The challenge to delivering oral health services in rural America

Susan M. Skillman, MS[1]; Mark P. Doescher, MD, MSPH[1]; Wendy E. Mouradian, MD, MS[2]; Diane K. Brunson, RDH, MPH[3]

1 University of Washington, Rural Health Research Center
2 University of Washington, Pediatric Dentistry, Pediatrics, Dental Public Health Sciences and Health Services
3 University of Colorado School of Dental Medicine

Keywords
dental; oral health; rural; urban; workforce; prevention.

Correspondence
Ms. Susan M. Skillman, 4311 11th Ave NE, Suite 210, Seattle, WA 98105. Tel.: 206-543-3557; Fax: 206-616-4768; e-mail: skillman@u.washington.edu. Susan M. Skillman and Mark P. Doescher are with the University of Washington, Rural Health Research Center. Wendy E. Mouradian is with the University of Washington, Pediatric Dentistry, Pediatrics, Dental Public Health Sciences and Health Services. Diane K. Brunson is with the University of Colorado School of Dental Medicine.

Received: 1/29/2010; accepted: 3/16/2010.

doi: 10.1111/j.1752-7325.2010.00178.x

Abstract

Objectives: This review identifies the challenges to oral health in rural America and describes areas of innovation in prevention, delivery of dental services, and workforce development that may improve oral health for rural populations.
Methods: This descriptive article is based on literature reviews and personal communications.
Results: Rural populations have lower dental care utilization, higher rates of dental caries, lower rates of insurance, higher rates of poverty, less water fluoridation, fewer dentists per population, and greater distances to travel to access care than urban populations. Improving the oral health of rural populations requires practical and flexible approaches to expand and better distribute the rural oral health workforce, including approaches tailored to remote areas. Solutions that involve mass prevention/public health interventions include increasing water fluoridation, providing timely oral health education, caries risk assessment and referral, preventive services, and offering behavioral interventions such as smoking and tobacco cessation programs. Solutions that train more providers prepared to work in rural areas include recruiting students from rural areas, training students in rural locations, and providing loan repayment and scholarships. Increasing the flexibility and capacity of the oral health workforce for rural areas could be achieved by creating new roles for and new types of providers. Solutions that overcome distance barriers include mobile clinics and telehealth technology.
Conclusions: Rural areas need flexibility and resources to develop innovative solutions that meet their specific needs. Prevention needs to be at the front line of rural oral health care, with systematic approaches that cross health professions and health sectors.

Rural populations in the United States have lower dental care utilization, and higher rates of dental caries and permanent tooth loss than urban populations for many reasons, including lower rates of private dental insurance coverage among rural adults and children, limited availability of dental care, and higher rates of poverty (1-7). This review identifies the challenges to improving oral health in rural America and describes potential solutions including enhancing prevention and public health measures, developing a larger workforce prepared for rural practice, increasing the flexibility and capacity of the rural oral health workforce, and overcoming distance barriers.

The challenges to oral health in rural America

Seventeen percent of US residents live in nonmetropolitan, or rural, areas of the country that cover 80 percent of its land mass (8). Over the next decade and a half, the migration of retired baby boomers will significantly increase the populations of rural and small-town America. Rural populations age 55-75 are expected to increase by 30 percent between 2009 and 2020 (9). Access to health care in general is limited in many rural areas compared with urban areas of the United States, and rural residents experience greater travel times and

miles to access care than their urban counterparts (10). There are many ways to define what constitutes a rural area, but most experts agree that in the United States "rural" is a heterogeneous concept that includes areas ranging from communities within short-commuting distances to urban centers to remote frontier areas that can only be accessed by long-travel distances (some accessible only by air or water). Solutions to the challenges of providing health services to different rural populations must address the broad range of barriers faced by this diverse array of communities.

The need for oral health services is increasing in rural areas. Oral health ranks as the fifth most important among 28 priority conditions according to the Rural Healthy People 2010 (11). Many rural households use well water or are connected with small nonfluoridated water districts, making the growing rural populations at greater risk of dental caries than urban populations where water fluoridation is more common. Rural residence, particularly in the southeastern United States, is associated with higher rates of smoking and smokeless tobacco use which are associated with oral and pharyngeal cancer, periodontal disease, and caries (4). Older members of the population are living longer, most are retaining their own teeth, and as a result they will require more dental services later in life than was the case for previous generations. Older rural residents have less favorable dental indicators than urban residents, lower rates of dental insurance coverage, and access dental care less appropriately (12).

