Expanded Function Allied Dental Personnel and Dental Practice Productivity and Efficiency

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Abstract: This study examined the impact of expanded function allied dental personnel on the productivity and efficiency of general dental practices. Detailed practice financial and clinical data were obtained from a convenience sample of 154 general dental practices in Colorado. In this state, expanded function dental assistants can provide a wide range of reversible dental services/procedures, and dental hygienists can give local anesthesia. The survey identified practices that currently use expanded function allied dental personnel and the specific services/procedures delegated. Practice productivity was measured using patient visits, gross billings, and net income. Practice efficiency was assessed using a multivariate linear program, Data Envelopment Analysis. Sixty-four percent of the practices were found to use expanded function allied dental personnel, and on average they delegated 31.4 percent of delegatable services/procedures. Practices that used expanded function allied dental personnel treated more patients and had higher gross billings and net incomes than those practices that did not; the more services they delegated, the higher was the practice's productivity and efficiency. The effective use of expanded function allied dental personnel has the potential to substantially expand the capacity of general dental practices to treat more patients and to generate higher incomes for dental practices.

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Almost all dentists employ various combinations of dental hygienists, dental assistants, and administrative staff. Many studies have examined the impact of these personnel on clinic productivity and finances. The evidence is convincing: the effective use of allied dental personnel increases output per dentist and net incomes.[1-3]

Several states allow dental hygienists and dental assistants to provide expanded functions. In Colorado, for example, dental hygienists can give local anesthetics under direct dentist supervision. Likewise, Colorado allows certified expanded function dental assistants (EFDAs) to assist dentists in providing reversible restorative, prosthetic, and other services.[4] The evidence on the impact of EFDAs on practice productivity is mixed. Most studies took place in the 1970s and 1980s and were in controlled settings (clinical testing facilities, military bases, dental schools, etc.). Mainly looking at the time dentists spent completing restorations with and without EFDAs, those studies found that EFDAs increased the number of restorations produced per unit of time.[5-7] In contrast, the one study conducted in private practices found an increase in the number of restorative services produced per hour and gross income, but no change in net income.[8] Apparently, the efficient use of EFDAs requires many patients who need restorative care and the capacity to schedule patients, EFDAs, other staff, and dentists to maximize practice productivity.

Since the 1980s, the practice of dentistry has changed in two ways that may influence EFDA use: the percentage of patients requiring multiple restorations, especially in one quadrant, has declined;[9]

and composites rather than amalgams are now the primary material for intracoronal restorations in posterior teeth.[10] Currently, EFDAs are used in the Naval Dental Service, some public school clinics in Philadelphia, and several states.[11]

Colorado legalized the use of EFDAs over twenty-five years ago, and a recent unpublished study reported that Colorado dentists using EFDAs were younger, had taken EFDA continuing education courses, practiced with other dentists, and employed certified (versus noncertified) EFDAs.[12] The surveyed dentists also noted that EFDAs increased patient visits, productivity, and income and reduced practice stress and hours worked per week without a decline in net income. The reasons dentists gave for not using EFDAs included inability to hire trained EFDAs, higher salaries, inappropriate patient case mix, office size or design limitations, and concern about how to integrate EFDAs into practice.[12]

We conducted this study to investigate the current use of expanded function allied dental personnel in Colorado private general dental practices. The goal was to assess the effects of expanded function allied dental personnel use on practice outputs and efficiency. The specific objectives were to identify and measure the general factors that influence practice productivity and efficiency and to estimate the specific effects of delegation on practice productivity and efficiency.

Methods

We reviewed available survey instruments on practice operations and delegation of duties, consulted national experts, and then developed a practice survey instrument. We pre-tested the instrument in several Colorado general dental practices for clarity and ease of use.

We stratified the practices that participated in a previous Colorado delegation study into three groups based on their level of delegation: 50 percent low, 25 percent medium, and 25 percent high level of delegation. Of the 403 practices solicited, 164 agreed to participate in the study. After accounting for dentists who were retired, deceased, not in private practice, and not locatable, the adjusted response rate was 43 percent. We reviewed the completed surveys from the 164 practices for completeness and consistency and obtained 154 practices (59 percent low, 20 percent medium, and 21 percent high level of delegation) with usable data.

