craniofacial research; and, ultimately, the health of the public.
- Reliable and valid measures of oral health outcomes do not exist and need to be developed, validated, and incorporated into practice and programs.

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What Are the Needs and Opportunities to Enhance Oral Health?

Many factors have been implicated in determining oral health, and they have varying effects across the life stages. These factors are discussed in Chapter 10, where the incorporation of determinants of health in major public health initiatives such as Healthy People 2010 is highlighted. Essential factors include individual biology and lifestyle, the physical and social environment (including whether a community supports health-promoting measures such as water fluoridation), and the organization of health care. These factors are not independent but interact. An individual with no inherent health problems and a healthy lifestyle also needs to live in a healthy environment with ready access to and ability to pay for health care services. Studies of oral health over the lifetime highlight the interaction of these factors. The chapter focuses primarily on America's most vulnerable populations—children and the elderly—where issues of access, insurance, and reimbursement are critical in determining oral health and limit the delivery of care for individuals with special needs and those residing in institutions.

Chapter 11 focuses on the future and the promise of research born of the revolutions in genetics, biotechnology, and biomimetics—the new science of tissue repair and regeneration. Global demographics and technologic innovations signal the need for health literacy and universal access to care if we are to enhance oral health for all Americans.

Chapter 12 highlights the major findings and recommendations of the report. Everyone—individuals, communities, policymakers, health care providers, educators, and researchers—has a role in improving and promoting oral health. The major conclusion of the report is that oral health is essential to general health and well-being. A National Oral Health Plan will facilitate the means to improve the nation's oral health. The chapter concludes with five actions proposed toward that end: strengthen understanding of oral health and disease by the public, practitioners, and policymakers; accelerate building the science and evidence base; enhance health infrastructure and program integration; reduce barriers to oral health care; and increase public-private partnerships to address health disparities.

Factors Affecting Oral Health over the Life Span

When the World Health Organization (WHO) expanded the definition of *health* in 1948 to mean a complete state of physical, mental, and social well-being, and not simply the absence of infirmity, the move stimulated research to define the major factors affecting health and well-being. Investigators developed model systems of “health-related quality of life” and “oral-health-related quality of life.” Chapter 6 describes such models and provides examples of indices and instruments used to measure quality of life. What these models have in common are factors that include biological or physiological measures of health, but also take into consideration an individual’s ability to function normally in the routines of daily living, experience symptom relief, and fulfill usual roles in personal relationships and in family, work, civic, and social interactions. The researchers note that the factors are not mutually exclusive, but interact, feeding back on one another. Often the measurements include an individual’s subjective assessment of quality of life before and after the onset of the disease or disorder and its treatment.

In the context of a broadened concept of health, there is clearly more to attaining and maintaining good health and quality of life than seeking regular medical and dental checkups and performing daily personal hygiene routines. Other factors that are important have been incorporated in a number of models of “determinants of health,” which are described in the next section. These models recognize that the determinants themselves are subject to change with changes in society and also vary in their salience over the lifetime of an individual. The concluding sections of the chapter illustrate this variability by examining oral health at successive stages of the life span, from childhood to old age. The vulnerabilities of selected subpopulations within each age group are highlighted, with particular emphasis on the plight of poor children and many older Americans.

HEALTH IN THE CONTEXT OF SOCIETY

Thinking about what makes people healthy has inspired philosophers and historians over the centuries. Following is a brief overview that points to commonalities among the models proposed.

Historical Models

As early as the fifth century B.C., Hippocrates considered it essential that physicians know each patient’s way of life, habitation, work, and dietary habits (Porter 1997). He counseled those who were considering a new city of residence to take into account the geography, water supply, and behavior of the citizens, specifically whether they drank and ate excessively, were lazy, or enjoyed exercise and hard work (Rose 1993).

Recent accounts of the history of medicine and public health similarly recognize the roles of environment, lifestyle, and the health care provider in determining health. Pine (1997) has described four phases in the history of public health. Phase 1, from the middle to the late 1800s, was characterized by urbanization and industrialization that significantly contributed to suboptimal living conditions for workers. Sanitary reforms were the hallmarks of public health achievement during this period. In addition, epidemiological studies began to demonstrate causal relationships between compromised health status and conditions such as malnutrition and poor hygiene.

