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A Dental Hygiene Professional Practice Index (DHPPI) and Access to Oral Health Status and Service Use in the United States

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Purpose. The purpose of this article is to summarize a larger study that developed a statistical index that defines the professional practice environment of dental hygienists (DHs) in the United States, and to determine the extent to which the index scores are related to the number of DHs and dentists, the utilization of dental services, and selected oral health outcomes across the 50 states.

Methods. A Dental Hygiene Professional Practice Index (DHPPI) defines the professional status, supervision requirements, tasks permitted, and reimbursement options for DHs in each of the 50 states and the District of Columbia, as of December 31, 2001. Spearman rank order correlations between the DHPPI and numbers of oral health professionals, utilization of oral health services, and oral health outcomes in the 50 states are also presented.

Results. The analyses revealed that:

- There are significant differences in the legal practice environments (as reflected in the DHPPI) across the 50 states and the District of Columbia.

- Between 1990 and 2001, the number of DHs per capita increased by 46% in the United States, while the number of dentists per 100,000 population increased by only 10%.

- The DHPPI was not significantly correlated with the number of DHs or dentists in the 50 states in 2001.

- The DHPPI was significantly positively correlated with the salaries of DHs in 2001.

- The DHPPI was also significantly and positively correlated with a number of indicators of utilization of oral health services and oral health outcomes.

Conclusions. Both access to oral health services and oral health outcomes are positively correlated with the DHPPI. This suggests that states with low DHPPI scores would be logical candidates for revised DH practice statutes and regulations to accomplish these objectives.

Keywords: Scope of practice, dental hygiene, oral health outcomes, access to oral health services

Introduction

A major study of the legal scope of practice of dental hygienists (DHs) in the 50 states and the District of Columbia was conducted in 2002 and 2003. This article summarizes the key findings from the full report prepared as part of that study[1], and presents some conclusions for consideration by planners and policy makers interested in the evolving roles and responsibilities of DHs in the United States.

DHs played a much greater role in the oral health system in 2000 than they did a decade earlier. Some of the increase in roles and responsibilities was numerical, reflecting the significant increase in the number of DHs, from around 72,000 in 1990 to more than 120,000 in 2001 (Table I)[2, 3, 4]. As important as was the growing number of DHs across the 50 states, much of the expansion in roles and responsibilities of DHs was qualitative, reflecting the increasing involvement of DHs in providing preventive and restorative oral health services. The contributions of DHs to both quality of care and access to care-and their potential for even greater contributions in the future-did not go unnoticed in state legislatures and governors' offices. Over the past decade, virtually every state expanded the legal scope of practice of DHs. DH roles, which were historically rooted in preventive care, have been slowly expanding into a variety of basic restorative services, stimulated in part by government and private initiatives to increase access to care for underserved population groups[5].

Table I. Dental Hygienists and Dentists per 100,000 Population, by State, Selected Years