Despite the fact that there are known safe and effective measures that can prevent the most common oral diseases, these conditions continue to affect people of all ages, and profound oral health disparities exist among the US population (4). Among measures called for by the US surgeon general in 2000 to improve the nation's oral health were strengthening the US public health infrastructure; increasing oral health prevention; assuring the capacity, flexibility, and diversity of the workforce; and distributing the workforce more equitably. The rural dental workforce was noted to be significantly smaller than in urban centers in 2000 (1). In 2008, there were 22 generalist (general practice, pediatric, or public health) dentists per 100,000 population in rural areas of the country compared with 30 per 100,000 in urban areas, and a higher percentage of generalist dentists in rural areas were age 56 or older compared with urban areas, indicating even greater maldistribution is likely in the future as the dentists retire (13). Almost half of rural federally qualified community health centers surveyed in 2004 reported dentist vacancies that had been unfilled for more than 7 months (14).

While nationally the dentist-to-population ratio is expected to remain near current levels, access to care for the underserved, including rural populations, is not expected to improve noticeably without policy interventions (15). For example, low socioeconomic status and lack of insurance in rural populations contribute to low levels of oral healthcare access due, in part, to socioeconomic status and insurance coverage (16). Deficits in rural utilization may also reflect the sparse populations of rural areas and travel barriers that must be overcome to reach providers (17).

In summary, multiple challenges must be overcome to improve the oral health of rural populations. While there is variability across regions, characteristics of rural oral health delivery systems include limited access to preventive/public health services, fewer dental providers (generalists as well as specialists) per population than in urban areas, larger proportions of the population without insurance or adequate income to access oral health services, and more time and resources required to bridge the geographic distances between populations and needed services.

Workforce and service delivery solutions for oral health in rural America

Given the diversity of rural communities, improving their oral health requires practical and flexible approaches to better distribute the rural oral health workforce and expand access to oral health services, including strategies tailored to remote areas. Descriptions of oral health improvement programs are provided below, accompanied by specific examples in rural areas. Table 1 shows the challenges that are addressed by these oral health improvement programs, ranging from public health and behavioral health interventions, to recruitment and retention of the workforce, developing new care delivery models that use new workforce and technology innovations, and overcoming financial barriers to access.

Solutions that involve mass prevention/ public health interventions

Increase water fluoridation

Fluoridation of public water supplies has dramatically reduced the prevalence of dental caries in the United States (18,19). The lack of water fluoridation in many rural and remote areas is due in part to geographic and practical obstacles (reliance on wells and small water systems), but continuation of grant programs such as the CDC's Preventive Health and Health Services Block Grants that support fluoridation of rural community water supplies could encourage more communities to take this important step toward reducing future oral healthcare needs.

Provide oral health education, caries risk assessment and referral, and preventive services

Other effective and emerging caries prevention measures have been identified for young children and their families,

Table 1 Approaches and Programs to Overcome Challenges to Accessing Oral Health Services and Workforce Development in Rural Areas

	Approaches to overcoming rural barriers to oral health												
	Mass prevention/public health			Workforce prepared for rural			Increased flexibility and capacity of the oral health workforce		Overcome distance barriers		Reduce financial barriers		
Rural characteristics that are challenges to improving the population's oral health	Water fluoridation	Education, screening, and prevention	Behavioral health services	Recruit from rural areas	Education partnerships in rural areas	Loans/ scholarships for rural service	New roles for existing healthcare providers	New types of providers	Mobile/ portable dental clinics	Telehealth technology	Expand insurance coverage	Establish public insurance rates that encourage provider participation	Provide reduced cost services for low-income populations
Population:													
Long-travel distances to services							×	×	×	×			
Low rates of water fluoridation	×	×						×	×				
Growing older population with own teeth							×	×					
Low rates of insurance coverage		×							×		×	×	×
High poverty rates		×									×	×	×
High rates of tobacco use		×	×										
Workforce:													
Few dentists choosing rural practice	×	×		×	×	×	×	×	×	×			
Social/professional isolation for providers				×	×					×			
Providers not accepting publicly insured patients												×	
Limited referral networks for specialist care										×	×	×	

including toothbrushing with fluoridated dentifrices, use of occlusal sealants, application of topical fluorides and antimicrobials, family dietary counseling, and health education (20,21). These measures can be provided to infants, and preschool and school-age children in a variety of settings and by an array of providers. Examples of such rural programs include the south Texas "Caring for Kids" program, a comprehensive school-based dental program (22). More use of school-based programs, potentially in partnership with community and rural health centers or other safety net sites, could expand access to both preventive and treatment services. An increasing number of states provide reimbursement to primary care medical practitioners for delivering certain oral health preventive services in their offices (23). Also promising is the American Association of Pediatric Dentistry's Head Start Dental Home Initiative grant program which funds statewide programs to improve the oral health of children enrolled in Head Start through creation of dental home networks, including those that address the needs in rural communities (J. Crall, personal communication, February 17, 2010) (24). Finally, the Indian Health Service (IHS) reports more than twice the rates of sealant usage among 8- to 14-year-old IHS clients compared with the same age groups in the overall US population (25). Prevention is particularly important in these rural settings because of the high rates of caries among American Indian and Alaska Native children (26).