The second phase, between 1880 and 1930, was characterized by advances in bacteriology and immunology. Increasingly, the prevention of disease was being applied to populations as well as individuals. The third phase, from 1930 through 1974, was a therapeutic period. The hospital became the essential base and focus for medical services, and medical treatment grew more complex. With the development

of vaccines and antibiotics, along with the success of surgical procedures, people began to rely on medical interventions as the source of health. The biomedical approach became paramount, and people began to believe that health was *delivered* to them by health professionals. The contributions of hygiene, sanitation, and living conditions to health were diminished. Doyal and Doyal (1984) point out that success depended on the maximal compliance of the patient.

Contemporary Models

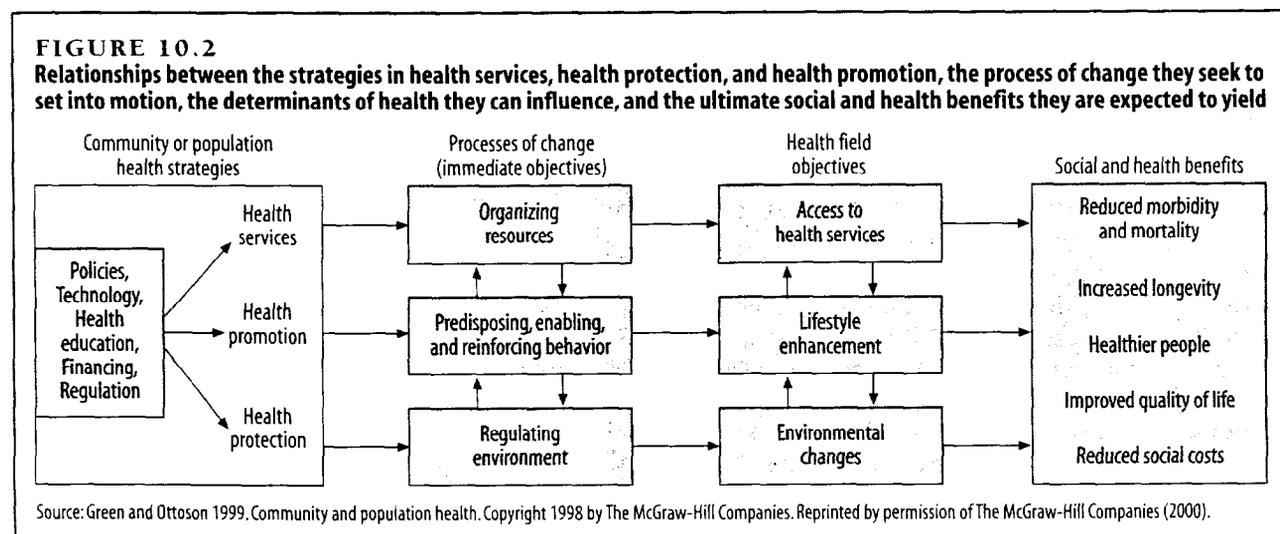
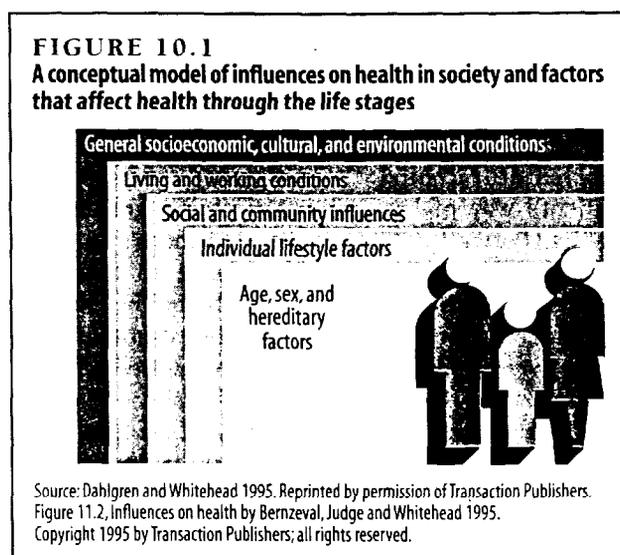
The fourth phase of public health, 1974 to the present, ushered in the modern era, referred to as “the new public health” (Ashton 1993). This phase developed out of a realization that health care costs were spiraling and there were few cures for an increasing burden of chronic diseases. The biomedical approach

