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# ORAL HEALTH WORKFORCE IN COLORADO

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*Synthesis of survey findings and  
implications for policy*

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## Introduction

This report on Colorado's oral health workforce summarizes findings from three workforce surveys administered by the Colorado Health Institute (CHI) between 2006 and 2008. It was prepared under contract with the Colorado Department of Public Health and Environment (CDPHE). The report examines the findings from two 2006 workforce surveys—one of licensed Colorado dentists and a second of licensed Colorado dental hygienists. A third survey of licensed Colorado dentists who work in rural areas was conducted in 2008. The report summarizes these findings in the context of relevant research and policy issues related to the training, recruitment and retention of the oral health workforce and related access issues specific to underserved populations. (Survey methods and a fuller discussion of the data can be found in Appendix A.)

### OVERVIEW OF ORAL HEALTH ACCESS AND THE ORAL HEALTH WORKFORCE

Although oral health access has improved over the past 50 years, many segments of the population still face socio-economic and geographic barriers to oral health care services. Low-income families, ethnic and racial minorities, immigrants, people with special health care needs and those living in rural areas are more likely to lack access to basic oral health care. This lack of access is due in part to the dearth of dentists and dental hygienists practicing in rural communities or those who will agree to accept publicly insured patients. Studies have found that people living in rural areas see oral health providers less frequently than those living in urban areas. <sup>1, 2</sup>

#### Oral health access: A national perspective

The number of practicing dentists has declined nationally in the past 20 years, raising policy concerns about the ability of the dental workforce to meet the growing oral health needs of Americans. Additionally, approximately 90 percent of the country's dentists provide services only to private-pay patients in the private sector. Public and nonprofit oral health clinics are relatively few in number. For example, only half of federally qualified health centers (FQHCs) and migrant health centers offer oral health care services. <sup>3, 4, 5</sup>

The Bureau of Health Professions in the federal Health Resources and Services Administration (HRSA) reports there are 4,048 designated Dental Health Professional Shortage Areas (HPSAs) across the country in 2009. Dental HPSA designations are used to determine eligibility for many federal and state programs including the National Health Service Corps, federal and state loan repayment programs, rural health clinic status and a number of Title VII Health Professions Training Programs. HRSA estimates that to meet the current demand for dental care, an additional 9,432 dentists would be required, assuming a 1:3,000 dentist-to-population ratio. <sup>6</sup>

Healthy People 2010 benchmarks issued by the federal Centers for Disease Control and Prevention (CDC) were established to monitor a broad range of national health objectives through the year 2010. Two of these objectives relate specifically to oral health:

- To increase the proportion of school-based health centers with an oral health component; and,
- To increase the proportion of local health departments and community-based health clinics that offer oral health services. <sup>7</sup>

## **Oral health access: A Colorado perspective**

In 2000, Colorado ranked sixth highest in the country for dentists per capita, with a dentist-to-population ratio of 70 per 100,000 (latest figure available from HRSA). In 2009, there are 18 entire counties and two partial counties in Colorado that are designated as geographic HPSAs, with another 18 designated as low-income dental HPSAs.<sup>8</sup> Additionally, nine counties do not have an active licensed dentist and 13 lack a dental hygienist.<sup>9</sup> In addition, Department of Regulatory Agencies (DORA) licensure data reveal that of all Colorado counties, 10 have only one licensed dentist and three have only a single dental hygienist. [See Appendix B to view maps of provider locations]

Six local public health departments and public nursing services provided oral health care services in 2005.<sup>10</sup> For the 2007-08 school year, eight school-based health centers (SBHCs) reported providing 2,238 dental visits. Services included dental screenings/diagnostics and preventive care such as sealants, fluoride applications and cleaning. In addition, Colorado's oral health safety net includes both stand-alone dental clinics and those that are operated by an existing community health center or other community-based clinic.

While dental sealants are a proven method for preventing tooth decay in children, only 37 percent of 3rd graders in Colorado had dental sealants applied in 2007.<sup>11</sup> The percentage of Colorado children with untreated tooth decay was greatest in geographic areas with the highest concentration of low-income residents. The Colorado Child Health Plan Plus (CHP+) program offers a dental benefit to children, but the benefit is capped at \$600 annually.<sup>12</sup>

Only 30 percent of Colorado's older adults (ages 65 and older) have any type of dental insurance as Medicare does not provide a dental benefit. In 2006-07, nearly 233,000 older adults in Colorado lived at or below 300 percent of the federal poverty level (FPL)<sup>13</sup>—\$32,490 for an individual. Lack of dental insurance challenges the ability of lower-income Medicare beneficiaries to seek out and pay for appropriate and timely oral health care. It also should be noted that Colorado's Medicaid program does not include an adult dental benefit, so for those low-income adults who qualify for Medicaid, the only dental coverage is for an acute dental episode that is associated with a systemic health problem and treated on an emergency basis.

Despite program initiatives implemented by policymakers in the past decade to improve public awareness of oral health issues, many Coloradans continue to face access barriers to receiving oral health services.<sup>14</sup> According to CDPHE, an estimated 540,000 elementary school hours were lost due to dental visits or oral health problems in 2007, an average of 1.2 hours lost per child.

## **2006 and 2008 Oral Health Workforce Surveys: Summary of findings**

### **2006 AND 2008 COLORADO DENTIST WORKFORCE SURVEYS**

A key objective of the 2006 and 2008 Colorado Dentist Workforce Surveys was to inform policymakers about the characteristics of the state's practicing dentists. The surveys examined a number of workforce-related issues such as personal demographic characteristics including education and post-graduate education, specialist training and practice setting as well as a limited set of patient-level characteristics. This analysis includes descriptive statistics and cross tabulations of variables of interest.

## 2006 COLORADO DENTIST WORKFORCE SURVEY

CHI mailed surveys to more than 4,400 dentists renewing their license in 2006. The two-wave mail protocol with an Internet option yielded 1,826 returned surveys for an overall response rate of 42 percent. Despite a respectable response rate for a two-contact survey, only 169 complete surveys were returned by rural dentists. Because rural dentists were underrepresented in the sample, CHI chose to report the 2006 survey findings in the aggregate and not include a rural/urban analysis. This analysis of the 2006 dentist workforce survey includes only dentists practicing in Colorado, not those who were licensed in Colorado but living outside the state.

Because CHI did not track who responded and who did not respond, it was unable to adjust for non-response bias by constructing “weights.” Weights scale the sample to match the population but depend on having some demographic information, such as gender, age, etc., available from the census data, in this case, DORA records. Without weights, the survey findings cannot be generalized to the entire population of Colorado dentists.

With support from CDPHE, CHI administered a follow-up survey in 2008 of rural Colorado dentists. Findings from both surveys follow.

## 2008 COLORADO RURAL DENTIST WORKFORCE SURVEY

Comparing the findings from the 2006 and 2008 dentist workforce surveys should be done judiciously. As previously noted, findings from the 2006 survey cannot be generalized to the population of licensed dentists in Colorado. In contrast, the 2008 *rural* dentist survey included multiple mailings and non-responders were tracked by CHI staff. This administration mode allowed CHI to weight the respondents to reflect the entire population of rural dentists practicing in Colorado based on gender, rural/urban classification and year of dental school graduation. The overall response rate for the rural dentist survey was 70 percent.

The analyses of the 2008 survey findings used the Rural Urban Commuting Area (RUCA) codes to specify the degree of ruralness in the rural/urban analysis conducted—isolated, small rural and large rural areas. These distinctions serve to categorize differences between various rural populations:<sup>15</sup>

- Isolated: population under 2,500;
- Small rural: population 2,500-9,999; and,
- Large rural: population 10,000-49,999.

## Characteristics of the 2006 and 2008 Dentist Workforce Surveys

### Ethnicity

Because of small numbers of ethnic minorities in the 2006 dentist survey, the data were analyzed as a dichotomous variable—White and non-White. Of Colorado respondents, few were minorities—94 percent were White and only 6 percent were non-White.

In the 2008 rural dentist survey, however, race and ethnicity were examined more fully. The second most represented group based on ethnicity was White Hispanic, the majority of whom were practicing in isolated rural areas of the state.

Table 1. Race and ethnicity of Colorado rural dentists, 2008\*

Race/ethnicity	Isolated (N=54)	Small rural (N=143)	Large rural (N=119)	Overall (N=316)
White Hispanic	8.1%	4.0%	3.4%	4.4%
Non-White Hispanic	2.8%	1.1%	2.4%	1.9%
White	81.3%	92.1%	90.8%	89.8%
Asian/Pacific Islander	2.8%	1.9%	1.1%	1.8%
Mixed	5.0%	0.9%	2.3%	2.1%

SOURCE: 2008 Colorado Rural Dentist Workforce Survey

\* No respondents reported African American, Native American or Alaska Native as their race.

### Gender

Of those dentists responding to the 2006 survey, the majority was male and reflective of the gender distribution of all dentists licensed in Colorado contained in the DORA database.