Solutions that offer behavioral health services for adults

Behavioral interventions encompass counseling efforts to improve oral health, ranging from increasing brushing and flossing to reducing tobacco use. Studies have shown that oral healthcare professionals can help reduce tobacco use (27,28). In Minnesota, the Dental Fax Referral Program provides free phone-based tobacco cessation interventions (available to all rural and urban residents) through referrals from dental offices (29). Such services could find broader use in primary care offices.

Solutions that train more providers prepared to work in rural areas

As populations grow and the aging dentist workforce retires, rural areas will be in greater competition with urban areas for dentists. Recruiting healthcare providers of any type to rural areas can be difficult if they are not willing or prepared to live in a rural community or if they face insurmountable financial barriers to practice. Physicians are more likely to practice primary care in rural areas if they have less educational debt, if they come from a rural area, if they have rural training opportunities during their education, or receive an education scholarship that obligates them to service in a rural/underserved area (30). These lessons are being applied to dentist education in several schools seeking to promote rural practice among their graduates and through financial incentives to oral health providers working in rural and underserved areas.

Recruit students from rural areas

The University of Colorado is establishing an interdisciplinary rural track for students in dentistry, medicine, and pharmacy, based on a study that found more than 50 percent of rural dentists in Colorado grew up in a rural area (31). The University of Washington's School of Dentistry's Regional Initiative in Dental Education (RIDE) program, initiated in 2007, was designed to increase the number of dentists in rural and underserved parts of the state. RIDE does not limit admission to students from eastern Washington or rural areas, but more students from these backgrounds have been drawn to the program. RIDE students spend their first year of study at the joint Eastern Washington University/Washington State University health sciences campus on the less populated eastern side of the state, away from the main urban dental school. During clinical years, RIDE students return for 4-6 months of community training experiences at clinical sites across eastern Washington (32).

Create education partnerships in rural locations

Training in rural areas not only gives students exposure to rural and safety net practice, but also provides development opportunities for professionals in the rural facilities partnering with academic institutions. The Colorado rural track includes rural grand rounds, seminars, and rotations with the goal of building leadership skills needed to practice in rural areas (33). Similarly, the RIDE program includes faculty development and continuing education for affiliate faculty located at student placement sites. Dental residents in New Mexico, a highly rural state in which nearly all counties are designated health professional shortage areas (HPSAs), participate in community-based rotations, and more than half practice in-state after completing their residencies (34). The Arizona School of Dentistry and Oral Health, which selects students with public service orientations and builds community service into its curriculum, reports that between 25 and 33 percent of its graduates work in community health centers (many of which are likely to be in rural areas) after graduation (35).

Provide loan repayment and scholarships

At the federal level, the National Health Service Corps has both a loan repayment and a scholarship program for

primary care (general practice and pediatric) dentists who want to reduce the financial burden of dental school. In return for service (usually 2-4 years) at an approved site in an HPSA, recipients receive awards that pay all or most of their tuition costs and some other expenses. Between 1996 and 2004, approximately 85 percent of rural counties in the United States had been an HPSA at least 1 year (36). It would take 9,642 practitioners to meet the need in 2009 for dental providers in the 4,230 dental HPSAs (37). Many states also have loan repayment and scholarship programs for dentists who commit to service in underserved and rural areas.

Solutions that increase the flexibility and capacity of the oral health workforce

Despite efforts such as those described above to recruit more dentists into rural areas, any successes in rural dentist recruitment will be competing with the rapid rate at which rural dentists will be retiring and leaving the workforce. Concurrent efforts to deploy nondentist providers in prevention and treatment are needed to fill rural service gaps and reduce future need for dental care. These include:

Promote new roles for existing healthcare providers

Permit greater dental hygienist autonomy

Enhanced training and expansion of scopes of practice for dental hygienists may help to increase the capacity and productivity of general and pediatric dental practices, and community health clinics (38). Only two states (Colorado and Maine) allow dental hygienists to own their own practices and provide preventive services without dentist supervision. In 11 other states, dental hygienists can practice only in safety net settings without direct dentist supervision (39). In Colorado, some dental hygienists are providing oral health services in primary care and pediatrics offices through the Co-Location Project (33). Dental hygienists are eligible for the NHSC loan repayment program, as well as some state loan and scholarship programs. With financial incentives and practice autonomy, more dental hygienists might become attracted to rural practice.

