SCIENTIFIC ARTICLES

An Assessment of the Dental Public Health Infrastructure in the United States

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Abstract

Objectives: *The National Institute of Dental and Craniofacial Research commissioned an assessment of the dental public health infrastructure in the United States as a first step toward ensuring its adequacy. This study examined several elements of the US dental public health infrastructure in government, education, workforce, and regulatory issues, focused primarily at the state level.* ***Methods:*** *Data were drawn from a wide range of sources, including original surveys, analysis of existing databases, and compilation of publicly available information.* ***Results:*** *In 2002, 72.5% of states had a full-time dental director and 65% of state dental programs had total budgets of $1 million or less. Among U.S. dental schools, 68% had a dental public health academic unit. Twelve and a half percent of dental schools and 64.3% of dental hygiene programs had no faculty member with a public health degree. Among schools of public health, 15% offered a graduate degree in a dental public health concentration area, and 60% had no faculty member with a dental or dental hygiene degree. There were 141 active diplomates of the American Board of Dental Public Health as of February 2001; 15% worked for state, county, or local governments. In May 2003, there were 640 US members of the American Association of Public Health Dentistry with few members in most states. In 2002, 544 American Dental Association members reported their specialty as Dental Public Health, which ranged from 0 in five states to 41 in California. Just two states had a public health dentist on their dental licensing boards.* ***Conclusions:*** *Findings suggest the US dental public health workforce is small, most state programs have scant funding, the field has minimal presence in academia, and dental public health has little role in the regulation of dentistry and dental hygiene. Successful efforts to enhance the many aspects of the US dental public health infrastructure will require substantial collaboration among many diverse partners.*

Key Words: public health dentistry, health personnel, dental hygienists, dental licensure, dental education

Introduction

In its narrowest definition, dental public health is one of the nine specialties of dentistry recognized by the American Dental Association Council on Dental Accreditation (1). More broadly, dental public health has been defined as the "...science and art of preventing and controlling dental diseases and promoting dental health through organized community efforts. It is that form of dental practice that serves the community as a patient rather than the individual. It is concerned with the dental health education of the public, with applied dental research, and with the administration of group dental care programs as well as the prevention and control of dental diseases on a community basis" (1). Although descriptive of what some dental public health practitioners may do, that definition does not fully capture the scope of dental public health practice. In addition to health education and program administration, dental public health is concerned with policy development; advocacy; conduct of research in epidemiology, health services, and disease prevention; and monitoring trends in disease and risk factors in populations. In reality, personnel who are not board certified specialists in the field and often are not dentists perform much of what might be considered public health dentistry.

Several recent initiatives have highlighted the challenges facing oral health in the United States. The Office of the US Surgeon General released its first report on oral health in America several years ago (2). The major findings of that landmark report were: 1) oral diseases and disorders in and of themselves affect oral health and well-being throughout life; 2) safe and effective measures exist to prevent the most common dental diseases; 3) lifestyle behaviors, such as tobacco use, that affect general health affect oral health as well; 4) there are profound oral health disparities within the US population; 5) more information is needed to improve America's oral health and eliminate health disparities; 6) the mouth reflects general health and well-being; 7) oral diseases and conditions are associated with other health problems; and 8) scientific research is key to further reduction in the burden of oral diseases and disorders. The "framework for action" to address those issues, spelled out in the Surgeon General's Report on Oral Health, highlighted the plan's principal components:

- Change public perceptions regarding oral health and disease so that oral health becomes an accepted component of general health
- Accelerate the building of the science and evidence base and apply science effectively to improve oral health

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- Build an effective health infrastructure that meets the oral health needs of all Americans and integrates oral health effectively into overall health
- Remove known barriers between people and oral health services
- Use public-private partnerships to improve the oral health of those who still suffer disproportionately from oral diseases

In short, that framework calls for a dental public health approach for solving the problems.

Another major recent initiative was the release of the *Healthy People 2010* Objectives for Improving Health (3). Among the focus areas included in *Healthy People 2010* was oral health, with the overall goal being to prevent and control oral and craniofacial diseases, conditions, and injuries and to improve access to related services. That goal was supported by 17 specific objectives that largely will require concerted dental public health action to achieve.

An extensive systematic review was undertaken in recent years to develop the evidence-based Community Guide to Preventive Services, which included a chapter on oral health (4). Appointed by the Centers for Disease Control and Prevention, the Task Force on Community Preventive Services concluded there was strong evidence to recommend community-based water fluoridation and school-based or school-linked pit and fissure sealant delivery programs to prevent dental caries. The evidence was insufficient to recommend other strategies or address other oral health conditions.

Finally, the American Dental Association's Future of Dentistry report (5) adopted a vision of "Improved health and quality of life for all through optimal oral health," and laid out broad recommendations to help achieve that vision.

Implementing the framework outlined in The Surgeon General's Report on Oral Health in America, achieving the Healthy People 2010 Objectives for improving oral health, realizing the vision of the Future of Dentistry report, promoting the evidence-based recommendations of the oral health chapter of the Community Guide to Preventive Services, and moving beyond these to fill the gaps in dental public health will require a viable dental public health infrastructure. That infrastructure includes an adequate workforce, a sufficient administrative presence within health departments, adequate financial resources to implement programs, and the ability to use personnel in an effective and efficient manner. To be most effective, that dental public health workforce should be appropriately trained, represent the diversity of America, and be sustainable for the foreseeable future.