Table 2. Comparison of survey respondents' gender to Colorado licensed dentists, 2006 and 2008

	2006 dentist survey sample (n=1,176)*	2006 DORA database (N=3,065)	2008 rural dentist sample (N=251)	2008 DORA database (N=362)
Male	83.8%	83.4%	86.8%	86.7%
Female	16.2%	16.6%	13.2%	13.3%

\*Actively working in Colorado

SOURCES: 2006 Colorado Dentist Workforce Survey, 2008 Colorado Rural Dentist Workforce Survey, Colorado Department of Regulatory Agencies dentist licensure data

Because the 2006 sample included all dentists contained in the DORA database, including those licensed in Colorado but living or working outside the state, it was not possible to compare the gender distribution of the 2006 sample to the weighted 2008 rural Colorado dentists. Although quite similar, slightly more male dentists were practicing in rural areas in 2008 when compared to the gender distribution of all licensed dentists in Colorado in 2006.

### Age

Of the 2006 dentist respondents, 70 percent were 45 years or older, portending an aging dental workforce in Colorado. Most noteworthy is that almost 40 percent were over the age of 55 and reported planning to retire within 10 years.

Table 3. Age of Colorado dentist respondents, 2006

Age cohort	
34 yrs or younger	10.0% (n=117)
35-44 yrs	20.6% (n=241)
45-54 yrs	31.8% (n=372)
55-64 yrs	30.3% (n=354)
65 yrs and older	7.4% (n=86)
Average age: 50 yrs	

SOURCE: 2006 Colorado Dentist Workforce Survey

The age distribution of rural Colorado dentists surveyed in 2008 was quite similar to the sample of dentists surveyed in 2006. Both surveys found an average age of 50 years, although the rural dentists were almost twice as likely to report being 65 years or older. The oldest group of rural dentists was found in isolated rural areas of Colorado where 21 percent were age 65 and older.

Of Colorado's rural dentists in 2008, 28 were already retired and an additional 25 (8%) reported planning to leave their practice in the next 12 months. Of those planning to leave, 52 percent (13 of 25) were in solo practice. Based on these survey findings, two counties would potentially lose their only dentist upon the current dentist's retirement.

Among the reasons rural dentists gave for planning to leave their practice within the next 12 months, retirement was the top reason, followed by planning to relocate and administrative and management responsibilities that were too burdensome.

Table 4. Age of rural Colorado dentists by rural classification, 2008

Age cohort	Overall (N=317)	Isolated rural (N=24)	Small rural (N=143)	Large rural (N=120)
34 yrs or younger	11.1%	5.3%	14.7%	9.5%
35-44 yrs	23.1%	16.4%	19.3%	30.7%
45-54 yrs	24.9%	18.2%	26.9%	25.7%
55-64 yrs	29.9%	39.5%	29.5%	25.8%
65 yrs or older	11.0%	20.6%	9.6%	8.3%
Mean age	50 yrs	55 yrs	50 yrs	49 yrs

SOURCE: 2008 Colorado Rural Dentist Workforce Survey

#### Dental education of Colorado's licensed dentists

Nationally, 58 dental schools operate in 34 states. Colorado has one dental school that accepts 52 students annually.<sup>16</sup> Traditionally, Colorado has depended on dentists migrating into the state to supply its dental health workforce since the University of Colorado Denver School of Dental Medicine



(UCDSDM) only supplies one-quarter of the new dentists entering practice in the state annually. Many rural dentists were trained outside of Colorado since the dental school was not established until 1977. Approximately 17 percent of 2006 survey respondents reported attending dental school in Colorado in the period between 1977 and 2008. In 2008, 74 percent of Colorado’s rural dentists had been trained outside the state. Other than Colorado, the top four states in which Colorado’s rural dentists received their training were Nebraska, Missouri, Illinois and California.

Preparation for dental practice

The 2008 rural dentist survey asked specific questions regarding the adequacy of classroom instruction during dental school in preparation for a rural practice. Using a scale of 1-5, with one representing most adequate and 5 representing inadequate, Table 5 reports the finding that rural dentists felt least prepared to care for infants, persons with disabilities and persons with behavioral health problems.

Table 5. Adequacy of classroom instruction for rural practice, Colorado rural dentists by rural classification, 2008

Classroom instruction	Overall mean* (N=300)	Isolated (N=53)	Small rural (N=137)	Large rural (N=112)
Dental care for pregnant women	2.5	2.7	2.4	2.5
Dental care for infants (0-3 yrs)	3.2	3.4	3.3	3.2
Dental care for children/adolescents (4-19 yrs)	2.1	2.1	2.1	2.0
Dental care for persons with disabilities	2.7	3.0	2.6	2.7
Dental care for persons with behavioral health problems	3.1	3.4	3.1	3.1
Treatment of caries	1.3	1.2	1.3	1.3
Preventive dental care	1.7	1.7	1.7	1.7

\*Scale of 1-5 with 1 indicating “fully prepared.”

SOURCE: 2008 Colorado Rural Dentist Workforce Survey

Interestingly, when the rural dentists were compared by age, younger dentists felt somewhat more prepared than older ones to care for people with disabilities or behavioral health problems.

Table 6: Adequacy of classroom instruction for rural practice, Colorado rural dentists by age, 2008

Classroom instruction	<=34 years (N=35)	35-44 years (N=69)	45-54 years (N=82)	55-64 years (N=91)	65+ years (N=32)
Dental care for pregnant women	2.4	2.5	2.3	2.7	2.4
Dental care for infants (0-3 yrs)	3.0	3.4	3.0	3.4	3.4
Dental care for children/adolescents (4-19 yrs)	2.0	2.4	2.0	2.0	1.9
Dental care for persons with disabilities	2.2	2.8	2.5	3.0	3.0
Dental care for persons with behavioral health problems	2.7	3.3	2.9	3.5	3.3
Treatment of caries	1.3	1.3	1.3	1.2	1.2
Preventive dental care	1.7	1.7	1.8	1.6	1.8

\*Scale of 1-5 with 1 indicating “fully prepared.”

SOURCE: 2008 Colorado Rural Dentist Workforce Survey

When asked to rate how prepared they were to practice clinical dentistry upon graduation from dental school, the majority of rural dentists (61.6%) rated their preparation a 1 or 2 on a scale of 5 with 1 being “fully prepared.” Approximately 18 percent said they were “fully prepared” with less than 4 percent reporting they did not feel prepared.

#### Specialty training after dental school

Few dentists responding to the 2006 survey had specialty training after dental school as illustrated in Table 6.

Table 7. Specialty training of Colorado dentist respondents, 2006

Specialty	Percent
Pediatric dentistry	2.7%
Endodontics	2.0%
Orthodontics and maxillofacial orthopedics	4.2%
Periodontics	2.6%

SOURCE: 2006 Colorado Dentist Workforce Survey

Overall, specialty training among rural dentists was quite low, with only 3 percent of rural dentists in the 2008 survey reporting training in maxillofacial surgery and one percent in pediatric dentistry.

#### Practice setting

A large majority of dentist respondents in 2006 reported owning their dental practice (80%). When asked about the type of facility in which they practiced, respondents overwhelmingly reported that they worked either in a solo (64%) or group practice (30%).

Almost all the 2006 respondents worked in a clinical setting (96%), while the remaining 4 percent worked as dental school faculty. Very few respondents indicated working in a non-traditional dental practice such as a long-term care facility (less than 1%), public health agency (1%) or community health agency (2%).

Primary practice annual patient visits

In the 2008 survey, rural Colorado dentists reported a total of 589,351 patient visits to their primary practice locations in 2007, with an average of 2,638 patient visits per dentist per year. Dentists in large rural areas reported the most, averaging 2,867 patient visits per year, followed by small rural areas at 2,649 per year. Dentists in isolated areas of the state averaged 2,082 patient visits on 2007.

Language spoken: Rural dentists

Asked if they spoke a language other than English to communicate with their patients, more than one-quarter (25.8%) of rural dentists in 2008 reported that they spoke Spanish with some of their patients.

Rural dentists’ lifestyle choices

In 2008, rural dentists were asked about hours worked and why they chose to practice in a rural setting. Findings revealed that dentists practicing in rural Colorado in 2008 had been in practice in the state for an average of 17 years, with nearly 14 of these years spent at their current practice location. They worked an average of 34 hours per week with 31 hours spent in direct patient care.

Table 8. Hours worked per week, Colorado rural dentists by rural classification, 2008

Rural classification	Average hours worked per week	Average direct patient hours worked per week
Isolated (n=54)	30.1	26.9
Small rural (137)	34.5	32.2
Large rural (116)	35.9	32.0
Overall (n=307)	34.3	31.2

SOURCE: 2008 Colorado Rural Dentist Workforce Survey

When rural dentists were asked why they chose to practice in their current community, three themes surfaced: quality of life (94%), recreational/leisure time activities (85%) and slower pace of life (84%). Knowledge of these themes may be useful in developing recruitment and retention strategies for rural oral health providers.