Support Expanded Function Dental Auxiliaries (EFDAs) and dental assistants

The scopes of practice of EFDAs and dental hygienists vary by state, but in general dental assistants work under the close supervision of dentists and provide supportive clinical services in direct relationship to treating a patient, and EFDAs perform dental assistant duties and also provide limited restorative functions. These dental professionals expand the capacity of dentists, which may allow them to see underserved patients more efficiently. Dental assistant and EFDA occupations may also provide entry points on a career ladder that leads to more advanced oral health professions, and as a result enhances professional satisfaction.

Involve medical providers in oral health care

With increasing rates of caries among young children, more prevention efforts are needed. It is recommended that children have an oral health assessment by age 1 (40). This goal, however, has not been reached, and adding to the difficulty is that more rural than urban parents report that their child is "too young" to visit the dentist (5). But, by the time children reach the age of 3, many have visited a primary care provider 11 times for routine well-child checkups (40). As a result, the practices of pediatricians, family physicians, nurses, and nurse practitioners are increasingly being promoted (and reimbursed) as sites for the delivery of oral health preventive services (38). Nearly two-thirds of the states reimburse physicians for fluoride varnish applications for Medicaid patients (23). In North Carolina, a state with large rural areas, nearly 600,000 preventive oral health services have been delivered to children birth to 3 years of age by more than 3,000 practitioners trained through the program since 2000 (K. Close, personal communication, January 13, 2010) (41). By 2009, Washington had trained nearly 1,100 physicians, advanced registered nurse practitioners and physician assistants to apply fluoride varnishes, and provided dental disease preventive services during well-child exams for which they were able to receive Medicaid reimbursement (42).

Create new types of providers

Dental Health Aid Therapists (DHAT) and dental therapists

Alaska's native populations have high rates of oral disease and tremendous difficulties accessing oral health services. The DHAT program, introduced in Alaska in 2003, trains selected individuals from the native communities in basic educational, preventive, restorative, and administrative services to work in remote areas where dentists rarely visit. Under indirect supervision from a dentist who is not located in the community, DHATs provide dental screenings, take X-rays, make diagnoses, apply sealants and topical fluorides, and perform simple extractions and restorations. The DHAT's scope of practice is written by the supervising dentist and may be revised periodically with increased skills obtained through continuing education. Patients with needed care outside the DHAT's scope of practice are referred to a dentist (L. Fiset, personal communication, January 25, 2010) (43,44). A preliminary evaluation of the Alaska DHAT program found that the first cohort of these new providers was delivering the

regular and intensive preventive care (a major goal of the program), surgeries, and restorative care within their scopes of practice, and patients were being referred appropriately (44). A comprehensive evaluation of the effectiveness of the Alaska DHAT program is underway (45). Minnesota has initiated a program to train two levels of dental therapists, basic and advanced, to provide both preventive and some restorative dental care (39).

Proposed new provider types

At least three new oral health provider types are being considered for practice in the United States. The American Dental Association (ADA) has proposed the community dental health coordinator (CDHC) and the oral preventive assistant (OPA) be introduced into the workforce. CDHCs, whom the ADA expects would come from the underserved communities in which they will serve, would receive 18 months of post–high school training to provide educational, care coordination, intraoral assessment, and limited intraoral treatment services in safety net facilities (39). Similarly, OPAs would provide a very limited set of preventive services in dental offices or safety net settings, and would receive training much like that of the CDHC. The American Dental Hygienists' Association has proposed introduction of the advanced dental hygiene practitioner (ADHP). ADHPs would perform diagnostic, preventive, restorative, and therapeutic services directly to patients, a function similar to that of the nurse practitioner in medical practice (39). CDHCs and OPAs would require supervision of a dentist, while ADHPs, a profession requiring more advanced education, could work more autonomously.

Solutions that overcome distance barriers

A unifying characteristic of rural areas is the long distances that often must be traveled to reach commercial, education, and healthcare hubs. These distances vary by region, but in general they pose significant barriers to low-income and elderly populations who often lack their own vehicles and have few, if any, available public transportation options. These geographic barriers need to be considered in any plan to improve rural access to oral health services.