	DHs per 100K Pop			Percent Change		DDS/100K			DH '01:
State	1980	1990	2001	'80 - '90	'90 - '01	1987	1998	% Chg	DDS '98
Alabama	29.5	30.7	54.1	4.0%	76.4%	36.7	38.2	4.0%	1.42
Alaska	21.4	36.5	54.7	70.8%	49.8%	52.5	67.6	28.8%	0.81
Arizona	19.6	27.5	33.3	40.6%	21.1%	45.6	39.3	-13.9%	0.85
Arkansas	11.9	21.9	35.8	83.5%	63.4%	37.4	36.6	-2.2%	0.98
California	20.5	26.5	31.9	28.8%	20.6%	56.6	58.4	3.3%	0.55
Colorado	23.6	32.1	46.7	36.3%	45.3%	63.7	58.6	-8.0%	0.80
Connecticut	32.4	46.1	61.6	42.0%	33.8%	72.6	68.9	-5.1%	0.89
Delaware	35.5	48.0	57.6	35.2%	19.9%	41.8	41.3	-1.1%	1.39
District of Columbia	6.1	16.5	24.2	169.5%	47.0%	75.5	100.2	32.7%	0.24
Florida	23.3	30.5	44.1	31.2%	44.4%	46.1	43.8	-4.8%	1.01
Georgia	26.5	33.4	40.9	25.9%	22.4%	41.4	37.9	-8.5%	1.08
Hawaii	15.5	20.2	24.8	30.0%	22.6%	72.8	74.9	2.9%	0.33
Idaho	14.3	26.5	47.9	85.5%	80.7%	50.1	47.3	-5.5%	1.01
Illinois	16.0	26.4	37.3	65.1%	41.4%	57.0	58.5	2.8%	0.64
Indiana	15.8	26.8	40.2	69.9%	49.7%	43.7	42.7	-2.2%	0.94
Iowa	13.8	25.5	36.8	85.3%	44.5%	50.3	49.2	-2.3%	0.75
Kansas	16.6	24.6	42.7	48.1%	73.3%	46.7	45.3	-3.0%	0.94
Kentucky	11.7	15.3	31.9	30.7%	109.0%	47.2	48.1	1.9%	0.66
Louisiana	12.4	16.4	27.6	31.7%	68.7%	41.2	42.2	2.5%	0.65
Maine	30.9	38.3	63.6	23.7%	66.0%	44.5	45.1	1.4%	1.41
Maryland	21.0	29.1	53.1	38.5%	82.4%	58.6	63.3	8.0%	0.84
Massachusetts	35.4	41.8	63.4	18.2%	51.5%	66.4	65.9	-0.7%	0.96
Michigan	26.4	42.8	64.4	61.9%	50.6%	57.1	53.4	-6.5%	1.21
Minnesota	27.2	42.9	55.7	57.7%	29.8%	61.2	55.4	-9.5%	1.01
Mississippi	6.9	19.0	23.0	174.3%	20.6%	32.8	34.2	4.1%	0.67
Missouri	10.8	14.9	27.6	38.6%	84.9%	48.4	44.4	-8.3%	0.62
Montana	19.3	18.3	17.1	-5.4%	-6.3%	57.4	49.8	-13.3%	0.34
Nebraska	16.6	20.6	37.5	23.9%	82.1%	54.6	57.3	4.9%	0.65
Nevada	7.0	32.0	37.2	356.4%	16.4%	43.9	32.5	-26.0%	1.14
New Hampshire	21.4	58.9	63.6	175.2%	8.1%	55.7	52.2	-6.2%	1.22
New Jersey	19.4	32.7	41.4	68.2%	26.8%	66.8	67.1	0.5%	0.62
New Mexico	14.0	22.4	37.1	60.2%	66.0%	39.2	36.6	-6.7%	1.02
New York	25.0	32.2	35.6	28.7%	10.8%	71.0	66.1	-6.9%	0.54
North Carolina	24.9	29.9	51.9	20.2%	73.6%	37.4	36.9	-1.2%	1.41
North Dakota	13.9	39.1	54.8	180.8%	40.0%	44.6	46.0	3.1%	1.19
Ohio	20.1	30.8	53.1	53.4%	72.7%	50.6	48.1	-4.8%	1.10
Oklahoma	13.2	19.9	32.2	50.6%	62.3%	41.8	43.4	3.9%	0.74
Oregon	24.3	42.2	74.6	73.3%	76.9%	63.8	58.4	-8.6%	1.28
Pennsylvania	18.0	25.0	43.6	38.5%	74.2%	56.5	56.7	0.5%	0.77
Rhode Island	25.3	35.6	54.0	40.4%	51.7%	51.8	51.0	-1.6%	1.06
South Carolina	16.6	25.6	35.8	54.4%	39.9%	36.9	38.6	4.7%	0.93
South Dakota	11.7	18.2	38.7	55.7%	111.8%	43.4	43.6	0.4%	0.89
Tennessee	15.7	30.7	37.3	95.6%	21.7%	48.5	44.6	-8.1%	0.84
Texas	15.9	22.0	37.1	38.9%	68.3%	42.6	40.5	-5.0%	0.92
Utah	9.4	16.1	32.1	70.2%	99.8%	62.5	52.8	-15.6%	0.61
Vermont	46.6	40.0	88.7	-14.2%	122.0%	53.9	54.3	0.9%	1.63
Virginia	14.0	23.6	35.6	68.0%	51.0%	47.8	49.9	4.5%	0.71
Washington	28.7	41.1	57.7	43.4%	40.5%	61.4	56.3	-8.3%	1.03
West Virginia	19.2	27.7	45.0	43.8%	62.8%	38.6	41.1	6.6%	1.09
Wisconsin	25.9	35.3	58.6	36.2%	66.2%	60.4	52.6	-12.9%	1.11
Wyoming	20.9	15.9	22.9	-23.9%	44.1%	50.3	46.8	-6.9%	0.49
US	**20.4**	**29.1**	**42.4**	**42.8%**	**45.6%**	**46.6**	**51.4**	**10.4%**	**0.82**