Community in which dentist grew up

In the medical workforce literature, one of the strongest predictors of whether a physician chooses a rural practice setting is where the physician grew up. The findings from the 2006 dentist survey were hard to interpret in this regard as more responding dentists grew up in an urban or suburban area (77%) than in a rural area. Of respondents who were practicing in a rural area, 58 percent reported growing up in an urban or suburban area and 42 percent reported growing up in a rural area.

Table 9. Area in which Colorado rural dentists grew up by practice setting, 2006

Where grew up	Overall (n=1,157)	Rural (n=165)	Urban (n=992)
Rural	25.1%	41.8%	22.4%
Suburban	50.7%	35.8%	53.1%
Urban	24.2%	22.4%	24.5%

SOURCE: 2006 Colorado Dentist Workforce Survey

Of the 352 dentists responding to the 2006 survey who had grown up in Colorado, 15 percent were practicing in a rural area and 85 percent in an urban area. These statistics precisely mirror the urban/rural population split in Colorado as 85 percent of the population lived in an urban metropolitan area and 15 percent lived in a rural area in 2006 according to the U.S. Census Bureau.

Conversely, the data from the 2008 rural dentist survey found that growing up in a rural community was strongly associated with dentists locating their practices in a rural area. The survey found that 54 percent of dentists practicing in a rural area grew up in a rural community.

Table 10. Area in which Colorado rural dentists grew up by practice setting and rural classification, 2008

Where grew up	Overall (N=313)	Isolated (N=54)	Small rural (N=141)	Large rural (N=118)
Rural	54.1%	52.2%	54.0%	55.1%
Suburban	33.2%	35.0%	33.1%	32.4%
Urban	12.7%	12.8%	12.9%	12.5%

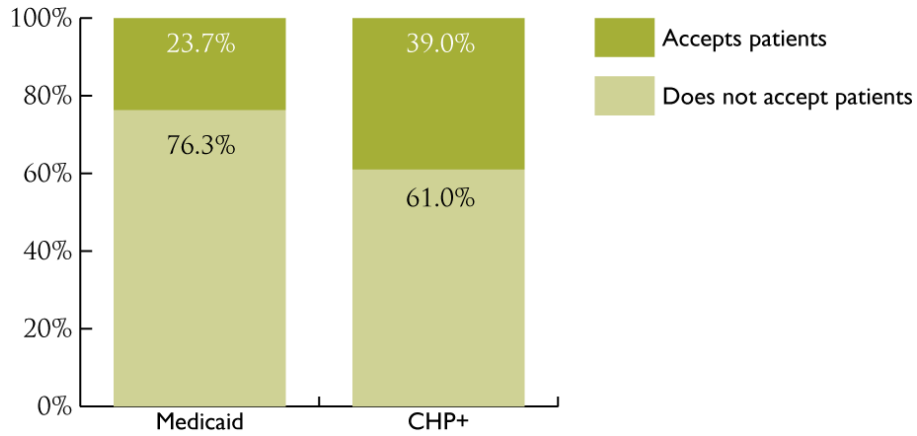
SOURCE: 2008 Colorado Rural Dentist Workforce Survey

These very different findings between the 2006 and 2008 surveys point to the under-representation of rural dentists in the 2006 survey and the bias toward urban dentists that resulted.

#### Public insurance: Participation in the Medicaid and Child Health Plan Plus (CHP+) programs

In 2007, the Center for Studying Health System Change found that among the range of health care services offered, oral health care was the most difficult to obtain for low-income individuals, in large part because of the dearth of dentists willing to accept public insurance.<sup>17</sup> The Center found that the tendency for dentists to refuse to serve publicly financed patients was linked to student debt after dental school, now averaging \$162,155, and the overhead costs involved in running a private dental practice which averaged 60 cents for every dollar earned.<sup>18</sup> The dentist community reports that low reimbursement rates under the Medicaid program in particular make it not in their financial interest to serve Medicaid patients. Graph 1 illustrates the level of Colorado dentist respondents' participation in the Medicaid and CHP+ programs in 2006.

**Graph 1. Rates of dentist respondents' participation in Medicaid and CHP+, 2006**

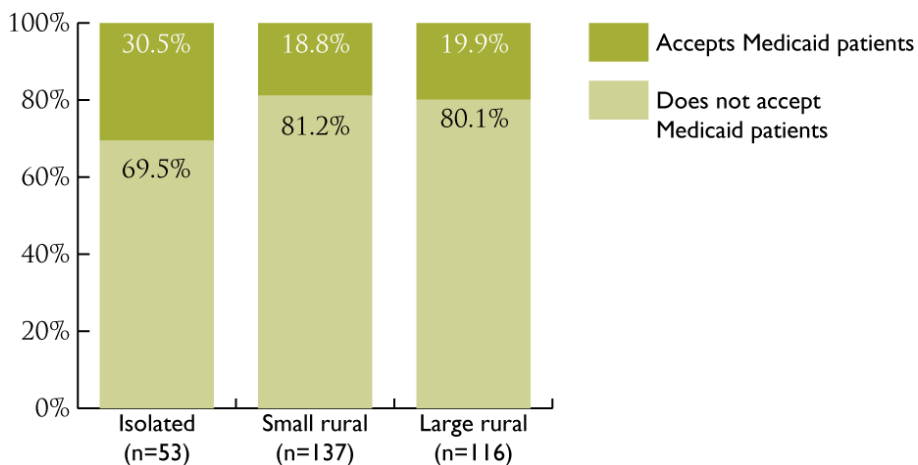


SOURCE: 2006 Colorado Dentist Workforce Survey

Slightly higher participation rates in Medicaid were reported among rural dentists in the 2008 survey. Dentists practicing in isolated areas were more likely to accept Medicaid patients, although rural dentists in general, like their urban counterparts, were not inclined to accept Medicaid patients (Graph 2). Colorado's rural dentists reported not accepting Medicaid patients for a number of reasons beyond the low reimbursement rates including patients not keeping appointments and not following recommended oral hygiene practices. Rural dentists also indicated experiencing frustration with Medicaid's billing processes and payment responsiveness.

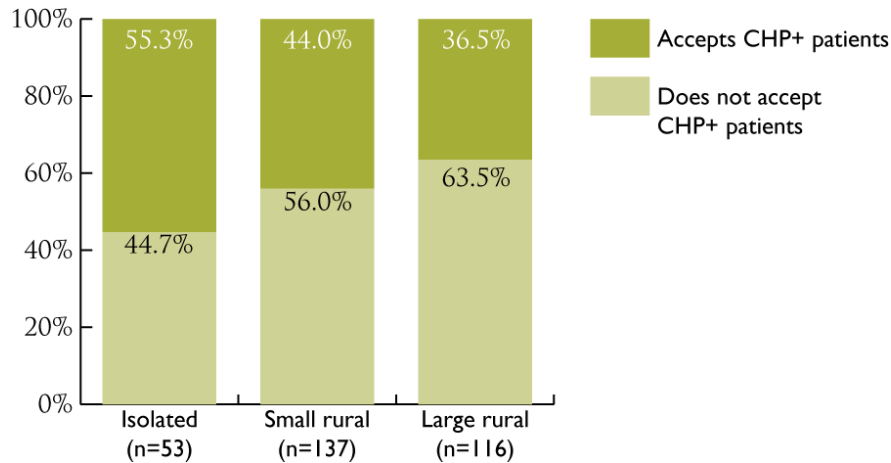
Alternatively, rural dentists in 2008 and the 2006 respondent sample of all licensed dentists were more willing to accept children enrolled in CHP+. Again, dentists practicing in isolated rural areas were most likely to serve CHP+ children (Graph 3).

**Graph 2. Rate of participation in Medicaid by Colorado rural dentists, 2008**



SOURCE: 2008 Colorado Rural Dentist Workforce Survey

Graph 3. Rates of participation in CHP+ by Colorado rural dentists, 2008



SOURCE: 2008 Colorado Rural Dentist Workforce Survey

Similar to low participation rates in Medicaid and CHP+, few rural dentists reported that they offered a sliding-fee payment schedule for their low-income patients (13%). Dentists' offering a sliding fee payment option was highest in isolated rural areas (16%) and lowest in large rural areas (12%).

#### Employment of dental hygienists: The rural experience

The 2008 rural dentist survey asked about the number of dental hygienists rural dentists employed and found that two-thirds had at least one hygienist in their employment. Approximately 57 percent had one or more full-time dental hygienists and 48 percent had one or more part-time hygienists. Thirty-two rural dentists were recruiting a dental hygienist at the time of the survey, of which only seven were full-time positions.

#### Rural dentists' collaboration with physicians and nurses

Rural dentists were nearly evenly divided in their reported collaborative activities with physicians and nurses to provide preventive oral health care services. Approximately 51 percent reported they engaged in collaborative activities, while 49 percent did not. Dentists in small rural areas were slightly more likely to collaborate (53%).