Provide mobile clinics

An alternative to rural residents traveling to dental providers is the use of mobile dental clinics. These clinics operate in many states and generally are designed to provide free or low-cost preventive, and in some cases restorative, dental care to underserved populations. The services and staffing of mobile dental clinics vary, as do sources of financing. Mobile clinics may be staffed by dentists and/or dental hygienists along with various support personnel, and may be paid or volunteer for their services. In California, 30 percent of mobile dental programs surveyed in a 2008 study reported that they targeted rural populations (46). The Colorado Smilemaker mobile dental clinic exposes senior dental students to rural areas of Colorado while providing preventive care and limited restorative care to uninsured low-income children (33). Florida's "Smiles on Wheels Mobile Dental Program" targets low-income preschool through third grade children in its travels to five rural counties in the Florida panhandle (47). While mobile clinics can provide a stopgap answer to unmet dental needs, they do not provide "continuous" care and are not a "dental home" for residents of rural communities.

Offer telehealth for diagnosis, consultation, and continuing education

Telehealth is a broad term than can involve different components of healthcare delivery. In general, telehealth technology is employed to help overcome the barriers of geographic distance and travel time between patients and healthcare providers. In the context of oral health care, telehealth technology (using the Internet, telephones, and a variety of other wired and wireless forms of telecommunication) can be used to provide access to medical records, digital imaging, communication between patients, and providers, as well as among providers, and patient and provider education. Teledentistry has the potential to make traditional dental care more efficient, facilitate greater use of nondentist providers, and improve early diagnosis and treatment of oral disease. Adoption of teledentistry will be aided as electronic medical records and health information technology become more widespread. The technology used for telehealth is also adaptable for continuing education, allowing the rural provider to have communication and consultation with peers without requiring travel away from his or her rural practice. By facilitating consultations between rural generalist providers and specialists, repeated telehealth sessions can serve as a form of "grand rounds" and expand the competencies of rural providers (48).

There are several examples of telehealth programs that hold promise for improving oral health in rural areas. One demonstration project in Tennessee found that providing telehealth links between rural dentists and urban dental specialists reduced patient travel time and electronically transmitted dental films between sites (49). Demonstrations in inner city Early Head Start programs showed that teledentistry could be used effectively to assess caries prevalence in young children. One New York study used telehealth assistants (child care center employees with less than 2 hours of training in the use of intraoral cameras) to obtain images of the teeth of children in child care centers. These images were

screened remotely and scored for caries presence and degree of severity (50).

In California, a virtual dental home demonstration is being developed to use teledentistry to link between community-based oral health professionals (such as registered dental hygienists in alternative practice) and dentists in their offices and clinics (51). The proposed model would allow the community-based provider to input patient data into an electronic medical record where it would be accessed remotely by a dentist who would develop a treatment plan, and collaboratively the providers would coordinate needed services.

With funding from the Denali Commission that is building new health clinics in most of Alaska's native villages, the Alaska DHAT program will soon benefit from enhanced telehealth technology. The basic tools available now for referring with supervising dentists, telephones, and e-mail will be enhanced by providing digital intraoral camera and X-ray technology (L. Fiset, personal communication, January 25, 2010).

Conclusions

Compared with urban populations, rural populations have greater financial barriers to oral healthcare services, lack access to adequate preventive services, and rely on fewer oral healthcare professionals to serve their needs. Moreover, as the rural population grows and ages, the risk of adverse dental health outcomes will continue to increase. If the status quo persists, the rural dentist workforce, already inadequate to meet the service needs in rural areas, will not keep pace with the escalating need for care. A variety of approaches to solving these problems are being implemented and tested across a range of rural and underserved communities as outlined in this article.

But, many obstacles remain for improving oral health in rural areas. Public financing is needed for preventive and public health programs, but securing such funding is difficult even when the economy is healthy. Programs that identify disease in low-income populations, but rely on referrals for treatment often face difficulties because of the limited numbers of dentists who are willing to take Medicaid patients (47). Encouraging providers to work in rural areas can only be successful to the extent that patients and reimbursement are available at levels that support their practices. There is not yet widespread deployment of nondentist providers with sufficient scope of practice and/or financial support to help tackle the built-up demand for oral health care and need for preventive services in rural areas. Primary care providers may have interest in helping address oral health needs, but the oral health education of clinicians and translation into practice lags (41,52). Diffusion of electronic health technology to the oral health arena holds promise, but has been slow in rural areas, and as a result rural areas will not quickly realize the full benefits of telehealth, electronic medical records, and health information technology.