As a first step toward ensuring the adequacy of the dental public health infrastructure in the United States, the National Institute of Dental and Craniofacial Research (NIDCR) commissioned this assessment. Although it is nearly impossible to identify or measure all possible components of that infrastructure, this study examined a number of topics under the broad heading of government, education, workforce, and regulatory issues. Where possible, emphasis was placed on infrastructure at the state level. The present report summarizes the findings presented in the full report, which is available from NIDCR at http://www.nidcr.nih.gov/NR/rdonlyres/E7AEAF78-667F-43D8-BA48-A981A01CD437/0/US_Dental_Public_Health_Infrastructure_8_2004.pdf.

Methods

Data for this report come from a wide range of sources, including original data collection, analysis of existing databases, and compilation of publicly available information. All surveys created for primary data collection were approved by The University of Florida Health Science Center Institutional Review Board.

Government. Data on dental public health programs within state health departments were drawn primarily from the 2001 and 2002 State Synopsis Surveys of Dental Public Health Programs (6), conducted by the Association of State and Territorial Dental Directors (ASTDD) in collaboration with the Centers for Disease Control and Prevention (CDC), Division of Oral Health. Contact persons within each state health department were asked, among other items, (a) whether there was a dental presence within the health department; (b) the number of full-time equivalent employees (FTEs) and budget for state DPH programs; (c) the types of services provided by the dental public health program; and (d) activities related to the core public health functions, which includes assessment, policy development, and assurance. For states that did not respond to the ASTDD/CDC State Synopsis Survey for that year, data were derived from the Oral Health America Survey of State Dental Directors, as reported in its annual National Grading Project (7, 8).

Federally-funded Community Health Centers (CHCs) and Migrant Health Centers (MHCs) provide family-oriented primary and preventive health care services for people living in rural and urban medically underserved communities. Among other services, many CHCs and MHCs provide dental care services through their affiliated clinics. To assess the extent of dental service provision through Community Health Centers and Migrant Health Centers, the Uniform Data System database maintained by the Health Resources and Services Administration (HRSA), Bureau of Primary Health Care was searched (9).

Directed by the Surgeon General, the U.S. Public Health Service Commissioned Corps is one of the seven Uniformed Services of the United States (10). It is a specialized career system designed to attract, develop, and retain health professionals who may be assigned to Federal, State or local agencies or international organizations. Information on the number and agency assignment for Dental Officers and Dental Hygienists in the U.S. Public Health Service (PHS) Commissioned Corps was obtained directly from the Commissioned Corps.

Education. A survey questionnaire was developed to assess the presence and size of dental public health departments within schools of dentistry, the organizational placement of dental public health relative to other dental specialties, and the number of faculty members with a master of public health degree or equivalent in addition to a dental degree. The survey asked about the availability of advanced education in dental public health and also asked about the number of clock hours in the predoctoral dental curricula devoted to specific dental public health topics including: oral epidemiology; evaluation of the scientific literature and research design; community-based preventive dental programs; dental care delivery systems; modes of financing dental care; jurisprudence; ethical issues; and extramural field experience.

Survey questionnaires were mailed to the deans of all 54 accredited U.S. schools of dentistry in January 2001. The cover letter requested that the dean either complete the survey or forward it to the person who could best answer it. A second mailing was sent to non-responders one month after the initial due date.

This project also assessed the dental public health faculty and curriculum contents of accredited dental hygiene programs. Dental public health presence in dental hygiene programs was assessed through an email-based survey. A list of accredited programs in dental hygiene was obtained from the American Dental Hygienists' Association (ADHA) in February 2001. A short e-mail-based questionnaire and cover letter were sent to the contact person listed for each of the 251 identified programs. The programs were asked the number of faculty members with a graduate degree in a public health field, the number of clock hours in each of eight dental public health subjects, and the number of students enrolled in the program.

The cover letter and questionnaire were sent via fax to 22 programs for which there was either no e-mail address or there was a technical problem in sending them electronically. A second e-mail was sent to all non-responders two weeks after the deadline.

Because dental public health professionals largely receive their public health education and training from accredited schools of public health, this project assessed the dental public health presence and capacity in those institutions. In February–March 2001, all schools of public health that were accredited by the Council on Education for Public Health (n=35) were surveyed regarding their dental public health presence. The survey asked about the presence and size of a department of public health dentistry, the number of faculty members who held a dental or dental hygiene degree in addition to their public health degree(s), the availability of courses on dental public health topics, and the availability of a program with a concentration in dental public health at the master's degree level or beyond.

Information on the number of accredited dental public health residency programs, enrolled residents, and residents' stipend and tuition was obtained from the American Dental Association (ADA) (11). To put the stipend support for dental public health residencies in perspective, this project compared the stipends for two comparable types of training programs: pediatric dental residencies and preventive medicine residencies. These were thought to be reasonable comparisons because, similar to dental public health residencies, many pediatric residency programs are supported by the Health Resources and Services Administration and because preventive medicine has a similar population-based public health approach to health promotion and disease prevention. Data on stipends for pediatric dental residents also were obtained from the ADA; stipend data for preventive medicine residents were obtained from the American Medical Association (12). Mean annual stipends were calculated for each of the three types of residency programs.

The Prevention Research Centers (PRCs) are a network of academic centers, public health agencies, and community partners conducting applied research and practice in chronic disease prevention and control. There are currently 28 PRCs situated in academic research centers in 25 states, housed within schools of public health, medicine, or osteopathy. The oral health presence in the PRCs was determined by examining several Internet sources: the CDC website for the PRCs (13), the individual websites for each of the 28 PRCs (if one was available), and the website for the PRC Oral Health Network (14).