### **2006 COLORADO DENTAL HYGIENIST WORKFORCE SURVEY**

Dental hygienists are integral providers of oral health care who focus on the prevention and treatment of oral diseases to maintain overall health. Dental hygienists were surveyed in 2006 to complement the findings from the 2006 Colorado Dentist Workforce Survey in order to provide a more comprehensive understanding of the state's oral health workforce. Because CHI administered the survey, staff was able to weight the sample to the entire licensed dental hygienist population practicing in Colorado in 2006. As noted earlier, weighting a sample requires knowledge of some characteristics of the underlying population. The overall response rate for the dental hygienist survey was almost 60 percent.

## Characteristics of Colorado dental hygienists: 2006

### Gender

The table below illustrates the gender distribution of respondents to Colorado's 2006 dental hygienist survey and how it mirrors the DORA database of licensed hygienists. This gender distribution is in contrast to dentists who were predominately male in both the 2006 and 2008 dental workforce surveys which are consistent with national data on the oral health workforce.

Table 11. Comparison of survey respondents' gender to Colorado's licensed dental hygienists, 2006

	2006 dental hygienist respondents (n=2,170)	DORA Database (N=3,698)
Male	1.2%	1.7%
Female	98.8%	98.3%

SOURCE: Colorado Department of Regulatory Agencies, 2006 dental hygienist licensure data; 2006 Colorado Dental Hygienist Workforce Survey

### Age

While the dentist surveys drew attention to an aging workforce, especially the 2008 rural dentist survey, only 16 percent of rural dental hygienists in 2006 were 55 years and older. Most dental hygienists were mid-career with an average age of 45 years.

Table 12. Age of Colorado dental hygienists by rural and urban practice location, 2006

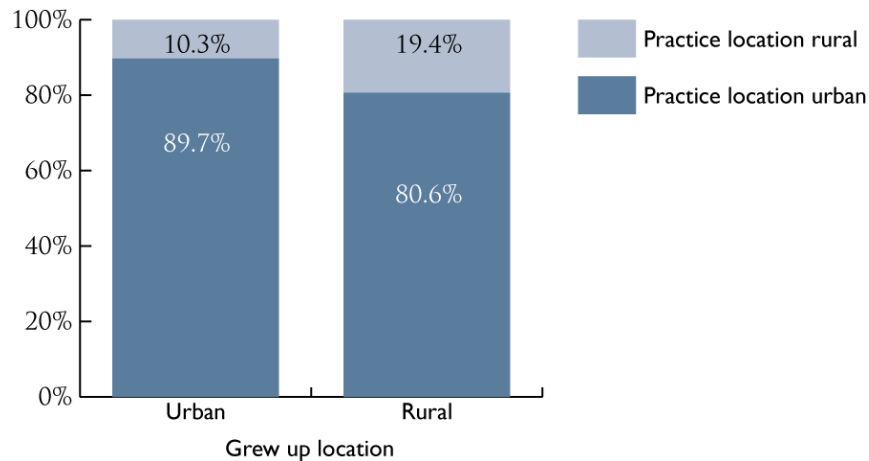
	Rural (n=443)	Urban (n=2,490)
34 yrs and younger	18.0%	20.2%
35-44	29.1%	25.7%
45-54	36.7%	37.3%
55-64	15.5%	15.5%
65yrs and older	0.7%	1.3%
Average age: 45 yrs		

SOURCE: 2006 Colorado Dental Hygienist Workforce Survey

Community in which dental hygienist grew up and practice location

Although 54 percent of Colorado dentists who grew up in a rural community were practicing in a rural area in 2008, only 19 percent of dental hygienists who grew up in a rural community reported practicing in a rural area.

Graph 4. Community in which Colorado dental hygienists grew up and current practice location, 2006



SOURCE: 2006 Colorado Dental Hygienist Workforce Survey

Dental hygiene education

Colorado has three dental hygiene programs that accept 66 students collectively each year:

- Colorado Northwestern Community College (27 students annually)<sup>19</sup>
- Community College of Denver (24 students annually)<sup>20</sup>
- Pueblo Community College Dental Hygiene (15 students annually).<sup>21</sup>

The only program in Colorado offering a bachelor’s degree in dental hygiene, the University of Colorado Denver School of Dental Hygiene, stopped admitting students in 2007 at which time 20 students were admitted into the program.<sup>22</sup>



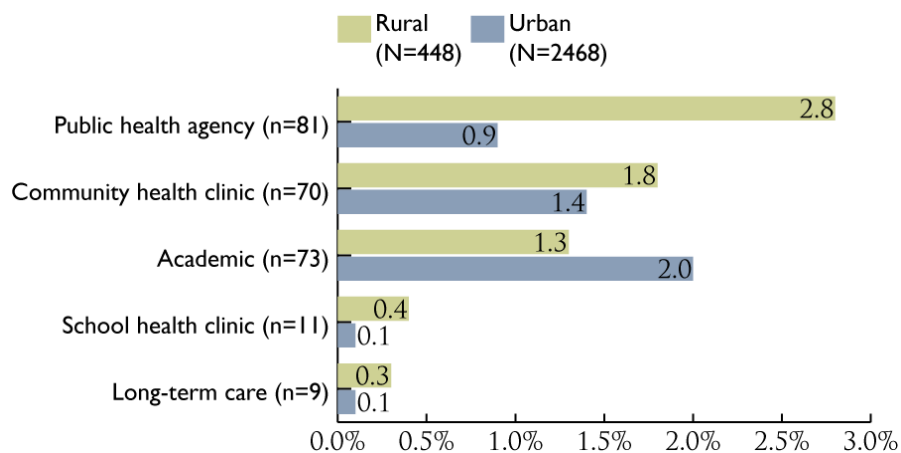
The American Dental Hygienist Association (ADHA) has maintained a policy statement since 1986 stating its “intent to establish the baccalaureate degree as the minimum entry level for dental hygiene practice in the future.” In the early 1990s, however, federal budget cuts resulted in the closure of many bachelor programs for dental hygiene.<sup>23, 24</sup> Currently, only 13 percent of entry-level dental hygiene programs offer a bachelor’s degree.<sup>25</sup> A 2008 publication of a survey administered to dental hygiene program directors found more graduates from bachelor’s degree programs were able to find dental hygiene employment when compared to graduates of associate degree programs (95% vs. 78%).<sup>26</sup>

CHI’s 2006 dental hygienist survey found more dental hygienists who practiced in rural areas had associate degrees than their urban counterparts (73% vs. 62%), who were more likely to have completed a bachelor’s degree (33% vs. 24%). With the closure of the University of Colorado Denver baccalaureate degree in dental hygiene program, these percentages may change over time, but since only 60 percent of Colorado’s dental hygienists are educated in Colorado, the impact may be minimal.

Practice setting

Most dental hygienists were employed in a solo or group practice—63 percent of rural and 58 percent of urban hygienists were employed in a solo practice, while 23 percent of rural and 31 percent of urban dental hygienists worked in a group practice. Of the 2,170 dental hygienists who completed the survey, 244 worked in the non-traditional settings as illustrated in Graph 5.

Graph 5. Non-traditional practice settings of Colorado’s dental hygienists, 2006



SOURCE: 2006 Colorado Dental Hygienist Workforce Survey

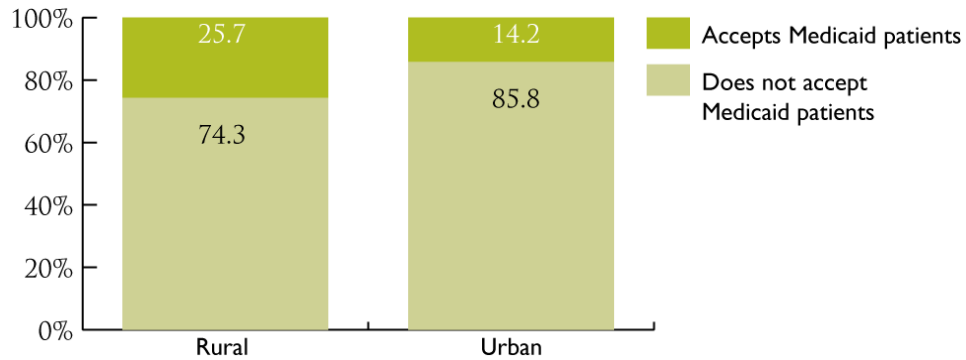
Rural dental hygienists participating in the survey were more likely to report practicing in a public health agency, school-based clinic or long-term care setting than their peers in urban practices. In each case, clinics generally have established referral agreements with local dentists for patients who need care that is outside the scope of practice of a dental hygienist.<sup>27</sup>