Future directions

A multipronged approach to oral health is needed to address the challenges of rural populations. Rural areas vary greatly in terms of geography (i.e., population density, mountains and water to be navigated, seasonal weather obstacles) and political influences (i.e., state government policies and resources; federal policies regarding associations with HPSAs, IHS, federally qualified health centers). As a result, rural communities need flexibility to develop strategies that meet their specific needs and take advantage of their resources. The Institute of Medicine's Committee on the Future of Rural Health Care recommended that rural communities should have the flexibility and the assistance needed to adopt quality improvement approaches that have the greatest impact in rural contexts (53). This includes financial resources to innovate and evaluate the effectiveness of new programs, as well as mechanisms to disseminate this evidence so that proven new approaches can be replicated. One advantage of rural areas is that they offer opportunities for innovation because smaller-sized communities may be able to achieve coordination, collaboration, and decision making with fewer bureaucratic hurdles than in more complex urban settings. Strategies to improve oral health that bundle services and programs to use scarce resources more efficiently make sense for rural communities (e.g., community regulation of school-based snacks and vending could contribute to reducing dental caries and preventing obesity).

Improving oral health in rural America should not be done piecemeal, however. Limited and sporadic efforts, such as relying on dentist volunteerism to overcome access barriers in underserved areas, are not substitutes for systematic approaches to oral health care (54). Prevention needs to be at the front line of rural oral health care, with systematic approaches that cross health professions and health sectors. Comparative effectiveness research to identify the safest and most effective oral health practices for different rural settings is needed, as are assessments similar to those carried out in medicine to better understand the factors that increase the likelihood of dentists and other oral health providers practicing in rural areas.

The National Advisory Committee on Rural Health and Human Services in 2004 recommended increasing funds for oral health services and workforce development, grants for rural water fluoridation, support for state-level infrastructure to coordinate oral health programs, research on oral health disparities, and evidence to help guide policymaking (55). Local, state, federal, and private stakeholders/policymakers need to continue to address these recommendations. Rural

oral health disparities will be addressed effectively only when innovative solutions that address the wide range of rural challenges are implemented.

Acknowledgments and conflict of interest

The authors would like to acknowledge Martha Reeves for production assistance. Dr. Mouradian acknowledges the US Department of Health and Human Services, Maternal and Child Health Bureau Leadership Education in Pediatric Dentistry grant (T17MC000020). Conflict of interest: the authors have no conflicts of interest to declare.