Workforce. A survey of dentists who were certified as specialists by the American Board of Dental Public Health (ABDPH) was conducted in February 2001 to assess their current employment status, employment setting, professional activities, membership in professional organizations, recent attendance at major dental conferences, year of dental school graduation, and year of board certification. The survey questionnaires were sent to all known active diplomates of the board at that time (n=141), based on the list provided by the Executive Secretary of the American Board of Dental Public Health. Persons who did not respond to the initial mailing were sent a second mailing two months after the original due date.

One approach to identifying the number of dental public health practitioners included assessment of the number of members of key organizations, including three major national dental public health organizations in the United States: the American Association of Public Health Dentistry (AAPHD), the Oral Health Section of the American Public Health Association (APHA), and the Association of State and Territorial Dental Directors (ASTDD). The membership databases of these organizations were accessed via the organizations' websites and were examined in April–May 2003 for the number and state distribution of members. Full membership in ASTDD is limited to one per state, and the member is the state or territorial dental director except where there is no director of a state oral health program. ASTDD allows associate membership

for persons other than state or territorial dental directors.

ADA members can self-identify Dental Public Health as their specialty area. The ADA online membership directory (15) was searched in December 2002 to determine the number of active members who reported their specialty as Dental Public Health, by state. Two other major dental organizations, the National Dental Association and the Hispanic Dental Association, did not have information available for the number of members that identified their specialty as public health dentistry.

Oral health problems disproportionately affect disadvantaged populations among underrepresented minority groups in the United States (2). As the Surgeon General noted, 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. This report, therefore, included an assessment of the racial/ethnic composition of practicing dentists and dental students. Data on the racial/ethnic composition of the practicing dental community, by state, was derived from a 1999 report by the American Dental Association (16); newer data were not available. Self-reported race/ethnicity of first-year dental students in 2001 was derived from a report by the American Dental Education Association (17).

Regulatory issues. All states and the District of Columbia have boards of dentistry, a board of dental examiners, or a state dental commission. In general, those boards have the power to adopt rules and regulations regarding the practice of dentistry and dental hygiene and to issue, suspend, or revoke state licenses for the practice of those professions. In some states, the board administers the licensing examination for dentists or dental hygienists. State boards of dental examiners always include dentists, and the large majority of boards also include dental hygienists and members of the public. Some

TABLE 1
State dental directors and full-time equivalent employees (FTEs) in state dental programs in the United States, by state, 2001–2002

State	Full-Time State Dental Director*		FTEs		Contracted FTEs	
	2001	2002	2001	2002	2001	2002
Alabama	Y	Y	2	3	0	0
Alaska	N	N	0	0	0	0
Arizona	Y	Y	12	11	4	5
Arkansas	Y	Y	1	2	0	0
California	N	N†	—	—	—	7
Colorado	Y	Y	2	4	0	0
Connecticut	Y	Y†	1	—	1	—
Delaware	Y	Y†	18	—	2	—
District of Columbia	N†	N†	—	—	—	—
Florida	Y	Y†	4	—	0	—
Georgia	Y	Y	2	4	25	54
Hawaii	Y	Y	26	28	0	0
Idaho	Y	Y†	2	—	3	—
Illinois	Y	Y	6	9	0	0
Indiana	Y	Y	9	11	1	0
Iowa	Y	N†	4	—	—	—
Kansas	N	N†	—	—	—	—
Kentucky	N	Y	3	11	5	4
Louisiana	N	N	2	2	0	2
Maine	Y	Y	4	4	3	4
Maryland	Y	N†	2	—	—	—
Massachusetts	Y	Y	1	3	—	0
Michigan	N	Y	0	1	0	0
Minnesota	Y	Y	1	1	—	0
Mississippi	N	N	2	1	—	0
Missouri	Y	Y	7	2	7	9
Montana	Y	Y	1	1	0	0
Nebraska	Y	Y†	2	—	0	—
Nevada	N	N	2	1	0	0
New Hampshire	Y	Y	0	2	13	20
New Jersey	N	N	3	1	0	3
New Mexico	Y	Y	16	14	20	3
New York	Y	Y	13	11	0	0
North Carolina	Y	Y	81	80	0	0
North Dakota	Y	N	4	4	4	1
Ohio	Y	Y	17	16	0	0
Oklahoma	Y	Y	14	3	1	12
Oregon	Y	Y	2	1	1	0
Pennsylvania	Y	Y	1	2	0	0
Rhode Island	N	N	1	1	1	0
South Carolina	Y	Y†	1	—	0	—
South Dakota	N	N	0	—	0	—
Tennessee	Y†	Y†	—	—	—	—
Texas	Y†	Y†	—	—	—	—
Utah	Y	Y	4	5	0	0
Vermont	Y	Y	6	7	0	0
Virginia	Y	Y	5	5	1	5
Washington	Y	Y†	2	—	0	—
West Virginia	N	N	3	4	20	18
Wisconsin	Y	Y	1	2	0	0
Wyoming	Y	Y	2	2	0	0
Proportion of states with full-time dental director	74.5%	72.5%				
Median			2	3	0	0
Range			0–81	0–80	0–25	0–54

*Y= Yes, full-time dental director; N=No full-time state dental director

† State did not respond to the ASTDD/CDC State Synopsis Survey for that year; data were derived from the Oral Health America Survey of State Dental Directors, as reported in its annual National Grading Project [Oral Health America 2002; 2003].