Dental practices vary in size, composition, and management structures (i.e., inputs), and this variation influences their effectiveness in producing patient care services (i.e., outputs). We defined practice efficiency as the effectiveness with which a given set of inputs are used to produce outputs. To assess productivity and efficiency, we used two output measures: number of patient visits and gross billings. For input measures, we used the annual work hours of dentists, dental hygienists, dental assistants, and other staff and the number of operatories.

We developed three delegation measures, based on survey questions. The first measure was based on responses to this question: "Do you currently use, or at one time used, expanded function auxiliaries in your primary practice location?" We assigned a value of 1 if the answer was "Yes, currently use" and a value of 0 if the answer was "No, never used" or "Yes, once used but have discontinued." For the other two measures, we calculated indices from dentists' responses to this question: "Of all the times specific procedures/activities were performed, approximately what percentage was delegated to chair-side assistants or dental hygienists?" Diagnostic/preventive/adjunctive procedures were not used in the calculations because most practices delegated these procedures to "traditional" dental hygienists and dental assistants. Endodontics, oral surgery, and other services were combined into one category. This resulted in five service categories that mainly included expanded services. We constructed a simple average delegation index by calculating the average response rate in each category and then calculating an overall average. We also constructed a weighted average delegation index by weighting the means of the five categories by their corresponding share of practice gross billings. The results of the simple and weighted indexes on practice productivity and efficiency were similar, so only data on the simple index are presented.

We performed univariate and bivariate analyses to assess practice characteristics and level of delegation. We used a Cobb-Douglas production function to estimate the contribution of key inputs involved in the production of services, with and without the delegation index. We used ordinary least squares to estimate the incremental contribution of the various factors to practice outputs.

We used Data Envelopment Analysis (DEA) to estimate the clinical (technical) efficiency of dental practices.[13] DEA generates a measure of efficiency for each dental practice relative to the most efficient practices in the sample. With a 0 to 1 efficiency score

for each practice, we used a second-stage regression analysis to examine the factors that accounted for efficiency score differences.

Results

Table 1 shows the characteristics of the 154 study practices. They averaged 5,365 patient visits per year, dentists spent an average of 2,289 hours per year in their practices, and total allied dental personnel hours were 8,126. Practices averaged 2,064 square feet and had 4.6 operatories. Laboratory and supply expenses were about $110,000 per practice. Gross billings averaged $859,761, and practice net income was $283,952. For all these variables there was substantial variation among practices. The majority of practices had one dentist (66.2 percent), and almost none had more than six dentists (Table 2). About 64 percent of practices had four or fewer operatories, but 15.6 percent had more than six.

The majority of practices (63.6 percent) reported using expanded function allied dental personnel (Table 3). Thirty-six percent of practices reported not using expanded function allied dental personnel. Table 4 compares the characteristics of practices that reported they did or did not use expanded function allied dental personnel at both the practice and dentist level. The differences between the two groups are statistically significant for all variables except "Other Staff Hours." Specifically, practices reporting using allied dental personnel had much higher gross and net incomes, provided almost twice as many visits, had many more auxiliary hours, had more operatories and space, and had much higher laboratory and supply expenses. Interestingly, practices reporting not using expanded function allied dental personnel responded positively when asked to indicate the percentage of time specific procedures/activities were delegated to them. Their average delegation index was 17.3 percent.

Table 5 shows the mean percentage of each service/procedure delegated to allied dental personnel by category of services. Specifically, for diagnostic and preventive services this table indicates that the mean level of delegation was 90 percent or more. There was one exception: for the placement of occlusal sealants, the mean percentage delegated was only 67 percent.

For the category "operative, primary, and permanent teeth," the mean percentages of delegation were 33 percent or more for restorative procedures and 46 percent for the placement of temporary filling materials. For fixed prosthodontics, the mean percentage delegation was about 67 percent and for final impressions and permanent crown cementation about 35 percent. For removable prosthodontics, the mean delegation percentages for preliminary RPD/CD were 80 percent and 74.6 percent, respectively, and for final RPD/CD impressions, 48.4 percent and 35.7 percent, respectively. The mean for RPD/CD adjustment was 36.7 percent.