References

1. Eberhardt MS, Ingram DD, Makuc DM *et al. Urban and rural health chartbook. Health, United States, 2001*. Hyattsville: National Center for Health Statistics; 2001.
2. Economic Research Service. *Rural poverty at a glance. Rural development research report number 100*. Washington: Economic Research Service, US Department of Agriculture; 2004.
3. Liu J, Probst JC, Martin AB, Wang JY, Salinas CF. Disparities in dental insurance coverage and dental care among US children: the National Survey of Children's Health. *Pediatrics.* 2007;**119**(Suppl 1):S12-21.
4. US Department of Health and Human Services. *Oral health in America: a report of the surgeon general*. Rockville: US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health; 2000.
5. Vargas CM, Dye BA, Hayes K. Oral health care utilization by US rural residents, National Health Interview Survey 1999. *J Public Health Dent.* 2003;**63**:150-7.
6. Vargas CM, Ronzio CR, Hayes KL. Oral health status of children and adolescents by rural residence, United States. *J Rural Health.* 2003;**19**:260-8.
7. Wall TP, Brown LJ. The urban and rural distribution of dentists, 2000. *J Am Dent Assoc.* 2007;**138**:1003-11.
8. Economic Research Service. *Rural population and migration [Internet]*. Washington: US Department of Agriculture; 2009. [cited 2009 Dec 22]. Available from: http://www.ers.usda.gov/Briefing/Population/
9. Cromartie J, Nelson P. *Baby boom migration and its impact on rural America. Economic research report number 79*. Washington: Economic Research Service, US Department of Agriculture; 2009.
10. Probst JC, Laditka SB, Wang JY, Johnson AO. Effects of residence and race on burden of travel for care: cross sectional analysis of the 2001 US National Household Travel Survey. *BMC Health Serv Res.* 2007;**7**:40.
11. Fos P, Hutchison L. *The state of rural oral health: a literature review. Rural healthy people 2010: a companion document to healthy people 2010*. Volume 2. College Station: The Texas A & M University System Health Science Center, School of Rural Public Health, Southwest Rural Health Research Center; 2003.
12. Vargas CM, Yellowitz JA, Hayes KL. Oral health status of older rural adults in the United States. *J Am Dent Assoc.* 2003;**134**:479-86.
13. Doescher MP, Keppel GA, Skillman SM, Rosenblatt RA. *Policy brief: the crisis in rural dentistry*. Seattle: WWAMI Rural Health Research Center, University of Washington; 2009.
14. Rosenblatt RA, Andrilla CH, Curtin T, Hart LG. Shortages of medical personnel at community health centers: implications for planned expansion. *JAMA.* 2006;**295**:1042-9.
15. Guthrie D, Valachovic RW, Brown LJ. The impact of new dental schools on the dental workforce through 2022. *J Dent Educ.* 2009;**73**:1353-60.
16. Mertz E, O'Neil E. The growing challenge of providing oral health care services to all Americans. *Health Aff (Millwood).* 2002;**21**(5):65-77.
17. Allison RA, Manski RJ. The supply of dentists and access to care in rural Kansas. *J Rural Health.* 2007;**23**:198-206.
18. Horowitz HS. The effectiveness of community water fluoridation in the United States. *J Public Health Dent.* 1996;**56**(5 spec no):253-8.
19. Ripa LW. A half-century of community water fluoridation in the United States: review and commentary. *J Public Health Dent.* 1993;**53**(1):17-44.
20. Tinanoff N, Reisine S. Update on early childhood caries since the surgeon general's report. *Acad Pediatr.* 2009;**9**:396-403.
21. Milgrom P, Zero DT, Tanzer JM. An examination of the advances in science and technology of prevention of tooth decay in young children since the surgeon general's report on oral health. *Acad Pediatr.* 2009;**9**:404-9.
22. The Center for Health and Health Care in Schools. *A rural school-based oral health program for south Texas [Internet]*. Washington: Center for Health and Health Care in Schools. [cited 2010 January 27]. Available from: http://www.healthinschools.org/static/cfk/projects/southtx.aspx
23. American Academy of Pediatrics. *AAP oral health initiative: fluoride information by state [Internet]*. Elk Grove Village: American Academy of Pediatrics. [cited 2010 January 29]. Available from: http://www.aap.org/commpeds/dochs/oralhealth/fluoride.cfm
24. American Academy of Pediatric Dentistry. *AAPD head start dental home initiative provides funds to support state efforts [Internet]*. Chicago: AAPD. [cited 2010 January 28]. Available from: http://www.aapd.org/blastemail/2009/October9(HeadStart).asp
25. Blahut P. Indian Health Service. In: Institute of Medicine, editor. *The US oral health workforce in the coming decade: workshop summary*. Washington: Institute of Medicine, National Academies Press; 2009. p. 16-19.
26. Indian Health Service. *An oral health survey of American Indian and Alaska Native dental patients: findings, regional differences, and national comparisons*. Rockville: US Department of Health and Human Services; 1999.