— = Data not reported

states also include other dental personnel, such as dental assistants or denturists. The licensure and regulatory issues under the control of state boards of dentistry can directly impact the health of the public. Therefore, information was sought on the degree of representation on those boards by public health dentists. The presence of public health dentists on state boards of dental examiners as of April 2003 was determined by: (1) examining the composition of board as described in each state's statutes pertaining to the establishment of a board of dentistry; (2) obtaining a list of the current members of each state's board members; and (3) determining the specialty status of each dentist member of each board. The statutes governing state boards of dental examiners and current board members for nearly all states were found on the Internet. The lists of current board members were obtained either from each board's website or from minutes of a recent meeting of the board. Seven state boards that did not have the list available on the Internet were contacted by telephone or e-mail.

Dental hygienists can potentially facilitate access to preventive dental services, conduct oral health promotion activities outside of dental office settings, and provide screening and preventive services in dentally underserved institutional settings (18). However, in nearly every state the scope of dental hygiene practice is regulated by state boards of dental examiners, which are composed primarily of dentists with a substantially smaller number of dental hygienists. Since regulations on the scope of practice of dental hygiene may have implications on the available dental public health infrastructure and access to care (19, 20), information on the levels of supervision by a dentist required for a dental hygienist to provide routine prophylaxis or apply topical fluoride in each state and the District of Columbia was obtained from the ADA and the American Dental Hygienists' Association (ADHA). Because levels of required supervision differ for dental offices and institutional settings in a number of states, the regulations regarding those practice settings were examined separately. Most of the information was available from the ADA (21, 22). In addition, the ADHA has compiled a chart of dental hygiene permitted functions and supervision levels, by state (23). In cases where there were questions about the required level of supervision in a given state or the ADA and ADHA documents seemed to be contradictory, that state's dental practice act was consulted; the exact text of nearly all state practice acts was accessible on the Internet.

Results

Government - *State dental programs.* In 2001, 38 states had a full-time dental director; that figure dropped slightly to 37 states (72.5%) in 2002 (Table 1). Among the 46 states that responded to the 2001 State Synopsis Survey of Dental Public Health Programs, the median number of full-time equivalents employees (FTEs) in state dental programs was 2.0, with a range of 0–80. The median number of FTEs was slightly higher in 2002 (3.0), although data were available for just 36 states; the range was 0–81. Use of contracted FTEs was reported by 17 state programs in 2001 and 14 of the responding states in 2002.

Information on the total budget for the state's dental public health program was reported for 45 states in 2001 and 34 states in 2002 (Table 2). In 2001, about 40 percent of responding states had annual budgets of $500,000 or less; 4 (8.9%) state dental public health programs had total annual budgets of less than $100,000. The situation remained largely unchanged in 2002; 41% of responding states had an annual budget of $500,000 or less and 65% had total budgets of $1 million or less.

Based on the 37 states that provided information on programmatic activity on the 2001 State Synopsis Survey of Dental Public Health Programs, the most commonly provided program was oral health education and health promotion (86.5%), followed by oral health needs assessments/oral health surveys (78.4%) and school fluoride mouth rinse programs (78.4%). (Note: this excludes community water fluoridation, which is provided to varying degrees in nearly all states). Fluoride varnish programs were conducted by 5 (13.5%) of the responding states.

Government - *Federally-funded community and migrant health centers.* Of the 788 Community Health Centers (CHCs) identified in the HRSA Bureau of Primary Health Care's Uniform Data System database for 2003, 64.7 percent provided some type of dental services. The number and proportion of CHCs within each state that provided dental services varied widely, ranging from 1 to 45, and from 22.2 percent to 100 percent. The Healthy People 2010 target of at 75 percent of CHCs having a dental component (3) was met by 21 states. A total of 121 Migrant Health Centers (MHCs) were identified in the Bureau of Primary Health Care's program

TABLE 2
Budgets for state dental public health programs, 2001 and 2002

	Number of states	Precent of responding states	Number of states	Percent of responding states
Total Budget for State Dental Program				
< $100,000	4	8.9	2	5.9
$100,000-$250,000	7	15.6	7	20.6
$250,001-$500,000	7	15.6	5	14.7
$500,001-1,000,000	13	28.9	8	23.5
>$1,000,000	14	31.1	12	35.3
Total	45	100	34	100

Source: 2001 and 2002 State Synopsis Surveys of Dental Public Health Programs conducted by the Association of State and Territorial Dental Directors and the Centers for Disease Control and Prevention, Division of Oral Health.

database. Of those, 103 (85.1%) provided some type of dental care.

Of the 817 grantees supported by the Bureau of Primary Health Care in 2002 (excluding 26 grantees in Puerto Rico and US territories), 71.9% of grantees provided preventive dental services, 63.6% provided restorative dentistry, 66.3% provided emergency dental care, and 34.6% provided rehabilitative dental services (the Bureau of Health Professions Uniform Data System Manual does not provide explicit definitions for these services). The proportion of grantees that provided each type of service varied widely among the states. For example, the proportion providing preventive dental services ranged from 35% to 100%. However, the Uniform Data System database included only services provided directly by the grantee, and did not include services provided through referral to outside providers and paid for by the grantee.

Government - *US Public Health Services Commissioned Corps.* As of April 14, 2004, there were 489 Dental Officers in the PHS Commissioned Corps, which constituted 8.2 percent of all Commissioned Corps officers (N=5,973). The large majority of Commissioned Corps Dental Officers were assigned to the Indian Health Service (51%), the Bureau of Prisons (23%), or the Department of Homeland Security (11%). As of April 14, 2004 there were 61 dental hygienists in the PHS Commissioned Corps; most were assigned to the Indian Health Service (64%) or the Federal Bureau of Prisons (26%).