Sources: ADHA, 2002; ARF; US Bureau of Census

This expansion of the legal scope of practice was the subject of the larger study summarized herein. The larger study:

- created a Dental Hygiene Professional Practice Index (DHPPI) based on statutes and regulations for 2001;

- compiled a variety of statistics about DHs in the United States and several indicators of the oral health status of Americans and their access to oral health services; and

- performed a variety of statistical analyses to assess the extent to which the DHPPI is related to number of practicing DHs, number of practicing dentists, a number of oral health status indicators, and access to care for the underserved in the 50 states.

The DHPPI

To help planners and policy makers understand the extent of practice possibilities for DHs in each of the 50 states, a DHPPI was developed that assigned points for various practice options and possibilities deemed important by an advisory committee comprised of practitioners, researchers, educators, and regulators. The criteria in the index for 2001 were selected to represent the characteristics of an "ideal" professional practice for DHs, based on conversations with representatives of the ADHA in early 2002. By strictly applying the scoring rules for each of the criteria to the statutes and regulations in each state, the resulting index provides a basis for comparing the legal scope of practice across all states.

Once the index was developed and scored, the resulting DHPPI scores were subjected to an extensive review process. Drafts of the detailed state-level scoring protocols and the overall rankings for all 50 states were made available to interested parties in many of the 50 states. This review was accomplished with the assistance of the American Dental Hygienists' Association (ADHA), which provided access to state DH planning groups at the ADHA annual meeting in June 2002. This review process led to a number of modifications to the index and resulted in the final index scores summarized below.

The DHPPI has four broad components (regulation, supervision, tasks permitted, and reimbursement), which reflect the ways in which DHs can practice. Scores were determined only by options and restrictions found in legislation or regulation; variations in actual practice not supported by statutes or regulations were not considered. Higher scores on the DHPPI are generally associated with broader sets of tasks, more autonomous practice environments (i.e., less direct oversight by dentists), and greater opportunities for direct reimbursement for services.

DHPPI 2001 State Scores

Table II presents the DHPPI for the 50 states and the District of Columbia as of 2001. As with many such indices, the differences in professional practice that underlie small differences in the DHPPI scores are also small. Thus, states that are close on the indices are generally similar in their legal scopes of practice. The DHPPI ratings of "Excellent," "Favorable," "Acceptable," "Limiting," and "Restrictive" in Table II were added to help readers characterize the practice environments in the different states in a more qualitative way. Although assignment of states to the five categories was subjective, these categories generally conform to objective characterizations of the practice environments in states as revealed in the field review process of the study.

Table II
Dental Hygiene Professional Practice Index, 2001
Index Components by State