27. Greene JC, Walsh MM, Masouredis C. A program to help major league baseball players quit using spit tobacco. *J Am Dent Assoc.* 1994;**125**:559-68.
28. Stevens VJ, Severson H, Lichtenstein E, Little SJ, Leben J. Making the most of a teachable moment: a smokeless-tobacco cessation intervention in the dental office. *Am J Public Health.* 1995;**85**:231-5.
29. University of Minnesota. The Minnesota Dental Clinic (Stop Tobacco) Fax Referral Program [PDF]. [cited 2010 February 17]. Available from: http://www1.umn.edu/perio/tobacco/MN_Fax.pdf
30. Phillips RL, Dodoo MS, Petterson S, Xierali I, Bazemore A, Teevan B, Bennett K, Legagneur C, Rudd J, Phillips J. *Specialty and geographic distribution of the physician workforce: what influences medical student and resident choices?* Washington: Robert Graham Center; 2009.
31. Goodrich G. *Presentation: 2008 Rural Dentist Survey findings: preliminary findings and overview of data [Internet]*. Denver: Colorado Health Institute; 2008. [cited 2010 January 22]. Available from: http://www.coloradohealthinstitute.org/Global/Presentations/2008/2008-Rural-Dentist-Survey-Findings.aspx
32. University of Washington School of Dentistry. *Regional Initiatives in Dental Education (RIDE) [Internet]*. Seattle: University of Washington School of Dentistry. [cited 2010 January 29]. Available from: http://www.dental.washington.edu/ride/RIDE_index.php
33. Brunson D. Rural populations. In: Institute of Medicine, editor. *The US oral health workforce in the coming decade: workshop summary*. Washington: The National Academies Press; 2009. p. 14-16.
34. Derksen D. Health commons. In: Institute of Medicine, editor. *The US oral health workforce in the coming decade: workshop summary*. Washington: Institute of Medicine, National Academies Press; 2009. p. 91-92.
35. Dillenberg J. Creating future leaders. In: Institute of Medicine, editor. *The US oral health workforce in the coming decade: workshop summary*. Washington: Institute of Medicine, National Academies Press; 2009. p. 53-55.
36. Doescher MP, Fordyce MA, Skillman SM, Jackson JE, Rosenblatt RA. *Policy brief: persistent primary care health professional shortage areas (HPSAs) and health care access in rural America*. Seattle: WWAMI Rural Health Research Center, University of Washington; 2009.
37. Health Resources and Services Administration. *Shortage designation: HPSAs, MUAs & MUPs [Internet]*. Rockville: Health Resources and Services Administration, US Department of Health and Human Services; 2009. [cited 2010 January 29]. Available from: http://bhpr.hrsa.gov/shortage/
38. Mertz E, Mouradian WE. Addressing children's oral health in the new millennium: trends in the dental workforce. *Acad Pediatr.* 2009;**9**:433-9.
39. Edelstein BL. *Training new dental health providers in the US*. Battle Creek: The W.K. Kellogg Foundation; 2009.
40. American Academy of Pediatrics. *Recommendations for preventive pediatric health care: bright futures/American Academy of Pediatrics*. Elk Grove Village: Author; 2008.
41. Douglass AB, Douglass JM, Krol DM. Educating pediatricians and family physicians in children's oral health. *Acad Pediatr.* 2009;**9**:452-6.
42. Skillman SM, Andrilla CH, Alves-Dunkerson JA, Comenduley M, Yi J, Doescher MP. *Washington State's oral health workforce. Final report #130*. Seattle: WWAMI Center for Health Workforce Studies, University of Washington; 2009.
43. Ballweg R. Dentex: the dental health aide therapist in Alaska. In: Institute of Medicine, editor. *The US oral health workforce in the coming decade: workshop summary*. Washington: Institute of Medicine, National Academies Press; 2009. p. 82-84.
44. Pew Center on the States and National Academy of State Health Policy. *Help wanted: a policy maker's guide to new dental providers*. Washington: Author; 2009.
45. W.K. Kellogg Foundation. *News release: evaluation to measure effectiveness of oral health care model in rural Alaska native villages*. Battle Creek: Author; 2008.
46. Carr BR, Isong U, Weintraub JA. Identification and description of mobile dental programs – a brief communication. *J Public Health Dent.* 2008;**68**:234-7.
47. Health Resources and Services Administration. *The outreach sourcebook. Volume 11, rural health demonstration projects, 2001-2004*. Rockville: Health Resources and Services Administration, US Department of Health and Human Services; 2005.
48. Folke LE. Teledentistry. An overview. *Tex Dent J.* 2001;**118**(1):10-18.
49. Dimmick SL, Burgiss SG, Robbins S, Black D, Jarnagin B, Anders M. Outcomes of an integrated telehealth network demonstration project. *Telemed J E Health.* 2003;**9**(1):13-23.
50. Kopycka-Kedzierawski DT, Bell CH, Billings RJ. Prevalence of dental caries in Early Head Start children as diagnosed using teledentistry. *Pediatr Dent.* 2008;**30**:329-33.
51. Glassman P. Registered dental hygienists in alternative practice and virtual dental homes. In: Institute of Medicine, editor. *The US oral health workforce in the coming decade: workshop summary*. Washington: Institute of Medicine, National Academies Press; 2009. p. 86-89.
52. Lewis CW, Boulter S, Keels MA, Krol DM, Mouradian WE, O'Connor KG, Quinonez RB. Oral health and pediatricians: results of a national survey. *Acad Pediatr.* 2009;**9**:457-61.
53. Institute of Medicine. *Quality through collaboration: the future of rural health*. Washington: The National Academies Press; 2004.
54. Mouradian WE. Band-aid solutions to the dental access crisis: conceptually flawed – a response to Dr. David H. Smith. *J Dent Educ.* 2006;**70**:1174-9.
55. National Advisory Committee on Rural Health and Human Services. *The 2004 report to the secretary: rural health and human services issues*. Washington: US Department of Health and Human Services; 2004.