Finally, for the categories periodontal, endodontic, oral surgery, and other, the mean delegation level for the two periodontal services was greater than 70 percent, but was low for endodontic and oral surgery procedures, except for suture removal. The mean percentages of delegation for orthodontic, anesthesia, and brush biopsy services were somewhat higher, but relatively few practices responded to these items.

Table 6 shows the impact of various levels of delegation on patient visits, gross billings, and net

Table 1. Characteristics of Colorado general dental practices (N=154) in study, 2005

Characteristic	Mean	Std. Dev.	Min.	Max.
Total annual visits	5,365	4,222	784	25,991
Dentist hours	2,289	1,454	800	9,214
Dental hygienist hours	1,992	1,638	0	8,820
Dental assistant hours	3,285	2,468	0	13,500
Other staff hours	2,849	2,645	0	16,400
Total allied hours	8,126	5,432	1,470	31,448
Square feet	2,064	1,407	800	13,000
Operatories	4.6	2.5	1	20
Lab expenses	$57,893	$45,719	$4,000	$300,000
Supply expenses	$52,503	$44,958	$3,676	$236,816
Gross billings	$859,761	$647,301	$98,343	$3,594,756
Practice net income	$283,952	$252,522	$39,000	$1,600,000

income per practice. Clearly, there is a positive and substantive relationship between level of delegation and patient visits, gross billings, and net income. At 40 percent delegation, patient visits were higher by 27.1 percent, gross billings by 22.1 percent, and net income by 106.0 percent. Table 7 shows the relationship between level of delegation and net income per dentist hour, controlling for patient (e.g., per capita income, race) and market characteristics (e.g., dentist per square mile, percentage insured, dentist EFDA training). At the 40 percent level of delegation, net income per hour was 22 percent higher than with no delegation.

Discussion

This study was based on a sample of 154 private general dental practices located in the state of Colorado. The sample was selected from among practices participating in a previous expanded function allied dental personnel study. Therefore, caution must be used in generalizing the results to all Colorado private general dental practices or to similar practices in other states.

The primary finding of this study is that ninety-eight practices (64 percent) reported using some expanded function dental hygienists and EFDAs. This is a substantial number, especially considering that another 11 percent of practices said they once used but had discontinued the use of expanded function allied dental personnel. Thus, 75 percent of practices, the great majority, had experience using expanded function allied dental personnel. The practices that had stopped using them did not give a reason for their decision, and this issue merits further investigation.

As expected, practices that did and did not use allied dental personnel were very different. Practices using them were substantially larger with more dentist hours per year, more operatories and square feet, and more dental hygienists, dental assistants,

Table 2. Dentists and operatories per practice of Colorado general dental practices in study (N=154)

Number of Dentists	Percentage	Number of Operatories	Percentage
1	66.2%	Less than 3	9.7%
2	21.4%	3	25.3%
3	7.1%	4	29.2%
4	1.9%	5	14.3%
5	1.9%	6	5.8%
6	1.3%	More than 6	15.6%

Note: Percentages do not total 100% because of rounding.

Table 3. Responses to question about use of expanded function allied dental personnel in practice

	Number	Percentage
Yes, currently use	98	63.6%
Yes, once used but have discontinued	17	11.0%
No, never used	39	25.3%

Note: Percentages do not total 100% because of rounding. Question was worded as "Do you currently use, or at one time used, expanded function auxiliaries in your primary practice location?"

Table 4. Comparison of practices reporting not using and using allied dental personnel

	Use=No (N=56)		Use=Yes (N=98)	
	Per Practice	Per Dentist	Per Practice	Per Dentist
Gross billings (2005)	$602,990	$456,317	$1,006,487	$594,191
Practice net income	$209,825	$158,786	$326,311	$192,641
Annual visits	3,680	2,785	6,328	3,736
Dentist hours	1,915	1,450	2,502	1,477
Dental hygienist hours	1,429	1,081	2,314	1,366
Dental assistant hours	2,437	1,844	3,769	2,225
Other staff hours	2,434	1,842	3,086	1,822
Allied dental hours	6,301	4,768	9,168	5,413
Square feet	1,717	1,300	2,261	1,335
Number of operatories	3.7	2.8	5.1	3.0
Laboratory expenses	$39,296	$29,737	$68,520	$40,451
Supply expenses	$36,793	$27,843	$61,088	$36,064
Delegation index	17.3	13.1	39.5	23.3