	DHPPI Component					
State	**Regs**	**Sup**	**Tasks**	**Reimb**	**Total**	**DHPPI**
Maximum Score	**10**	**47**	**28**	**15**	**100**	**Rating**
Colorado	9	47	26	15	97	
Washington	10	45	26	15	96	
Oregon	10	41	22	15	88	**Excellent**
California	8	37	26	15	86	
New Mexico	10	37	24	15	86	
Connecticut	9	33	18	15	75	
Missouri	8	29	22	15	74	
Nevada	9	36	20	0	65	
Minnesota	8	36	20	0	64	**Favorable**
Maine	8	30	18	0	56	
Utah	7	21	20	5	53	
New York	9	23	18	0	50	
Arizona	6	21	18	0	45	
Idaho	7	18	20	0	45	
South Carolina	8	21	16	0	45	
Nebraska	7	21	16	0	44	
Wisconsin	7	21	16	0	44	**Satisfactory**
Pennsylvania	8	18	16	0	42	
South Dakota	6	16	20	0	42	
Louisiana	8	15	18	0	41	
Montana	9	16	16	0	41	
Texas	8	23	10	0	41	
Kansas	7	14	18	0	39	
New Hampshire	9	16	14	0	39	
Tennessee	7	14	18	0	39	
Vermont	9	16	14	0	39	
Ohio	6	16	16	0	38	
Indiana	8	19	10	0	37	
New Jersey	6	15	16	0	37	
Iowa	8	10	18	0	36	
Illinois	7	11	18	0	36	
Maryland	10	16	10	0	36	
Alaska	9	12	14	0	35	**Limiting**
Michigan	7	18	10	0	35	
Massachussetts	6	16	12	0	34	
Wyoming	4	14	16	0	34	
Florida	6	21	6	0	33	
Rhode Island	7	16	10	0	33	
District of Columbia	6	16	10	0	32	
Delaware	8	16	8	0	32	
Hawaii	5	11	16	0	32	
North Dakota	6	16	10	0	32	
Oklahoma	6	7	18	0	31	
North Carolina	6	9	14	0	29	
Arkansas	6	5	16	0	27	
Georgia	8	9	6	0	23	
Alabama	6	12	0	0	18	**Restrictive**
Kentucky	6	8	4	0	18	
Virginia	7	8	2	0	17	
Mississippi	6	7	2	0	15	
West Virginia	6	2	2	0	10	

Relationships Between DHPPI and Other Factors

The relationships between the DHPPI, numbers of DHs, and numbers of dentists helps to understand the practice environment for DHs in the US. Three different analyses are summarized below.

Table III shows the Spearman rank order correlations between the DHPPI and the numbers of dentists per capita in 2001 and the number of DHs per capita across the 50 states and the District of Columbia in 2001. These correlations provide insights about the relationship between the professional practice environments for DHs and the relative supply of dentists and DHs.

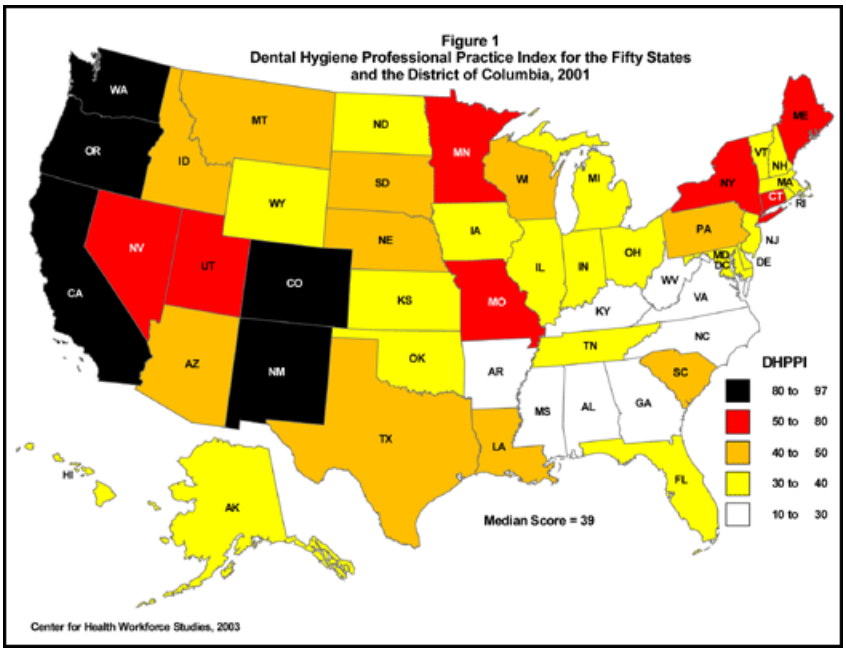
Table III. Relationship Between the 2001 DHPPI and the Supply of Oral Health Professionals