Participation rates in Medicaid and CHP+

In 2001, regulations were enacted that allowed unsupervised dental hygienists in Colorado to directly bill for Medicaid allowable services.<sup>28</sup> Similar to dentists in the 2006 and 2008 CHI surveys, a majority of dental hygienists, however, did not accept Medicaid patients. Rural dental hygienist respondents were almost twice as likely to accept Medicaid reimbursement and more than twice as likely to accept CHP+

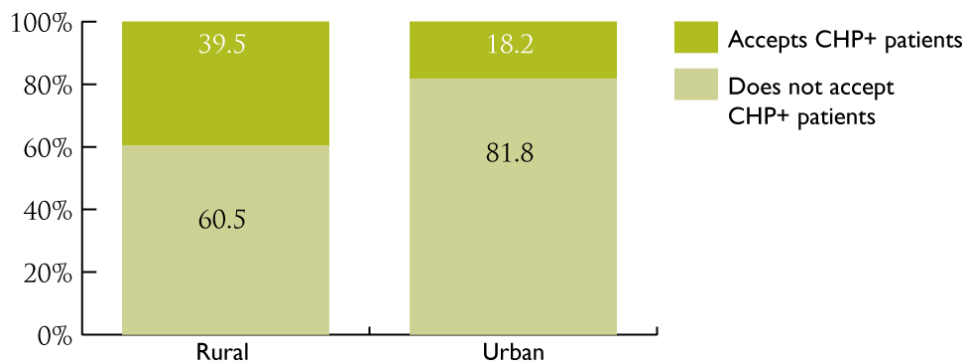
reimbursement as urban hygienists. Because the majority of dental hygienists who responded to the survey were employed by a dentist, this finding is not surprising as it mirrors that of the 2006 and 2008 dentist surveys.

Graph 6. Participation rates in Medicaid by Colorado dental hygienists, 2006



SOURCE: 2006 Dental Hygienist Workforce Survey

Graph 7. Participation rates in CHP+ program by Colorado dental hygienists, 2006



SOURCE: 2006 Dental Hygienist Workforce Survey

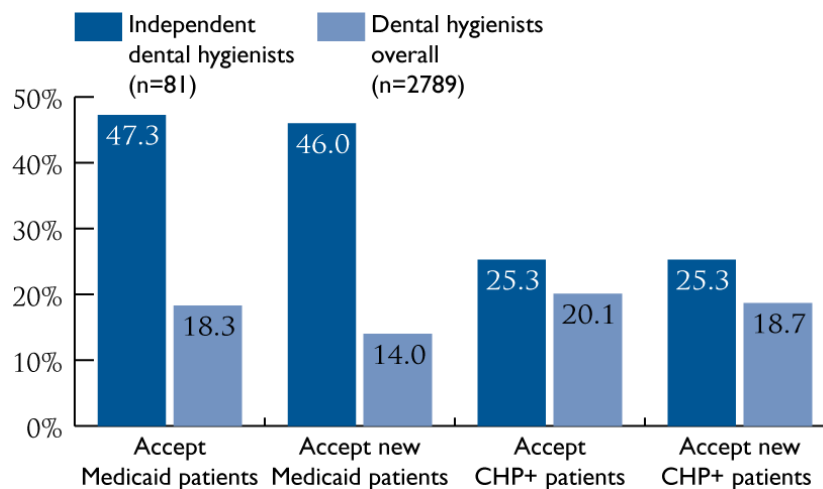
The low participation rate in Medicaid of both dental hygienists and dentists is a disturbing finding as Medicaid requires participating clinicians to conduct Early Periodic Screening, Diagnosis and Treatment (EPSDT) screens of all enrolled children, including providing dental sealants. The small percentage of dentists and dental hygienists reporting that they accept Medicaid patients prevents the EPSDT program from meeting its program goal of all enrolled children having access to comprehensive preventive care.<sup>29</sup>

#### Profile of independent practice dental hygienists

The ADHA identifies 19 states that have “varying forms of unsupervised practice or less restrictive supervision.”<sup>30</sup> Colorado and, more recently, Maine are two states that allow licensed dental hygienists to practice within their scope of practice without supervision or mandated collaboration with a dentist. The evidence-based studies that have been conducted regarding independent practice dental hygienists have found them to provide quality care to their patients and appropriately refer patients to dentists when care beyond their scope of practice is needed.<sup>31</sup>

Graph 8 illustrates how independent practice dental hygienists differ from those employed by a dentist with regard to their participation rates in the Medicaid program. Of all respondents to the 2006 survey, only 81 dental hygienists reported practicing in an unsupervised setting. Since DORA does not collect data on unsupervised dental hygienists, planners and policymakers do not know how many unsupervised licensed dental hygienists currently practice in Colorado.

Graph 8. Colorado independent dental hygienists accepting publicly insured patients, 2006



SOURCE: 2006 Colorado Dental Hygienist Workforce Survey

## Policy implications of oral health workforce surveys

Key informants interviewed for the 2006 dentist workforce survey agreed that the problems of access to appropriate oral health care in rural Colorado are complex with no single solution. Long-term success and sustainability to increase access to oral health care in rural areas will require policy change, community buy-in and public education; each of these approaches, singularly and in combination, holds promise for resulting in a better geographically distributed, appropriately available and accessible dental workforce. The data from the 2006 Colorado Dentist Workforce Survey, although not generalizable to the general dentist population in the state, confirm key informants' observations.

In the past few years, Colorado lawmakers have enacted several pieces of legislation dealing with oral health care.<sup>32</sup> Legislation passed in 2007 related to the Colorado practice of dentists and dental hygienists licensed in other states and appropriations for dental services for low-income children. In 2008, the legislature approved a bill to improve access to oral health services for Old Age Pension participants, and in 2009, lawmakers expanded the scope of practice of dental hygienists to include making a "dental hygiene diagnosis." One goal of this report is to recommend ways that CDPHE and others can track the implementation of legislative initiatives to better understand whether they are making a difference in the supply of oral health care practitioners in Colorado, particularly those committed to practicing in rural areas and to serving the state's underserved residents.

### **Option 1: Increase oral health outreach to toddlers and school-age children**

In 2006-07, more than 6,000 kindergarten and 3<sup>rd</sup>-grade children in Colorado were screened for untreated decay and caries experience. Of these, 23 percent of kindergartners and 25 percent of 3<sup>rd</sup> graders had untreated dental decay. Nearly half (45%) of kindergartners and 57 percent of 3<sup>rd</sup>-grade children had cavities and/or fillings (decay experience).<sup>33</sup>

Expanding annual dental screenings to a larger proportion of school-aged children, particularly those residing in rural areas of the state with few or no dental providers, would improve children's access to preventive oral health care. Likewise, making these dental services more available to preschool-age children in the state's Head Start Programs would be a cost-effective intervention. As noted earlier, Colorado could do better at ensuring that dental screenings occur when children enroll in a Head Start center.

Governor Ritter's *Building Blocks for Health Reform* contained a particular emphasis on improving access to health care for children by expanding income eligibility for children in the CHP+ program to 225 percent of the federal poverty level, expanding public outreach to and awareness of CHP+ and Medicaid, eliminating bureaucratic hassles in these programs and increasing dental reimbursement rates in Medicaid to 52 percent of commercial rates.

In 2009, as a result of the passage of the hospital fee bill (HB 09-1293), Governor Ritter committed his administration to expanding eligibility to Medicaid and CHP+ for children and adults. This expansion represents an opportunity to examine the oral health benefit and assess the capacity of oral health professionals who provide oral health care in Colorado. Expanded use of dental hygienists in the schools has proven efficacious in other states. South Carolina and Maine currently send dental hygienists into schools to provide preventive services, an effort the Colorado Dental Hygienists' Association has supported for Colorado. This is one of a number of expanded uses of dental hygienists that has met with success. Cavity Free at Three, a jointly funded, multi-year Colorado foundation initiative, is training physicians and nurses to provide oral health risk assessments, fluoride varnishes and sealants to children during their first three years as a part of their well-child visits.

An innovative pilot project funded by the Delta Dental of Colorado Foundation to place dental hygienists in pediatric offices also holds promise for reaching infants and young children before they enter the school system. There is increasing evidence for the importance of doing an initial screening of an infant's mouth prior to the age of one year to establish a baseline of information and to provide anticipatory guidance to mothers about the importance of proactive oral hygiene. Such guidance includes education about cavity-causing bacteria being transmitted between a mother and her infant when sharing spoons and other saliva contact.

### **Option 2: Opportunities for innovation in dental education**

Partnerships between the University of Colorado Denver School of Dental Medicine and other dental schools could be created to jointly develop curriculum specifically designed for rural track dental students. Since most dentists in a rural area may be the only dental provider for a large geographic area, training modules or seminars in pediatric dentistry, public policy and public health and practice

management could better prepare dental students for the opportunities and challenges they will encounter in being the only provider in town.