alone could not solve all health problems. Rene Dubos (1979, 1990) stated that theories of specific etiology provided only a partial explanation for the development of diseases; they could not explain under what conditions a specific cause of disease could be determined and was able to flourish.

McKeown (1979) cited three factors he believed were responsible for the major reductions in disease: the environment, economics, and behavior. His analysis of data from numerous countries confirmed that the achievements of medicine alone could not explain improvements in health. The decline in mortality from many diseases, including tuberculosis, whooping cough, measles, scarlet fever, diphtheria, and smallpox, had begun well before the development of specific vaccines and therapies. He concluded that “the misinterpretation of the major influences, particularly personal medical care, on past and future improvements in health has led to misuse of resources and distortion of the role of medicine” (McKeown 1976).

Taking a similar critical view, Cochrane (1971), the physician in whose honor the Cochrane Collaboration of clinical trials was established, challenged the medical establishment to test medical procedures, including those long believed to be effective, with rigorous randomized controlled trials, paying particular attention to cost-benefit analyses. Long-held traditions of dental care have also been questioned, resulting in increased emphasis on clinical trials, systematic reviews of the oral health literature, and evidence-based practice (Chapter 8).

In 1974, Marc Lalonde, then Minister of Health of Canada, released a report that clearly articulated that human biology and health care organization are not the sole factors that determine health (Lalonde 1974). What is now known as the Lalonde Report, or



the Health Field Concept, emphasized that lifestyle and environment were of critical importance.

Lalonde defined four elements as determinants of health: human biology, lifestyle, environment, and the organization of health care. These elements were considered interdependent, and it was their dynamic interactions over the course of a lifetime that determined the level of health and well-being attained by an individual. As well, the elements and their interaction have implications for the level of health attained by larger aggregations of people—from neighborhoods to nations. Lalonde stated that most of society's efforts to improve health, and the bulk of direct health expenditures, have been focused on the fourth element—the organization of health care, yet the main causes of sickness and death are rooted in the other three elements.

At a subsequent WHO meeting in Ottawa, Canada, a set of five actions to promote health and quality of life, based on the four determinants, was proposed. Implementation of these actions clearly required going beyond the confines of a hospital, a medical office, or a home. Specifically, the Ottawa Charter for Health Promotion (WHO 1986) called for 1) creating supportive environments, 2) building healthy public policy, 3) strengthening community

action, 4) developing personal skills, and 5) reorienting health services.

In a model proposed by Dahlgren and Whitehead (1995), the individual is surrounded by lifestyle factors, social and community influences, living and working conditions, and general socioeconomic, cultural, and environmental conditions (Figure 10.1). Green and Ottoson (1999) integrate the Lalonde Health Field Concept into a framework of population health strategies, processes of change, determinants of health, and ultimate social and health outcomes (Figure 10.2).

Cohen and Gift (1995) acknowledge the role of multiple determinants and quote the medical historian, Henry Sigerist, who, in the mid-1940s, stated, "Health is promoted by providing a decent standard of living, good labor conditions, education, physical culture, means of rest, and recreation. The coordinated efforts of large groups are needed to this end, of the statesman, labor, industry, of the educator and of the [health care provider] who as an expert in matters of health must define norms and set standards" (Sigerist 1946).

McGoldrick (1997) provides an overview of several health behavior models in current use (Table 10.1). Some of these models have been applied to

oral-health-related behavioral research. Using the Health Belief Model in a study of dental patients, for example, Kuhner and Raetzke (1989) reported that motivation and perceived severity of the condition were the primary predictors of compliance with oral hygiene instruction. Perceived benefits and experience were also important.