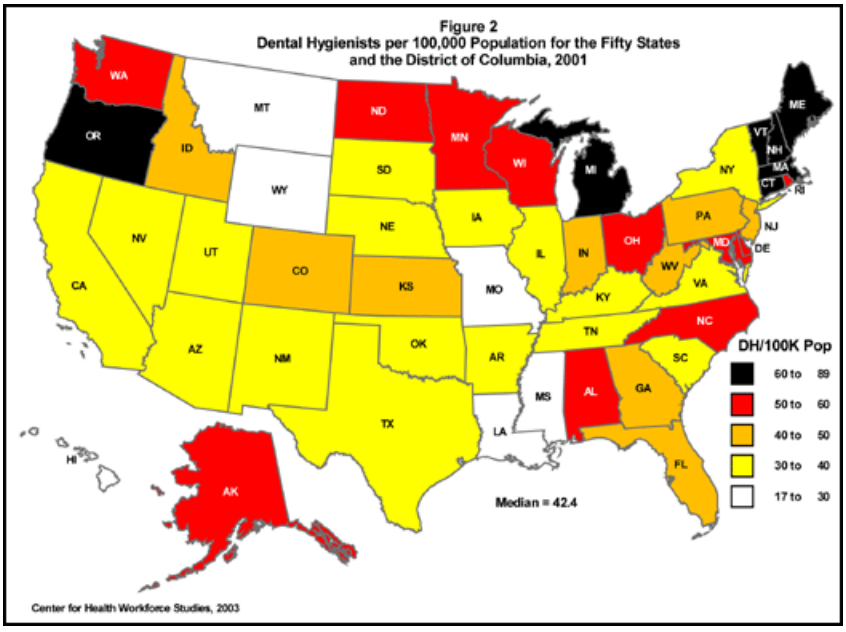
Dentists per capita, 2001	+0.13 (p=0.365)
Dental Hygienists per capita, 2001	+0.13 (p=0.355)

The Spearman rank order correlation between the DHPPI and numbers of DHs per 100,000 populations in 2001 is positive, but not statistically significant (Spearman's Rho = +0.13, p = 0.355). This indicates that states with more favorable practice environments for DHs (as measured by the DHPPI) show only slight tendencies to have more DHs per capita and more dentists per capita.

The correlation between the DHPPI and the ratio of DHs to dentists is also not statistically significant (Spearman's Rho = -0.038, p = 0.79). This suggests that the numbers of DHs are generally determined not by the legal practice environment of DHs, but rather by such factors as practice structures of dentists and demand for preventive oral health services.

The data also reveal some interesting geographic patterns. Figure 1 shows that states in the West have generally given DHs more autonomy in their practices (as indicated by the DHPPI) than have states in the Southeast. Figure 2, based on data in Table I, reveals relatively higher penetration of DHs in the Northeast and relatively lower penetration in the Southwest and Northern Plains.





The correlation of DHs per 100,000 population in 2001 with dentists per 100,000 population in 2001 is also positive, but not statistically significant (Spearman's Rho = +0.212, p = 0.136). This suggests that the numbers of DHs per capita are not driven by the number of dentists per capita, which suggests that dentists' hiring of DHs does not follow a consistent pattern across the states.

Other Findings of Interest

To test the hypothesis that DH salaries are higher in states with broader professional practice for DHs (as indicated by the DHPPI), Spearman rank order correlations were computed between the 2001 DHPPI and median hourly, mean hourly, and mean annual salaries for DHs in 2001. The positive and statistically significant correlations shown in Table IV confirm this hypothesis. This indicates clearly that DH salaries are higher in states that permit broader sets of tasks, have less restrictive supervision requirements, and have greater opportunities for direct reimbursement, although the precise mechanism of this relationship cannot be determined from these data.