What is of interest to note in this regard is that this generalist/specialist approach to practice in rural areas already appears to be happening, although not necessarily by design. According to the CHI survey findings, 20 percent of rural practicing dentists reported having a pediatric focus, 28 percent reported prosthodontics, 25 percent endodontics and 35 percent oral surgery. Given these numbers, dental schools would do well to provide additional coursework for dental students that focuses on the unique challenges of practicing in a rural area, including the breadth of practice skills and services they may be called upon to provide. Additionally, a population health focus is important when a single dental practice may be expected to care for the oral health needs of a large geographic area. This population focus, as curriculum content, should include attention to public programs and the policy goals behind such as Medicaid and CHP+ in terms of the role they play in extending dental care access to low-income children and their parents.

### **Option 3: Reimbursement and care coordination strategies**

While some Colorado counties do not have any dentists, others lack dentists who are willing to accept Medicaid and CHP+ patients. The CHI 2006 dentist survey indicates that this problem may be even more acute in urban areas of the state. Efforts to encourage dentists to accept families and children on Medicaid necessarily will have to address dentists' chief complaints about the program—low reimbursement rates, burdensome paperwork and slow claims processing. Although key informants acknowledged that there are “reality and myth” components to each of these complaints, it is the case that 68 percent of dentists practicing in a rural area and three-quarters of urban dentists responding to the 2006 CHI survey reported not accepting Medicaid patients. Among dentists with Medicaid patients in their practice, 73 percent of rural and 71 percent of urban dentists reported not accepting *new* Medicaid patients.

This issue represents a major political problem in Colorado's oral health benefit in Medicaid program; a problem that can only be addressed by the legislature and/or the administration. As noted above, Governor Ritter has proposed a significant increase in dental provider rates as part of his *Building Blocks to Health Reform* Initiative.

Key informants suggested additional strategies that could help to mitigate the willing provider problem, for example, an outreach campaign targeted at dentists to provide objective and unbiased information about the importance of this dental benefit to low-income children, including the impact of poor oral health on the physical health of Colorado's children. Another possible strategy is an outreach campaign that provides useful information to dental practices about how to make the economics of serving Medicaid children work.

Care coordination (care management) is often used in medical settings for hard-to-reach populations, but has not routinely been used in dental care. Care coordinators who navigate between medical and oral health providers can assist low-income families, including those who are uninsured and on Medicaid and CHP+, to use the health care system appropriately and also can provide health education and enrollment assistance to families eligible for publicly funded programs. Caring for Colorado Foundation

has provided grant funds to test and evaluate a care coordination model for dental care access and has found benefits to this approach such as fewer appointment “no-shows,” a greater number of people using the system appropriately and successful assistance in helping families with funding for their dental care needs.

#### **Option 4: Community-based interventions**

HRSA has developed criteria to determine whether geographic areas or populations have a shortage of health professionals. Designation as a Dental Health Professional Shortage Area (HPSA) ensures eligibility for more than 34 federal programs including the National Health Service Corps, scholarship funds and loan repayment. These programs are important tools currently promoted by the Colorado Rural Health Center to recruit oral health providers to rural Colorado. CDPHE’s Primary Care Office assists rural communities in completing the HPSA application process.

Once an area has a Dental HPSA designation, the community has expanded opportunities for local collaborations to recruit oral health professionals. Additional tools available to a rural community include low-cost loans for establishing a dental practice from a local bank, real estate assistance in finding a practice site and securing loan assistance, and entry into local community support systems such as the local school board and school superintendent’s office, recreational opportunities, local cultural events and other services that characterize the community’s unique resources and assets. Meaningful opportunities for community involvement and work for spouses are also important resources to be developed when recruiting health professionals to a community. Professional recruitment is a community investment and economic resource that cannot be overemphasized in a rural context. So saying, oral health recruitment is a community activity that requires the commitment of the entire community.

Colorado has five Area Health Education Centers (AHECs) that were established to assist communities in their health professional recruitment efforts. Designed to assist communities with the initial recruitment of a health professional, AHECs also provide continuing education and faculty appointment opportunities for health professionals practicing in a rural area of the state. The AHEC program is often an underutilized resource and increased coordination between the five AHECs, the Colorado Rural Health Center, the Office of Primary Care and the University of Colorado Denver School of Dental Medicine holds the potential to expand available community resources for the recruitment and retention of dentists in rural areas.

Community and migrant health centers with an oral health component are exemplary models of collaborative, interdisciplinary approaches that have been demonstrated to effectively provide a bridge between physical and oral health care. Best practices dissemination strategies should be promoted to rural areas across the state through various mechanisms, including the CHI Safety Net Indicators and Monitoring system that is currently developing best practice community studies for wide dissemination throughout Colorado.

Additional community-based interventions that could be leveraged to integrate oral health care and that should be evaluated for efficacy include:

- The Nurse Home Visitor Program administered by CDPHE. This program is evidence-based and sends nurses into the community to support first-time, at-risk mothers. CDPHE provides toothbrushes and information on oral health. An explicit link to dental hygienists' preventive services would strengthen the impact of the intervention on oral health outcomes.
- The Colorado Trust is funding a promatora model in three schools in the Native American community. Another type of community-based resource is the community liaison funded by Caring for Colorado Foundation.
- Outreach workers in the Women, Infants and Children (WIC) clinics could include basic oral health education about the importance of preventive and basic oral care services. Outreach and education are only as effective at improving population health outcomes as they are linked to actual preventive and oral health services. This is another example of the importance of having adequate providers available once oral health problems are identified.

### **Option 5: Recruitment and retention strategies**

Several key informants spoke directly to the issues related to recruitment and retention.

Dental hygienists provide preventive oral health care using evidence-based approaches to prevent caries and oral disease. The Dental Hygiene Practice Act guidelines were recently updated for the first time since 1985 to reflect these proven practices. The Colorado Dental Hygienists' Association currently is evaluating whether the Practice Act also needs updating to reflect the different settings in which dental hygienists apply their skills and expertise. As noted earlier, CHI recently undertook a study for Governor Ritter's policy office that included examining the evidence for expanding dental hygienists' scope of practice to address oral health care shortages in rural and other underserved areas of the state.

In 2004, the American Dental Hygienists' Association (ADHA) created the concept of Advanced Dental Hygiene Practitioners (ADHPs) to address the lack of access to oral health care for underserved communities across the country. ADHPs would be master's-level prepared oral health practitioners similar to nurse practitioners, functioning independently under remote supervision in community-based settings. The ADHP would be trained to manage the ongoing dental needs of patients, provide oral health education and full preventive services and perform simple extractions and restorations. The ADHA currently is seeking funding for a pilot project to demonstrate the efficacy of this new professional category. Colorado policymakers should monitor the evidence that may be forthcoming from demonstrations conducted elsewhere.

Colorado's rural health advocates enthusiastically promote a "grow-your-own" approach to increasing the supply of dentists and other oral health professionals opting to work in rural areas of the state. Of the programs listed below, particular attention should be paid to recruiting Colorado students into the oral health professions as they exit high school. It is one thing to expose students to careers in the oral health professions; it is another to actively recruit them into oral health profession schools—a strategy that requires an explicit commitment on the part of health professions programs. Options that promote a more focused approach to recruiting oral health professionals into rural areas include:

- Offering pre-medical and pre-dental educational opportunities and scholarships for rural high school students to attend conferences and university-based programs that are designed to introduce students to medical and dental careers.
- Providing rural experiences for dental and dental hygienist students. A rural track at the UCDSDM places residents in rural locations for a clinical rotation. Colorado's AHECs report they have provided 648 weeks of rural dentistry clinical rotations for 108 students. Both of these programs could be expanded to create a larger pool of dentists and hygienists interested in a rural practice setting.
- Promoting cross-training and jointly developed curricula between dentists and physicians to increase early detection of oral health problems since children tend to see a pediatrician before seeing a dentist. The Delta Dental of Colorado Foundation funded the establishment of the Frontier Center in 2005 for this purpose. Another goal of the Frontier Center is to develop evidence-based strategies for recruiting greater numbers of rural and minority students into UCDSDM.
- Supporting and expanding the Advanced Clinical Training and Service Program at UCDSDM. Fourth-year dental students currently have the opportunity to provide a year of dental service in an underserved community under the guidance of a practicing dentist. There are 50 participating clinics with students rotating to a new clinic setting each for four to six weeks.

#### **Option 6: Reviewing the evidence for new oral health professionals**

The Colorado Health Institute recently completed an evidence-based literature review of the scopes of practice of advanced practice nurses, physician assistants and dental hygienists in response to an executive order issued by Governor Ritter in February 2008. Other comprehensive approaches to school-based oral health screenings and preventive care are possible through legislation or executive branch decree.

The oral health literature is reporting other new types of oral health providers and methods for expanding access to oral health care in underserved areas, many of which have been implemented on a limited basis.