Education - *Schools of dentistry, departments of public health dentistry.* Responses were received from 45 (83%) dental schools. Of the 45 dental schools that responded to the 2001 survey, 44 provided information on the presence of a dental public health department; 31 schools (68%) had a department or division whose primary focus was public health dentistry, community dental health, or dental ecology. Of the 31 schools with an academic unit with a focus on public health dentistry, 26 of these academic units had an administrative placement within the school that was comparable to other dental specialties. Of the 31 dental public health academic units identified by survey respondents, the median number of faculty in those academic units was 5.0. Eleven (35%) of responding schools had units with 1–3 faculty members.

Education - *Dental faculty with public health training.* A median of 3.0 dental school faculty members with an MPH or other public health degree was reported by the 40 responding schools that provided that information; 5 (12.5%) had no faculty members with a public health degree.

Education - *Programs in dental hygiene.* Of the 251 accredited US dental hygiene programs identified by the American Dental Hygienists' Association as of February 2001, 130 (51%) responded to the survey. Among responding dental hygiene programs, 64.3% had no faculty member with a public health degree, 25.6% had one faculty member with such a degree, and the remaining 11.1% had two or more faculty members with a graduate public health degree.

Education - *Schools of public health.* A total of 27 of the 35 (77%) schools of public health accredited by the Council on Education for Public Health responded to the 2001 survey. Only one responding school indicated the existence of a department of dental public health or community dentistry within the school of public health. Four (15%) of the responding schools indicated that they offered a Master of Public Health degree in a dental public health concentration area, and five schools (19%) reported offering advanced training in dental public health. Among responding schools, 60 percent reported having no faculty members with a dental or dental hygiene degree, 28 percent reported one faculty member with a dental or dental hygiene degree, and 12 percent had two or more faculty members with those degrees.

Education - *Advanced training programs in dental public health (residencies).* As of June 2002, there were 18 accredited dental public health residency programs; nine programs were located in schools of dentistry and nine were sponsored by other institutions. All dental public health residency directors were certified by the American Board of Dental Public Health, and all but one director were employed full-time by the sponsoring institution.

In 2000–01, five of the nine dental school-based residency programs offered no stipend support for residents; the other four dental school-sponsored programs offered stipends ranging from $20,000 to $30,000. Five of the nine dental school-based residency programs charged fees and/or tuition, which ranged from $400 to $34,200 annually.

Mean first year stipends were about $6000 less for dental public health residencies (mean = $18,418) than for pediatric dentistry residencies (mean=$24,253), and were about one-half the mean levels of stipend support for preventive medicine residencies (mean=$37,482).

Prevention Research Centers (PRCs). Based on available information as of January 2004, at least 10 of the 28 PRCs have conducted at least one oral health-related project. In general, the number of oral health projects was small in each PRC with most PRCs having no more than one or two such projects. At least 16 PRCs have some degree of oral health faculty presence.

Workforce - *Board-certified public health dentists.* Of the 141 Diplomates of the American Board of Dental Public Health (ABDPH) classified as "active" as of February 2001, completed survey questionnaires were received from 125 (89%). Of the respondents, 80 (64%) were employed full-time in a dental public health related field, 15 (12%) worked part-time in dental public health, 12 (10%) were employed in field other than dental public health, four (3%) were unemployed at the time of the survey, and 14 (11%) respondents reported "other" employment status. Among the 14 respondents reporting "other" status, seven reported they were retired.

The two most common employment settings for active diplomates were federal government (28.7%) and schools of dentistry (28.7%) (Table 3). Five diplomates (4.1%) were em-

ployed by county or local governments and 14 (11.5%) worked for state governments. Based on the 93 active board-certified dentists who responded to questions about current professional activities, diplomates reportedly spent a mean of 39 percent of their time on administrative duties, followed by research (25%) and teaching (16 %).

Workforce - *Race/ethnicity of dental workforce and students.* In 1997, 1.9 percent of active dentists in the United States self-identified as black or African-American, compared to 12.1 percent of the US population (16). Blacks were underrepresented in the dental workforce relative to their proportion in the population in virtually every state. The estimated proportion of dentists who were black or African-American ranged from 0 percent in five states to 20.9 percent in the District of Columbia, with blacks comprising less than five percent of dentists in all but two jurisdictions. Hispanic/Latino dentists comprised 2.7 percent of dentists in the United States in 1997, compared to 10.9 percent of the US population, and were underrepresented in nearly all states. Underrepresentation was most pronounced in the states with relatively large Hispanic/Latino populations. The estimated proportion of dentists who self-identified as Hispanic/Latino ranged from 0 to 13.1 percent among the states.

Although "Asian or Pacific Islander" is a very heterogeneous group, it comprised a greater proportion of all active dentists (5.7%) than in the general US resident population (3.6%). This pattern was particularly notable in Hawaii, where Asians/Pacific Islanders comprise 73.8 percent of dentists and 63.1 percent of the general population, and in California, where they account for 11.8 percent of the general population but more than 20 percent of active dentists.

Overall, black/African-American students comprised 5.5 percent of first-year dental students in 2001 (17). Fourteen of the 54 dental schools had not a single black/African- American first-year student, and even in large, ethnically diverse states there were very few black/African-American students. Hispanics/Latinos comprised 5.2 percent and Asians/Pacific Islanders accounted for 21.6 percent of first-year dental students. There were just 19 American Indian/Alaskan Native first-year dental students in 2001.