Table 5. Number and percentage of practices in study delegating procedures/services to allied dental personnel by category of services

	Number of Practices	Mean Percentage
Diagnostic/Preventive/Adjunctive		
Take PA or BW radiographs	154	95.93%
Take panoramic radiographs	109	97.96%
Provide prophylaxis	143	91.69%
Place occlusal sealant(s)	111	66.88%
Administer topical fluoride	146	97.48%
Apply fluoride varnish	97	94.24%
Take and pour alginate impressions	149	87.82%
Operative, Primary, and Permanent Teeth		
Place wedge/matrix for amalgam	72	33.67%
Place/finish amalgam (1 surface)	62	38.24%
Place/finish amalgam (2+ surfaces)	60	36.23%
Place/wedge matrix for composite	84	35.89%
Place/finish anterior composite	69	37.97%
Place/finish posterior composite (1 surface)	77	38.38%
Place/finish posterior composite (2+ surfaces)	74	34.04%
Place temporary filling material	114	46.08%
Fixed Prosthodontics		
Place cord for a C&B impression	93	52.91%
Take final C&B impression	72	37.10%
Make temporary crown	123	70.70%
Cement temporary crown	129	69.19%
Remove temporary crown	122	68.21%
Adjust permanent crown before cementation	74	48.28%
Cement permanent crown	61	32.97%
Initial placement/adj. of stainless steel crown	39	23.33%
Cement stainless steel crown	42	35.95%
Make temporary bridge	95	67.53%
Cement temporary bridge	101	70.80%
Remove temporary bridge	106	66.75%
Adjust permanent bridge before cementation	67	43.21%
Cement permanent bridge	59	28.64%
Removable Prosthodontics		
Take preliminary RPD impression	124	80.03%
Take final RPD impression	70	48.39%
Try RPD framework in mouth	59	30.32%
Take preliminary CD impression	105	74.57%
Take final CD impression	61	35.72%
Take records for CD	57	29.11%
Adjust RPD or CD	80	36.69%
Rebase, reline, or repair denture	68	36.53%
Periodontics		
Place subgingival medicaments	102	75.02%
Scaling, root planing, and/or curettage	128	90.30%
Endodontics		
Medicate root canal	41	9.93%
Obturate root canal	38	1.32%
Oral Surgery		
Place suture	42	0.24%
Remove suture	98	45.91%
Other		
Adjust orthodontic appliance	28	27.50%
Place or remove orthodontic brackets/wires	21	45.95%
Local anesthesia	91	17.53%
Perform brush biopsy	37	23.00%

and administrative staff hours. With a larger operation, practices using expanded function allied dental personnel generated much higher gross billings, net income, and patient visits. Indeed, the average difference in net income between the two groups of practices was over $100,000.

The specific procedures/activities delegated were mainly associated with restorative and prosthetic treatments. For example, the mean percentage delegation level for placing and finishing amalgams and composite fillings was about 35 percent. For placing and adjusting temporary crowns and bridges, the average delegation level was even higher (50 percent to 70 percent). Among responding practices, the delegation level was 30 percent for cementing and adjusting permanent crowns and bridges. Likewise, the delegation percentage was relatively high for tasks associated with removable dentures. Examples include final RPD impressions (48.3 percent) and adjusting RPDs (36.6 percent).

Of particular interest, many practices delegated critical steps in the construction of fixed and removable prostheses. These included final impressions for crowns and partial and full dentures and the cementation and adjustment of permanent crowns and bridges. This finding suggests that properly trained and supervised allied dental personnel can provide these services effectively. Of course, this conclusion is conjecture, and more detailed studies are needed on the impact of delegation on the quality of care.

In terms of expanded dental hygiene services, the mean delegation level for local anesthetics was

Table 6. Impact of delegation on gross billings and net income per practice

Delegation Level	Patient Visits	Percent Difference	Gross Billings	Percent Difference	Net Income	Percent Difference
Zero	3,670	N/A	$598,679	N/A	$154,504	N/A
20%	4,139	12.9%	$661,642	10.5%	$236,414	53.0%
40%	4,666	27.1%	$731,228	22.1%	$318,324	106.0%
60%	5,261	43.4%	$808,131	34.9%	$400,234	159.0%
80%	5,931	61.6%	$893,123	49.1%	$482,144	212.1%
100%	6.688	82.2%	$987,054	64.8%	$564,054	265.1%

17.5 percent. The reasons that general dentists did not have dental hygienists deliver more local anesthetics to patients are unknown. Some possible factors that should be investigated include office workflow, patient acceptance, and dental hygienist training.