The United States published a first set of national health goals for 1990 in 1979. The goals focused on the reduction of mortality in four different age groups and emphasized increased independence for older adults. Since then, national health goals have been established by the U.S. Department of Health and Human Services for each decade and published under the title "Healthy People." For Healthy People 2010 the broad goal is to increase the quality and years of healthy life. The conceptual framework, illustrated in Figure 10.3, features at the center determinants comparable to the

TABLE 10.1
Examples of theories and models in health behavior

Basic Theories	Authors	Major Elements
Group-Dynamic Model	Lewin, 1947, 1951	Role-playing approach
Social Learning Theory	Rotter 1954, Bandura 1969, 1977	Identification, reinforcement, feedback, and reward
Theory of Reasoned Action	Ajzen and Fishbein 1977, 1980	Attitude-behavior relations
Theory of Planned Behavior	Schifter and Ajzen 1985	Perceived behavioral control
Self-Efficacy Theory	Bandura 1982	Behavior determined by cognition of individuals about their behavior
Health Belief Model	Rosenstock 1966, 1974, Becker and Maiman 1975, Becker et al. 1974	Behavior determined by psychological readiness to take action
Health Action Model	Tones 1987, Tones et al. 1990	Interaction of knowledge, beliefs, values, attitudes, drives, and normative pressures
Theory of Social Behavior	Triandis 1979	Behavioral intention
Precede Framework	Green et al. 1980	Predisposing, reinforcing, and enabling causes in educational diagnosis and evaluation
Sense of Coherence Theory	Antonovsky 1979a,b	Salutogenic paradigm—focus on successful coping
Health Promotion Model	Pender 1987	Cognitive-perceptual factors

Source: Adapted from Pine 1997.

elements in the Lalonde Report. They include the interaction of individual biology, behavior, and the social and physical environment amidst policies, interventions, and access to quality health care.

The United States has invested heavily in elements of human biology and health care organization, but the nation has also readily embraced the notion that lifestyles influence health. Physical fitness and self-care are concepts that mesh with the individualistic spirit of U.S. society. Much attention has been given to health education, behavior change, and “healthy living.”

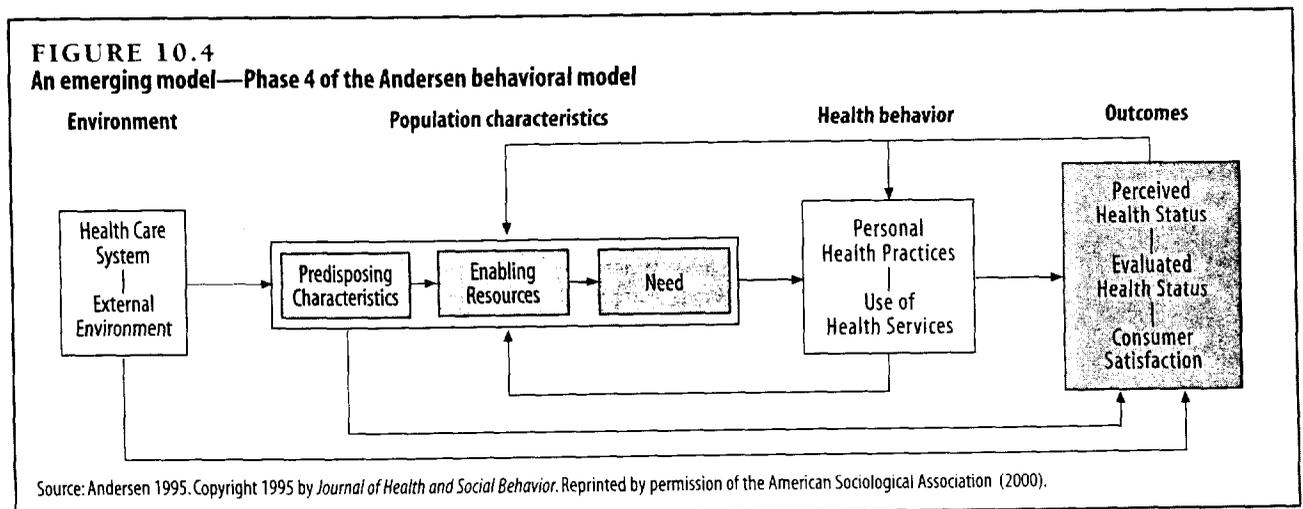
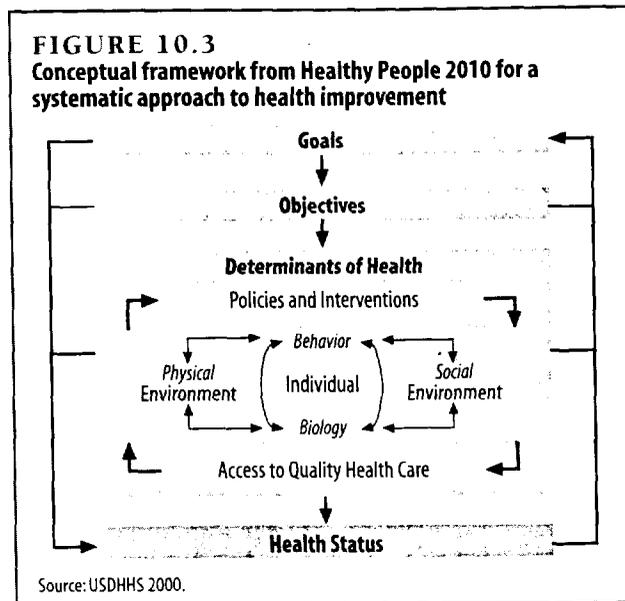
Applications to Oral Health