National oral health organizations. As of May 2003, there were 640 members of AAPHD residing in the United States and an additional 78 members living in other countries (Table 4). Three states (Delaware, Rhode Island, and Wyoming) had no AAPHD members and five states (Arkansas, Montana, South Dakota, Utah, and Vermont) had just a single member. Eight states (California, Illinois, Iowa, Maryland, Massachusetts, New York, North Carolina, and Texas) accounted for nearly 50 percent of the U.S. membership of AAPHD. There were 0.28 AAPHD members per 100,000 population in the United States; the number per 100,000 population exceeded 1.0 in just two states: Iowa (1.20) and Maryland (1.28). As of April 2003 there were 290 members of APHA who listed Oral Health Section as their primary section. There were 11 states with no member of the Oral Health Section, and 44 percent of the members resided in one of five states (California, Illinois, Maryland, Massachusetts, and New York). As of May 2003, there were 46 associate members of ASTDD.

In 2002, the ADA had 544 mem-

TABLE 3
Selected characteristics of active Diplomates of the American Board of Dental Public Health (n=125)

Characteristic	N	%
Place of employment*		
Federal government	35	28.7
State government	14	11.5
County or local government	5	4.1
School of dentistry	35	28.7
School of public health	6	4.9
Private organization	7	5.7
Other	20	16.4
Year of dental school graduation		
Before 1971	44	35.2
1971–1985	68	54.4
1986–2001	13	10.4
Year received MPH degree		
Before 1971	30	24.0
1971–1985	45	36.0
1986–2001	50	40.0
Professional organizations to which Diplomates belong		
American Association of Public Health Dentistry	112	89.6
American Dental Association	86	68.8
American Dental Education Association	30	24.0
American Public Health Association	55	44.0
Association of State and Territorial Dental Directors	13	10.4
Hispanic Dental Association	9	7.2
International Association for Dental Research	52	41.6
National Dental Association	2	1.6
Meetings attended in 2000		
American Association of Public Health Dentistry / Association of State and Territorial Dental Directors	57	45.6
American Public Health Association	21	16.8
American Dental Association	17	13.6
American Dental Education Association	15	12.0
Hispanic Dental Association	2	1.6
International Association for Dental Research	44	35.2
National Dental Association	4	3.2

Source: 2001 Survey of Diplomates of the American Board of Dental Public Health

bers who reported their specialty as Dental Public Health; of those, 79 were members of the Federal Service (Table 4). The number of ADA-member public health dentists in the states (excluding Federal Service members) ranged from 0 in five states (Maine, New Hampshire, South Dakota, Vermont, and Wyoming) to 41 in California. Overall, there was 0.17 ADA-member public health dentist per 100,000 population; no state exceeded 1 public health dentist per 100,000 population. Stated another way, there were 605,208 persons per ADA-member dental public health specialist in the United States.

Regulatory issues - *State boards of dental examiners.* As of April 25, 2003, information on the composition of the boards of dental examiners was found for all states except New Mexico and the District of Columbia. The median size of the state boards of examiners was 9 (range: 5–20), with a median of 6 members who were dentists (range: 4–13). All but two states (Connecticut and Washington) included at least one dental hygienist on the state board of dental examiners, although Washington State has a separate Dental Hygiene Examining Committee composed of three practicing dental hygienists and one public member that oversees clinical examination and certifies competency in dental hygiene practice. All but seven states included at least one public member with no financial connection to dentistry.

A public health dentist was identified for two state boards of dental examiners, Connecticut and Rhode Island. By statute, the Rhode Island State Board of Examiners in Dentistry includes the Chief of the Office of Dental Public Health, who must be a licensed dentist possessing a masters degree in public health or a certificate in public health from an accredited program. No other state had a similar requirement for its board of dental examiners.

Regulatory issues - *State practice acts regarding dental hygiene practice.* The states varied widely in the required degree of supervision of dental hygienists by a dentist, and the

TABLE 4
Membership in American Association of Public Health Dentistry (AAPHD), Oral Health Section of the American Public Health Association (APHA), American Dental Association (ADA) dental public health specialists, and ADA dental public health specialists per 100,000 population, by state, as of May 20, 2003

State	AAPHD	APHA Oral Health Section	ADA dental public health specialists (active)*	ADA dental public health specialists per 100,000 population†
Alabama	7	7	10	0.22
Alaska	7	1	6	0.96
Arizona	13	5	6	0.12
Arkansas	1	0	1	0.04
California	65	36	41	0.12
Colorado	7	4	18	0.42
Connecticut	13	5	2	0.06
Delaware	0	0	1	0.13
District of Columbia	5	4	1	0.17
Florida	22	7	31	0.19
Georgia	13	9	14	0.17
Hawaii	6	1	3	0.25
Idaho	2	0	1	0.08
Illinois	31	17	6	0.05
Indiana	5	3	8	0.13
Iowa	28	7	13	0.44
Kansas	3	1	4	0.15
Kentucky	9	1	7	0.17
Louisiana	2	0	2	0.04
Maine	3	1	0	0.00
Maryland	62	30	14	0.26
Massachusetts	31	16	23	0.36
Michigan	18	14	15	0.15
Minnesota	8	5	6	0.12
Mississippi	7	2	1	0.04
Missouri	10	5	7	0.13
Montana	1	0	3	0.33
Nebraska	6	1	1	0.06
Nevada	4	3	4	0.20
New Hampshire	8	0	0	0.00
New Jersey	14	15	12	0.14
New Mexico	19	1	4	0.22
New York	38	30	38	0.20
North Carolina	23	3	26	0.32
North Dakota	4	0	1	0.16
Ohio	10	6	13	0.11
Oklahoma	6	1	11	0.32
Oregon	12	3	9	0.26
Pennsylvania	19	15	7	0.06
Rhode Island	0	1	3	0.29
South Carolina	9	0	1	0.02
South Dakota	1	0	0	0.00
Tennessee	11	3	15	0.26
Texas	30	11	26	0.12
Utah	1	1	3	0.13
Vermont	1	1	0	0.00
Virginia	16	4	17	0.24
Washington	13	9	18	0.31
West Virginia	4	0	2	0.11
Wisconsin	12	1	10	0.19
Wyoming	0	0	0	0.00
Total	640	290	465	0.17