- *Expanded Function Dental Assistants* work under the direct supervision of a dentist to prepare or complete restorations, take x-rays, apply sealants and fluoride varnishes and polish teeth.
- *Dental Health Aides and Dental Health Aide Therapists* currently work on Alaska Native reservations in Alaska. The aides provide preventive services, while therapists are trained to do cleanings, fillings and uncomplicated extractions in addition to preventive services. All work is done under the general supervision of a dentist at regional hospitals.
- *Community Dental Health Coordinators* attend an 18-month training program and then work under the supervision of a dentist in medical offices and community settings to promote oral health and provide basic preventive screening services.

Because rural residents tend to have greater access to physical primary care than dental care, one promising intervention is to provide training, support and Medicaid reimbursement for primary care physicians to perform basic oral health preventive care and uncomplicated dental tasks. The UCDSDM rural track is providing such training opportunities for both physicians and residents in a “train-the-trainer” format which has introduced oral health into the medical school curriculum. West Virginia is



cross-training dental professionals, primary care physicians, nurse practitioners and physician assistants to provide early oral health screening to identify potential oral health problems in the early years of a child's growth and development.

The Colorado Oral Health Network (COHN) estimates that every dollar spent on oral health prevention can save as much as \$50 on restorative and emergency procedures. Children who receive early preventive oral health care have 40 percent lower costs later in life than children whose oral health is neglected. Investing in community water fluoridation creates approximately \$38 per dollar in savings on dental treatment costs.<sup>34</sup> These statistics offer Colorado policymakers and oral health stakeholders the ability to understand the cost benefit of investing in prevention. Unfortunately, both providers and patients continue to face barriers to offering or accessing quality oral health care due to several ongoing issues.

### **UNSUPERVISED DENTAL HYGIENIST AND DENTAL HYGIENE DIAGNOSIS (DHDX)**

Having the ability to practice independent of dentist supervision allows Colorado dental hygienists greater autonomy and choice of practice setting. Acting as a gatekeeper to oral health, unsupervised dental hygienists may be an affordable resource for patients to receive regular preventive care as well as a resource for referrals to dental specialists when additional care is needed. As stated in the 2008 Collaborative Scopes of Care Advisory Committee report,<sup>35</sup> however, dental hygienists face a current statutory restriction inhibiting their ability to make a dental hygiene diagnosis, specifically when a dental hygienist could inform a patient or the parent of a child patient about the presence of caries or gum problems. Although dental hygienists receive education in the evaluation, identification and dental hygiene diagnosis of oral hygiene-related diseases, they are unable to inform the patient, parent or guardian, for example, that the reason a sealant cannot be applied to their teeth or their child's teeth is due to the presence of dental caries.

During the 2009 legislative session, Senate Bill 129 was passed authorizing a dental hygienist to make a diagnosis, that is, identify an existing oral health problem that a dental hygienist is qualified and licensed to treat. This bill allows more specific, accurate and timely communication between patients and dentists upon referral by a licensed dental hygienist. A dental hygiene diagnosis could motivate the patient and provide a sense of importance to seeking necessary follow-up evaluation and care. On the other hand, key informants said an inaccurate dental hygiene diagnosis could lead to an unnecessary referral and delayed treatment of an undiagnosed condition, possibly increasing malpractice liability for a dentist who accepts referrals from dental hygienists.<sup>36</sup>

### **RURAL ORAL HEALTH ACCESS AND WORKFORCE POLICY OPTIONS**

#### **Data collection and policy monitoring**

In spite of recent foundation investments in health professions data, Colorado still suffers (as do most other states) from lack of data in the area of health professions workforce data. These data deficits result in sub-optimal estimates of workforce supply and the distribution of Colorado's primary care workforce.

Legislation should be considered that would require the health professions licensing boards housed in DORA to collect additional information from all applicants for a new or renewed Colorado license such as practice setting (e.g., community health center, private clinic, solo practice, school-based health center), practice address, years in active practice, certifications held, date of birth, highest degree held and/or others to be determined.

### **Colorado-specific evidence basis for collaborative models of primary care**

Colorado policymakers should consider authorizing demonstration projects to test the efficacy, safety and quality of using dental hygienists as oral health care providers in underserved areas of Colorado and in non-traditional settings such as school-based sealant programs and community health clinics. These studies should employ the highest standards of clinical and health services research to provide definite evidence of the processes and outcomes of care associated with various models of collaborative, interdisciplinary primary care practice.

### **Dentist and dental hygiene workforce supply and demand models**

These models would emulate the supply-and-demand models currently being developed by CHI for physicians. This step would help Colorado policymakers and other stakeholders forecast the supply of dentists and dental hygienists and project whether this supply will meet expected demand for oral health care. Through this information, appropriate planning could be implemented through education and workforce recruitment.

## **Appendix A. Survey methods**

### **2006 COLORADO DENTIST WORKFORCE SURVEY**

#### **Methods**

Between March and September 2006, using a two-wave mail protocol, survey questionnaires were sent to all dentists who held an active license to practice dentistry in Colorado (n=4,427). The questionnaires were mailed with an Internet option to the address in each licensee's contact database maintained by the Colorado Department of Regulatory Agencies (DORA). Accounting for surveys returned as undeliverable, CHI received completed surveys from 1,826 dentists for a 42 percent response rate. Of these, 1,286 listed a Colorado address as their practice location; this group comprised the sample for the analysis included in this report.

#### **Data limitations**

Survey findings cannot be generalized to the entire Colorado dentist population because there were not enough demographic data elements available to develop "weights." Weights are constructed using basic demographic information from responders and non-responders and are applied to the data in order to scale the results to represent the entire population rather than just the sample population. CHI, however, compared the sample population to the DORA database based on gender of the licensee. As Table 2 indicates, survey respondents were very similar to Colorado dentists as a whole.

### **2008 COLORADO RURAL DENTIST WORKFORCE SURVEY**

#### **Methods**

The survey was administered in four waves by mail and Internet beginning in July 2008. The first wave was a postcard alerting the 365 identified rural dentists that a survey was coming. The second mailing, which included a cover letter with "Frequently Asked Questions," a questionnaire, a self-addressed stamped envelope and a \$2 token, went out to all actively licensed dentists living in a rural Colorado area according to Rural/Urban Commuting Area (RUCA) codes. The survey forms were mailed to the contact address in each licensee's file at DORA. This address may have been the dentist's home or practice location. The third mailing was a postcard either reminding the dentists to fill out the survey or thanking them if they already sent it back. The fourth wave consisted of a cover letter and a second questionnaire.

CHI received survey responses from 190 rural dentists as a result of the first questionnaire mailing. The second survey mailing yielded an additional 61 responses. CHI received survey responses from a total of 251 rural dentists, or about 70 percent of those mailed a survey form.

#### **Survey limitations**

The primary limitation of the survey results is that it was a census survey which means that the questionnaire was mailed to all licensed rural dentists in Colorado in 2008. To reduce bias introduced via non-response, CHI provided non-response weights for the survey data. The information used to construct the weights included license issue date, gender and degree.