Within oral health, the self-care approach is best illustrated by the use of fluoride products for the reduction of dental caries. The successful adoption of

self-care regimens has been reinforced through the efforts of parents, caregivers, health educators, health professionals, advertisers, manufacturers, and early childhood programs such as Head Start that include oral health initiatives.

The Andersen Model. The oral health research community has begun to assess the behavior/lifestyle determinants of oral health as well. Andersen and colleagues point out that over the years concepts of health behavior have broadened from the biologic to the psychosocial (Andersen et al. 1988, Gochman 1988). Andersen has been a pioneer in the development of models of health determinants. The most recent refinement of the Andersen Behavioral Model (Figure 10.4) proposes that interactions among four major categories are critical to understanding the determinants of health. The first is the environment, described as the broader context in which populations live and behaviors occur. It includes the external environment and health care systems. The second category, population characteristics, includes three subsets: predisposing characteristics such as sociodemographic features, enabling resources such as those that enable the individual to pursue and achieve good health, and the need for care, which is defined by the individual's perceptions of necessary preventive interventions or treatments. The third category is the health behaviors themselves, and the fourth category, outcomes, includes perceived and evaluated health status and consumer satisfaction (Andersen 1995).

In weighing the contributions of the various determinants of oral health, Andersen et al. (1995) suggest that the external environment, relating to both specific and general health, is the primary determinant of oral health behaviors and outcomes. Oral-health-specific environmental determinants



range from positive factors such as water fluoridation to negative factors such as lack of food policies to deal with frequent sugar and carbohydrate intake. They define general environmental factors as those that deal with the relative wealth of the society, general economic "climate," and the political and societal norms that affect the delivery of oral health services.

Workplace Effects. Several researchers (Karasek and Theorell 1990, Marmot and Theorell 1988, Marmot et al. 1984, Syme 1996) have found an association between the level of control and flexibility people have in their work setting and the types of health conditions they develop and the subsequent levels of severity of those conditions. Abegg et al. (1999) looked at the relationship between oral hygiene performances and levels of flexibility of work schedule. They found a highly statistically significant relationship between flexibility of work schedule and tooth-cleaning frequency, range of oral hygiene aids used, and level of dental plaque. These associations remained even after adjusting for age, sex, socioeconomic status, and marital status (Abegg et al. 1999).