* Excludes 79 members of Federal Dental Service
†Based on 2000 US Census

states frequently differed in the rules governing dental hygiene practice in dental office or institutional settings. Only one state, Colorado, allowed unrestricted, unsupervised practice by a dental hygienist when performing basic dental prophylaxis. As of May 2003, 13 states required direct or indirect supervision of dental hygienists in dental offices; i.e. the supervising dentist must be physically present while dental hygienists were providing care. Eight states required direct or indirect supervision of dental hygienists working in institutional settings. Thirty-six states plus the District of Columbia permitted general supervision of dental hygienists in dental offices; i.e. the dentist need not be present when patient care is provided, but the supervising dentist must first examine the patient, develop a treatment plan, issue a written work order, and/or evaluate the hygienist's work within a fixed period of time. Forty-three states and the District of Columbia permitted general supervision in institutional settings.

Discussion

Government. State dental programs, in general, have few employees and small budgets. It is perhaps remarkable that programs are able to conduct as many activities as they do, with a median of just 2–3 full-time employees and typical annual budgets of less than $1 million. But more than one-quarter of states lack a full-time dental director; such states tend to be less likely than states with a full-time director to conduct core public health activities in oral health (24).

Although most federally-funded Community and Migrant Health Centers provide some level of dental care services, it is unclear whether these centers or local and county health departments conduct the full range of core public health functions in oral health.

It is not clear whether the number of Public Health Service Commissioned Corps Dental Officers and Dental Hygienists is sufficient to adequately address the mission of the Commissioned Corps, but the number is small in most federal agencies. Interestingly, there are more dental officers in the Department of Homeland Security (mostly in the US Coast Guard) than in the combined number of officers assigned to the Centers for Disease Control and Prevention, the National Institutes of Health, the Health Resources and Services Administration, and the Center for Medicare & Medicaid Services. It is not clear whether that distribution best reflects the primary threats to the oral health of the nation and their prevention and control.

Education. Dental public health has a minimal presence in schools of public health, which does not bode well for a field that requires a master of public health degree or equivalent as part of the minimal educational preparation. Even in schools of dentistry, dental public health tended to have a small presence, which creates several possible challenges to the future of dental public health: there are relatively few role models for dental students, many schools are unlikely to have a critical mass of public health dentists to be effective in specialty education or research, and the specialty may be dismissed as marginal by the school's administration, faculty, and students.

There are few training programs and residents, and there are very few board-certified public health dentists in state or local dental public health programs. Perhaps it is time to re-evaluate whether the current training and certification model for public health dentists, developed more than 50 years ago (25), is still appropriate in the 21st century. With substantial barriers to completing formal training in dental public health and few incentives, it is little wonder that the large majority of educators teaching dental public health topics in school of dentistry have not completed a dental public health residency program, are not board-certified public health dentists, and have little interest in pursuing such training or certification (26, 27).

Dental hygiene programs, arguably the most important training ground for oral health practitioners whose activities are almost entirely devoted to disease prevention, generally lack faculty with public health training. One potentially positive finding is that current entry-level dental hygiene programs typically devote a substantial number of curriculum hours to the provision of clinical services in public health settings. However, restrictions on dental hygiene practice imposed by some state dental licensing boards may limit the ability of dental hygienists to pursue careers in institutional settings in those states.

Workforce. Although there are no specific guidelines for the optimum number of adequately trained dental public health personnel, by almost any definition the workforce is small. There are virtually no board-certified public health dentists at the county or local level and minimal presence in state programs. Even applying broader definitions of public health dentists, based on membership in the major dental public health organizations or self-reported specialty among American Dental Association members, there are very few public health dental practitioners in any state. The number of dental public health workers in the United States other than dentists is unclear; the Public Health Workforce enumeration conducted for the Bureau of Health Professions in 2000 reported a total of 2,032 public health dental workers, including 1,240 in federal agencies and 792 in state and territorial agencies (28). However, no information on public health dental workers was reported by many states, and there was no information on the type of personnel employed or their activities.

The face of dentistry still does not reflect the face of America. Blacks/African-Americans, Hispanics/Latinos, and Native Americans are substantially underrepresented in the dental profession relative to their proportion in the population in virtually every state. The situation looks only slightly better among first-year dental school students than in the practicing dental community, ensuring that the current pattern will continue for some time. Cultural competency will remain a challenge without cre-

ative solutions to achieve a dental workforce that more closely mirrors the public it serves. Current initiatives such as the Pipeline, Profession, and Practice: Community-Based Dental Education Program, funded by the Robert Wood Johnson Foundation and the California Endowment at 15 U.S. dental schools, may help to increase the number of under-represented minority dental students (29).