Table IV. Relationship Between the 2001 DHPPI and Salaries of Dental Hygienists in 2001

Dental hygienist median hourly salary, 2001	+0.57 **
Dental hygienist mean hourly salary, 2001	+0.60 **
Dental hygienist mean annual salary, 2001	+0.66 **

** = p < 0.01

A second hypothesis tested in the study is that the DHPPI is positively correlated with the use of dental services by the general state populations because services are more widely available. A third hypothesis is that DHPPI scores are positively correlated with indicators of oral health outcomes in the population. Table V confirms both of these hypotheses using state-level estimates of dental service use and oral health outcomes constructed from the Behavior Risk Factor Surveillance System (BRFSS) survey[6]. The table shows that states with higher DHPPI scores tend to have smaller percentages of the population not visiting a dentist in the past year, smaller percentages of the population with teeth removed due to tooth decay or gum disease, and larger percentages of the population with *no* teeth removed due to tooth decay or gum disease. The p-values for all these statistical tests are less than 0.05.

Table V. Relationship Between the 2001 DHPPI and Several Measures of Access to Care and Extent of Oral Health Problems

% not visiting a dentist in the past year due to no reason to go	-0.29 *
% having 1 to 5 permanent teeth removed due to tooth decay or gum disease	-0.38 **
% having 6 or more, but not all, teeth removed due to tooth decay / gum disease	-0.52 **
% having all teeth removed due to tooth decay or gum disease	-0.39 **
% having no teeth removed due to tooth decay or gum disease	+0.49 **

* = $p < 0.05$
** = $p < 0.01$

Moreover, although not statistically significant, the DHPPI was positively correlated with the percent having their teeth cleaned by a dentist or DH within the past year and negatively associated with the percent having their teeth cleaned by a dentist or a DH further back in time (one to two years ago, two to five years ago, or never).

Unfortunately, it was not possible with existing data resources to confirm statistically that states with higher DHPPI scores offered greater access to dental services for underserved populations. Data do not exist for all 50 states that identify dental and DH practice locations, visits to dentists, utilization of dental services, and oral health outcomes in dental shortage areas. However, field work conducted as part of the larger study on which this article is based did reveal anecdotally that this is true. Until it is possible to locate individual DHs and dentists in dental shortage areas and isolate the services these practitioners provide in data systems like the Medical Expenditures Panel Survey (MEPS) and BRFSS, policy makers must be satisfied with anecdotal evidence about access to services in underserved areas.

Key Findings and Conclusions

Although it is not possible to establish causal relationships based on the analyses reported in this article, a number of general findings and conclusions about DHs and the DHPPI are justified by the results presented above.

- The number of DHs increased much faster than did the number of dentists in most states throughout the 1990s.

- There are substantial differences in the legal practice environments (as reflected in the DHPPI) across the 50 states and the District of Columbia.

- The DHPPI was *not* significantly correlated with the numbers of DHs per capita or dentists per capita across the 50 states and the District of Columbia as of 2001.

- The DHPPI was significantly positively correlated with the salaries of DHs as of 2001, indicating that DH salaries were higher in states permitting DHs more tasks and more professional autonomy.

- The DHPPI was also significantly correlated with a number of indicators of utilization of oral health services and oral health outcomes.

Despite the progress made in both numbers and professional practice of DHs across the United States, more can be done to increase the impact of these professionals on improved access and quality of care and reduced costs of care. In particular, more effort should be put into aligning DH professional practice with demonstrated DH clinical skills and competencies.[7] This alignment would promote greater autonomy for DHs in clinical situations in which they are competent to act/practice, and it would promote better access to basic preventive care in many geographic areas that cannot economically sustain the practice of a dentist, but could sustain the practice of a dental hygienist.

Discussion

Access to oral health services is widely recognized to be an important public health issue in the United States.[8] The research summarized above has shown that the professional practice environment for DHs (as measured by the DHPPI) is positively correlated with both utilization of dental services and oral health outcomes across the 50 states and the District of Columbia.