Excluding the category of diagnostic/preventive procedures, most practices delegated a relatively small percentage of all services that could be delegated. For example, the average delegation index was 55 percent or more for only 12.3 percent of practices. In contrast, for 60 percent of practices, the index was 35 percent or lower. The average level of delegation for delegating practices was about 31.4 percent. Interestingly, this is the same level of delegation (including diagnostic and preventive procedures) reported by Milgrom et al. in a study of 126 dental practices in the state of Washington.[8]

A critical unanswered question concerns what factors determine the percentage of services delegated by practices. Are there significant barriers to delegating more than 50 percent of services, and if so, what are these barriers? These issues need further investigation, but it is clear that practices have the potential to substantially increase their output by delegating more services.

The production functions revealed that gross billings and number of patient visits are largely determined by the number of dentist and allied dental personnel hours and the number of operatories per practice. About 75 to 80 percent of the variance in these two productivity measures was explained by these variables. Other studies have reported similar results.[1-3] In addition, these estimates indicate statistically significant economies of scale (the sum of all input coefficients is greater than one).

After controlling for dentist and auxiliary hours and number of operatories, practices that delegated expanded duties generated significantly higher gross billings and patient visits. Further, as practices delegated a larger percentage of services, the two productivity measures were higher substantially. For practices with a simple average delegation index of 40 percent, gross billings were 22 percent higher than in practices that did not delegate.

Table 7. Impact of delegation level on net income per dentist hour

Delegation Level	Net Income	Percent Change in Net Income
Zero	$110	NA
20%	$122	10.9%
40%	$134	21.9%
60%	$145	32.8%
80%	$157	43.7%
100%	$169	54.6%

These analyses indicate that the use of expanded function allied dental personnel has a significant and positive impact on practice productivity and specifically total net income and net income per dentist hour. These results are different from the findings of Milgrom et al., who reported that the use of expanded function allied dental personnel increased gross billings but not net incomes.[8] In part, this may be because, in the Washington study (in contrast to Colorado), most of the expanded functions were assigned to dental hygienists rather than dental assistants. Since dental hygienists normally have their own panel of patients to treat, it is probably more difficult to coordinate the scheduling of dentist and dental hygiene patients so that the time of both is used effectively.

In terms of policy implications, this study suggests that private general dental practices can increase productivity with the delegation of more functions to allied dental personnel and it is in their financial interest to do so. This is an important issue as the nation addresses the problem of access disparities. Specifically, general dental practices may have the potential to see many more patients, if the demand for care increases with improvements

in per capita income, dental Medicaid coverage, or private insurance.

A major challenge for dental education and the profession is to provide clinical training to students and residents on the effective use of allied dental personnel and especially those that have expanded functions. Currently, few dental schools offer didactic courses or clinical experiences focused on the effective use of allied dental personnel.

Finally, from both a professional and community perspective, it makes much more sense to put more resources into training dentists and allied dental personnel to practice more efficiently than to increase the number of dentists. Unfortunately, current trends are moving in just the opposite direction. This important public policy issue deserves more attention.

Conclusions

This study of 154 general dental practices in Colorado found that the majority of sample practices are assigning many reversible services related to the provision of operative and prosthetic services to EFDAs. In contrast, relatively few practices use dental hygienists to provide local anesthesia.

The impact of delegation on practice productivity and efficiency found in our study is substantial. As delegation increases, practices see more patients and generate higher gross billings and net incomes. Larger practices (e.g., more dentist and staff hours and space) are the primary employers of expanded function allied dental personnel.

This study suggests that general dental practices could substantially increase their capacity to see more patients with the effective use of expanded function allied dental personnel. States need to give serious consideration to allowing general dentists to employ expanded function allied dental personnel. Likewise, dental schools need to provide graduates a solid program of didactic courses and clinical experiences on the use and management of allied dental personnel of all types.

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