Regulatory issues. Despite the strong public health impact that may result from the actions of state dental licensing boards, there is virtually no dental public health presence on these boards. As was pointed out more than decade ago (30), there is a public health vacuum in state licensing boards. Perhaps a greater dental public health presence on state licensing boards might lead them to abandon initial clinical examination of U.S. dental school graduates. Those clinical licensing exams have no demonstrated effect in predicting the quality of dental care or in protecting the public (31), bear little association to dental school performance (32), delay dentists' entry in the workforce and restrict their ability to relocate, unnecessarily puts human subjects at risk (33), and frequently use outdated standards that result in inappropriate patient care (34). Perhaps, with more of a public health orientation, state boards of dentistry could redirect their energies toward activities that might ensure continued competence of practitioners and establish policies that enhance access to care.

In addition, dental hygiene remains under-represented on state dental licensing boards and generally lacks autonomy over its own licensing and practice. The more liberal standards of supervision allowed in institutional and public health settings compared to office settings may increase access to preventive services for some segments of communities, but the required levels of supervision in other settings may serve to restrict access to preventive dental services. In particular, standards of supervision that require a dentist to be physically present or to examine all patients prior to dental hygiene services may impede delivery of school-based dental screening and prevention services. Although school nurses routinely screen students for health conditions such as scoliosis, hearing loss, visual impairment, and head lice, dental hygienists in many states are explicitly prohibited from screening schoolchildren for oral health problems. Dental licensing boards' continued restriction on dental hygienists' ability to practice in underserved communities could lead to law suits similar to the one brought by the Federal Trade Commission against the South Carolina Board (35), and ultimately could lead to dentistry's loss of monopoly on providing dental care (36).

Recent developments suggest that there is real or perceived demand for training new types of health care professionals in the United States to increase access to care in settings currently underserved by dentists. For example, pediatric oral health therapists are being trained in New Zealand with the intention of having them provide care to children in remote Alaskan Native tribal areas, although the Alaskan Dental Health Aide Program initiative has been met with resistance from the American Dental Association (37). The American Dental Hygienists' Association recently called for the development of an Advanced Dental Hygiene Practitioner curriculum that would allow credentialed dental hygienists to provide diagnostic, preventive, restorative and therapeutic services directly to the public (38). It is too soon to evaluate the effectiveness or acceptance of these types of initiatives in the United States, although there is a long history of successful programs such as the New Zealand dental nurse/therapist and its variants in at least 41 other countries including Australia, Great Britain, Canada, Singapore, China (Hong Kong), and Thailand (39). Trained auxiliaries in the United Kingdom have been found to be comparable to dentists in performing oral assessments (40) and Canadian dental therapists were found to provide dental restorations of clinical quality comparable to those provided by dentists (41). Organized dentistry at the national and state levels continues to generally oppose increased autonomy of non-dentists, but trends in the number of dental graduates, demographic characteristics, and preferred practice settings of American dentists suggests that problems in access to care in many communities will not soon be alleviated solely by dentists.

Recommendations

After weighing the findings from this assessment, the following recommendations are offered to enhance the effectiveness of the dental public health infrastructure in the United States. There is no single organization or agency that has the ability to bring about the numerous changes that would need to occur to enhance the dental public health infrastructure in the United States, so successful efforts will require substantial collaboration among many diverse partners.

Government. 1) Develop state health department standards that require an adequately trained and credentialed state dental director in all states and the District of Columbia. "Adequate" training will need to be defined explicitly, but should include, as a minimum, a graduate degree in public health in addition to a degree in an oral health profession; 2) Provide adequate funding to permit all state health departments to conduct the core dental public health functions of assessment, policy development, and assurance. 3) Ensure that all county health departments have a county dental director with advanced education in public health; 4) Include dental services in the scope of services of all county health departments that provide direct clinical care and all federally-funded Community and Migrant Health Centers; 5) Examine the activities and responsibilities of all US Public Health Service Commissioned Corps dental officers to better characterize their scope of activities;

Education. 1) Develop model dental public health curricula for schools of dentistry and dental hygiene programs and work with the American Dental Education Association to dis-

seminate and promote the curricula; 2) Recruit dental public health faculty to schools of public health; 3) Develop core courses in dental public health within schools of public health; 4) Increase service learning opportunities for students in dental and dental hygiene programs in diverse, community-based settings; 5) Develop competencies for dental and dental hygiene education that include cultural competence, patient- and community-based prevention, and distributive justice; 6) Develop new models of specialty training in dental public health that ensure adequate coverage of dental public health topics, relevant experience, and financial support for graduate education; 7) Develop dental public health specialty training and credentialing for graduates of accredited dental hygiene programs; 8) Increase the number of dental public health researchers and oral health-related projects in Prevention Research Centers

Workforce. 1) Develop a set of incentives for pursuing dental public health board certification for state, county, and local dental personnel; 2) Ensure that the American Dental Association requires documentation of credentials for dentists who report their specialty as Public Health Dentistry; 3) Enhance outreach by schools of dentistry to increase number of dental and dental hygiene students from underrepresented minority groups.

Regulatory Issues. 1) Require dental public health representation on state boards of dental examiners; 2) Increase dental hygiene representation on state boards of dental examiners; 3) Develop evidence-based recommendations for level of dental supervision and scope of permitted dental hygiene services in underserved settings and communities.

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