Is there enough evidence to justify a recommendation that states modify their practice environments in order to achieve oral health outcomes? While the current study does not confirm a causal relationship between legal practice environment and access to oral health services, studies in two states support an affirmative answer to this question. Studies in California and Colorado, both of which were demonstration projects to assess the impact of greater autonomy for DHs, have revealed that:

- Patients in California's Health Manpower Pilot Project (HMPP) 139 were generally satisfied with services provided by DHs in unsupervised practices. The researchers concluded that "independent practice by DHs provided access to dental hygiene care and encouraged visits to the dentist."[9]

- Both structural and procedural aspects of unsupervised DH practices in the California HMPP 139 demonstration were generally acceptable to patients, with 98% of DH patients expressing satisfaction with their care. In most structural aspects, the care of patients surpassed that in traditional dental practices. The researchers concluded that "independent DH practice did not increase the risk to the health and safety of the public."[10] A study of six independent DH practices in Colorado reached the same conclusion.[11]

- Patients in unsupervised DH practices in the California HMPP 139 demonstration were more likely to have low incomes and to be non-white than patients in traditional dental practices. In addition, the independent DH practices were able to attract new patients. The researchers concluded that if an independent DH practice can attract sufficient patients, the practice may be a viable alternative to traditional dental practices. They also stated that "an independent [DH] practice might increase access to care, contain fees, and direct the flow of patients to dentists."[12] Other options for less restrictive practice models have been tried in a number of states, all of which appear to have improved access to care for one or another underserved population group.[13]

The findings of this study, when taken in conjunction with the findings based on the study of the California and Colorado initiatives, suggest that expanding the professional practice environment of DHs can improve access to oral health services, utilization of oral health services, and oral health outcomes. The time would appear right for careful studies in other states to confirm this conclusion.

Conclusion

Although the ADHA and others continually monitor changes in dental practice acts affecting DH practice in the 50 states and the District of Columbia, the DHPPI described above is the first attempt to create a single standard index that summarizes multiple aspects of professional practice that permits comparisons across states. The DHPPI offers policy makers an easy way to identify significant differences in practice environments for DHs in different states. The fact that statistical correlations exist between the DHPPI and several indicators of access to dental care, utilization of dental services, and oral health outcomes suggests that the index may provide valuable insights to planners and policy makers concerned about improving access to oral health care in the U.S. There are interesting opportunities for more sophisticated statistical analyses using multi-variable techniques to help understand some of the relationships revealed in this preliminary study.

The findings suggest that increasing the legal scope of practice of DHs and expanding opportunities for independent DH practice offer real opportunities to extend access to cost-effective DH services to low-income, non-white populations, with no health and safety risks to the public.

Defining and Applying the DHPPI

To create the DHPPI described in this article, researchers established strict criteria that were rigorously applied in the scoring process. The researchers were concerned about the accuracy and reproducibility of the reported index scores, but not about whether a particular state earned a high or low score.

The DHPPI had four broad components, each addressing a different aspect of the legal practice environment for DHs in the 50 states and the District of Columbia.

- Regulations has four components (type of oversight board, licensure by credential/endorsement, scope of practice defined in law or regulation, and lack of restriction to patients of record of primary employing dentist), with a maximum total score of 10 points.

- Supervision has 10 components (highest level of supervision in state laws and regulations, supervision requirements in dentist offices, long-term care facilities, schools, public health agencies, correctional facilities, mental health facilities, hospitals, and home settings, and no limits on settings allowed for practice by DHs), with a maximum total score of 47 points.

- Tasks Permitted has 13 components (prophylaxis - physical presence of dentist not required (PPDNR), fluoride treatment - PPDNR, sealant application - PPDNR, X-rays - PPDNR, place amalgam restorations, administer local anesthesia, administer nitrous oxide, DH allowed to perform initial screening, DH allowed to refer patient, DH may be self-employed other than as independent contractor, DH may supervise a dental assistant, DH may be supervised by a medical provider, and expanded functions available in state), with a maximum total score of 28 points.

- Reimbursement has two components (Medicaid reimbursement directly to DHs, and DH may be paid directly for services), with a maximum total score of 15 points.

A score was awarded or withheld for a component of the index only if it was explicitly permitted, stated, or prohibited in state statute or regulation. Actual practice conditions, if different from statutory or regulatory requirements, were not used as the basis for the indices because project staff had no basis for knowing about all the subtle variations in practice traditions and mores in different states.

All index scores represent legal standards in effect or passed as of December 31, 2001. Changes in statutes or regulations after that date were not scored, although many are noted in the full report. The actual scores assigned to the states for each component of the index can be found in the full study report.[1]

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Notes

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