## **2006 COLORADO DENTAL HYGIENIST WORKFORCE SURVEY**

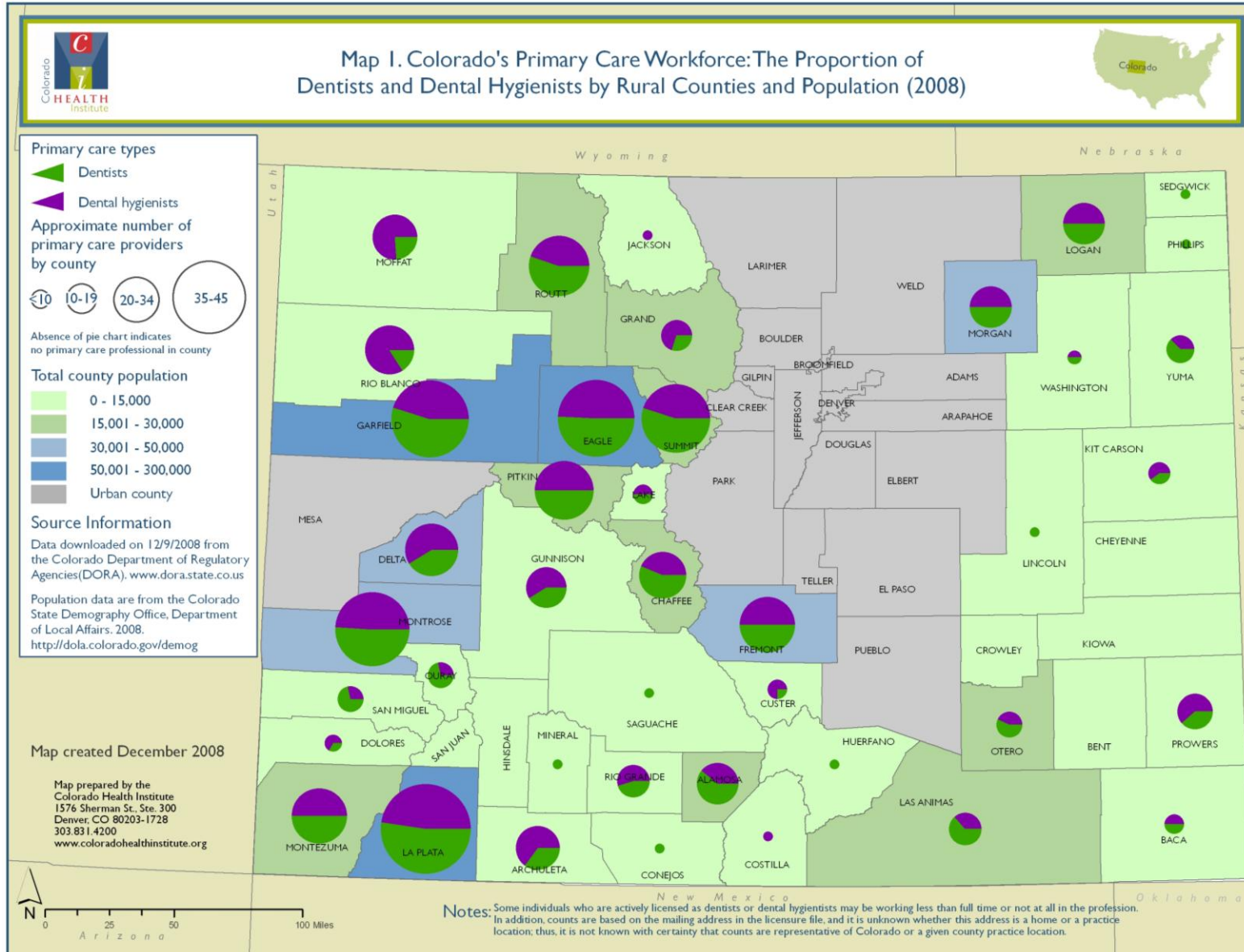
### **Methods**

In August 2006, survey questionnaires were mailed to all individuals who held an active license to practice as a dental hygienist in Colorado and had a mailing address in Colorado (N=3,698). The survey forms were mailed to the contact address in each licensee's licensure file at DORA, either a home or practice location. Due to undeliverable addresses, the number of dental hygienists presumed to have received a survey was 3,646. CHI received survey responses from 2,170 dental hygienists, or about 60 percent of those who were mailed a survey.

### **Survey limitations**

A survey form was mailed to Colorado licensed dental hygienists with a contact address in Colorado (N=3,698), but only a sample responded (N=2,170). To reduce non-response bias, CHI added a weight to the data file based on gender, graduation year and rural/urban classification to allow estimates to be generalized to the overall dental hygienist population in Colorado.

# Appendix B. Maps





Map 2. Colorado's Dental Health Professional Shortage Areas (HPSAs) and Locations of Dentists and Dental Hygienists



**Primary care types**

- ⊕ Dentists
- ◆ Dental hygienists

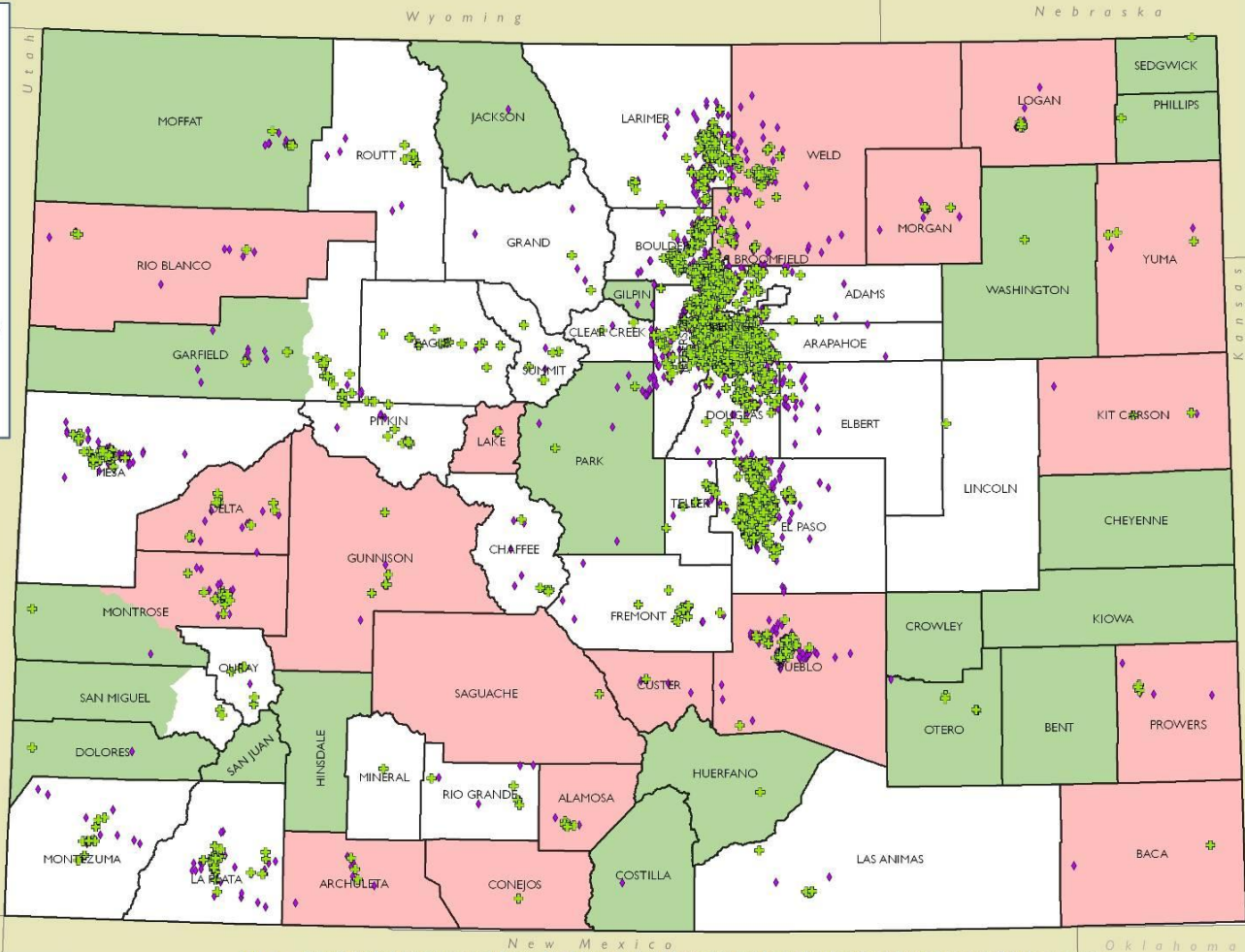
**Primary Care HPSA types**

- Geographic
- Low-Income
- Not Designated

**Source Information**

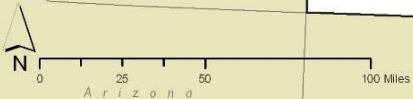
Data downloaded on 12/15/2008 from the Colorado Department of Regulatory Agencies (DORA). [www.dora.state.co.us](http://www.dora.state.co.us)

Shortage Designation Branch, HRSA, U.S. Department of Health and Human Services. Data downloaded 10/15/2008



Map created December 2008

Map prepared by the Colorado Health Institute  
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**Notes:** Some individuals who are actively licensed as dentists or dental hygienists may be working less than full time or not at all in the profession. In addition, counts are based on the mailing address in the licensure file, and it is unknown whether this address is a home or a practice location; thus, it is not known with certainty that counts are representative of Colorado or a given county practice location.



## Endnotes

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- <sup>5</sup> Andrilla, H., Et al. (2006). *Rural dental practice: A tale of four states*. Rural Health Research Center, University of Washington, School of Medicine, Department of Family Medicine. Available at: [http://depts.washington.edu/uwrhrc/uploads/RHRC\\_WPI07\\_Andrilla.pdf](http://depts.washington.edu/uwrhrc/uploads/RHRC_WPI07_Andrilla.pdf).
- <sup>6</sup> U.S. Department of Health and Human Services, Health Resources and Services Administration. "Shortage Designation: HPSAs, MUAs & MUPs." Available at <http://bhpr.hrsa.gov/shortage/>.
- <sup>7</sup> Healthy People. Available at: <http://www.healthypeople.gov/About/> (retrieved on 4/1/09).
- <sup>8</sup> Geographic HPSAs are defined as having a dentist-to-population ratio of 1:5,000 or greater or a dentist-to-population ratio of 1:4,000 in areas where less than half the population is on fluoridated water. Low-income HPSAs are those areas where at least 20 percent of the population is at or below 200 percent of the federal poverty level (FPL).
- <sup>9</sup> Colorado Department of Regulatory Agencies (DORA) (2009). "Active licensed dental hygienists, 2009." Available on the Colorado Health Institute Web site at: [http://datacenter.coloradohealthinstitute.org/data\\_results.jsp?i=105&rt=3&p=2&c=5](http://datacenter.coloradohealthinstitute.org/data_results.jsp?i=105&rt=3&p=2&c=5).
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