Effects of Income Inequality

Investigators are also studying how socioeconomic status affects oral health (Chapter 4). The degree of income inequality between the richest and the poorest within a country, state, or neighborhood contributes to the overall health of the population (Kawachi et al. 1997, Kennedy et al. 1996). There is conjecture from this research that increased income inequality leads to decreased levels of social cohesion and trust, or what has been described as a "disinvestment in social capital" (Kawachi et al. 1997). This is defined as "features of social organization, such as civic participation, norms of reciprocity, and trust in others, that facilitate cooperation for mutual benefit." Results of other studies indicate that lower levels of social trust are associated with higher rates of coronary heart disease, cancer, stroke, and infant mortality. However, study of healthy versus unhealthy communities is a relatively new field and offers an opportunity for oral health to be included. Additional research is needed to determine the attributes of a community that either favor or diminish the health of residents, what factors influence their development, how attributes can be changed to improve the health of a community, and how communities can build social capital. There are indicators of differentials in oral health status when poor and nonpoor populations are compared.

Across numerous indicators, the poor are more likely to have oral diseases, disorders, and conditions. Poor children are less likely to have dental sealants. In addition, the poor are less likely to visit a dentist or dental hygienist in the course of a year. The differentials in oral health status between the poor and nonpoor cross the life span and are major social indicators of the current status of oral health in America today and provide a challenging baseline against which improvements can be measured.

CHANGING VULNERABILITIES THROUGHOUT LIFE

As all models of health determinants recognize, the health of individuals and of society at large is not static. Vulnerabilities and risks for diseases and disorders change over a lifetime and are affected by chance events as well as deliberate actions of individuals and communities, of the sort proposed in the Ottawa Charter. The remainder of the chapter describes how oral health plays out across major life stages and identifies selected aspects of biology, behavior, environment, and the organization of health care that affect oral health. The plight of vulnerable subpopulations, in particular, children and older Americans, are highlighted. The information presented includes data from national surveys, such as those presented in Chapter 4, as well as studies of convenience populations.

Children

In general, society gives special attention to the developing years of childhood, acknowledging that much of what happens to affect the health of a child bears directly on the health and well-being of the adult that child will become. In the case of oral health, there is enough known about health promotion and disease prevention to improve the oral health and well-being of *all* children, beginning with prenatal care. Adequate nutrition during pregnancy, including adequate folate intake, avoidance of substances of abuse and therapeutic agents that have teratogenic potential, and the elimination and control of microbial infections in the mother increase the likelihood of an infant's healthy start. (See Box 10.1 on the effects of nutrients on oral health.) As more becomes known about how the health of mothers and other caregivers can affect the oral health of children, additional services may be warranted during the prenatal period (Chapter 5). Subsequent nurturing of the infant includes the home and health professional care necessary to promote health and interventions that

limit the infant's exposure to infections that contribute to oral diseases.

Throughout the first two decades of growth and development, children and young people are deeply influenced by the social and environmental opportunities and constraints imposed by families, commu-

nities, and society. Although every healthy newborn has the potential for success and good health, there are profound disparities in children's experiences and opportunities, which often manifest in inequities in oral and general health, education, and well-being. Many children achieve excellent oral health—sound

BOX 10.1 **The Role of Nutrition in Oral Health**

General malnourishment impairs normal growth, development, and maintenance of the body's tissues and organs and impairs immune responses and wound healing. Reduced resistance of oral tissues to disease can lead to increased colonization by oral pathogens and more sustained and severe oral infections. Clinical signs of malnutrition often appear first in the oral cavity.

Craniofacial Development. Adequate maternal intake of folic acid during pregnancy has been shown to be essential in preventing neural tube defects (incomplete fusion of the neural tube in embryo), which results in spinal cord defects after birth (Botto et al. 1999). Folic acid also appears to be important in preventing clefting syndromes (in which there is incomplete fusion in utero of paired labial or palatal tissues at the midline) (Tolarova and Harris 1995).

Tooth Development. Protein/calorie malnutrition and deficiencies in ascorbic acid, vitamins A and D, calcium, phosphorus, and iodine affect the human dentition (DePaola et al. 1999). These deficiencies in development can lead to tooth defects after teeth erupt, manifesting as enamel hypoplasia and hypomineralization, either of which can increase susceptibility to dental caries. Premature and very-low-birth-weight infants frequently show enamel defects (Seow 1987). Since tooth enamel is acellular, and hence not subject to turnover and repair, enamel defects in development are permanent (Jonasson et al. 1999, Jeffcoat 1998, Talbot and Craig 1998, Payne et al. 1999).

Supporting Bone. Adequate calcium intake, along with vitamin D and other essential vitamins and minerals, is needed not only to build but also to maintain healthy teeth and bones. The teeth are supported in the jaws by projections of maxillary and mandibular trabecular bone known as alveolar processes. When teeth are lost, alveolar bone resorbs, reducing the height of the bony ridge supporting the teeth. When serum calcium levels fall, withdrawal of calcium from alveolar bone to meet other tissue needs may precede calcium withdrawal from skeletal bone elsewhere in the body. Hence reduction in alveolar bone mass may be an early indication of skeletal osteopenia (reduced bone volume) or frank osteoporosis (Jeffcoat 1998, Jeffcoat et al. 2000).

Oral Soft Tissues. Oral mucosa undergoes rapid turnover. In particular, the gingival lining between the gums and the teeth (the sulcular epithelium) is replaced every 3 to 7 days. Thus the tissue requires a steady supply of nutrients to support DNA, RNA, and protein synthesis (Alfano 1976). Diets poor in folate, ascorbic acid, iron, and zinc are associated with increased permeability and decreased integrity of the sulcular epithelium. Protein, vitamins A and C, and zinc are important for synthesis of connective tissue (largely collagen), which constitutes part

of the attachment apparatus supporting the teeth in the jaw (Alvares and Siegel 1981, Vogel et al. 1986). The classic signs of scurvy, caused by severe vitamin C deficiency, include gingival bleeding, tooth mobility, and loss of connective tissue attachment. Painful oral lesions, including inflammation and cracks at the corners of the mouth and vertical fissuring of the lips, are changes associated with riboflavin, iron, or protein deficiency. Inflammation, a burning sensation, and tenderness of the tongue or palate are associated with deficiencies in B-complex vitamins, protein, or iron.

Oral Defense Mechanisms. Chronic deficiencies of ascorbate and iron may impair the function of white blood cells (especially polymorphonuclear leukocytes) in moving to sites of infection and initiating immune defense mechanisms. Zinc is a component of many enzyme systems and is also important in leukocyte activity (Hsu et al. 1991).

General Oral Health. Foods rich in fiber aid digestion and stimulate salivary secretion. Salivary flow is important in initiating the digestion of starch, in facilitating food tasting and swallowing, and in ensuring a ready supply of components in the oral cavity that protect and maintain the oral tissues.

Nutrients Associated with Specific Diseases

Dental Caries. The role of sugars and other carbohydrates is critical. Nearly all carbohydrates have caries-promoting properties. Most sweet foods contain a mixture of sugars (predominantly sucrose) and starches, which can be fermented by cariogenic bacteria to dissolve tooth mineral. Bacteria also use sucrose to generate glucans—sticky extracellular molecules that promote their attachment to tooth surfaces. The physical consistency, frequency of consumption, and the order in which foods are eaten affect cariogenicity. For example, following a sweet with a nonsweet food such as an aged cheese may counteract the acid attack on enamel. The presence of calcium and phosphates in the cheese also is beneficial (Jensen 1999, Rugg-Gunn 1993). Caries in tooth roots is produced by the same process as in tooth crowns and involves the same dietary etiology (Papapoulos et al. 1995), but may occur more rapidly because the root mineral, cementum, and underlying dentin are more soluble than enamel.

Periodontal Disease. Several studies have implicated deficiencies in ascorbate and folate with severity of gingivitis (Leggot et al. 1991, Pack 1984), but in general the role of nutrients in periodontal disease appears to be related to conditions that lead to increases in dental plaque, impaired host defenses, and weakened integrity of the periodontal tissues. More recently, surveys indicate that calcium intake for a large segment of the population is below recommended daily amounts (NHANES III) and that reduced calcium intake is associated with greater levels of periodontal disease in both men and women