Comparison of Clinical Productivity of Senior Dental Students in a Dental School Teaching Clinic Versus Community Externship Rotations


Abstract: The aim of this study was to report on the clinical and monetary productivity of fourth-year dental students at community-based clinical sites and school-based clinics at the Harvard School of Dental Medicine (HSDM). This study included forty-seven students from the graduating classes of 2006, 2007, and 2008. These fourth-year students were required to spend twelve weeks at one of several participating community health centers throughout Massachusetts and New Hampshire. Students also treated their patient pool in the teaching practice at HSDM in the fourth year. The most common sixty American Dental Association procedure codes were compared, and variables were created by grouping them by specialty or type of service. HSDM dental students completed 8,365 procedures at an externship site during their community experience. An average of 178 procedures was completed per student, and mean revenue of $17,486 was produced. In comparison, the same students completed 3,640 procedures during an equal amount of time spent (normalized for this study) at the school teaching practice clinic, where each student completed an average of seventy-seven procedures and generated $16,802 in revenue. The results of this study show that fourth-year dental students at the community health centers, working under the supervision of adjunct faculty, completed more than double the number of procedures they did in the HSDM teaching practice clinic. However, the revenue generated was very similar at the two sites. In addition, the types of procedures performed by students at externship sites were simpler than the complex and specialized procedures performed at the HSDM clinic, which include fixed and removable prosthetics, periodontal surgery, and implantology.

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"Trifecta," a term used to describe any successful phenomenon that comes in threes, is a good word to describe the perfect amalgamation and mutual benefits of community externship rotations to those involved in the process: dental schools, community health centers, and dental students. All three win from this initiative that after almost fifty years remains one of the most valuable training experiences for senior dental students. In general, community-based dental education has become an integral component of dental school education.

The development of extramural programs in U.S. dental schools began in the late 1960s. In the 1970s, these programs were enhanced due to additional funding and the growing concern of a shortage of dental professionals. Unfortunately, funding decreased in the 1980s, causing elimination of many of these programs. However, the last twenty years has seen a resurgence in these programs, so that in 2007, according to the American Dental Association (ADA), fifty-two out of the fifty-six dental schools required community-based clinical experiences as a component of their curricula.

Community externship programs provide students with the opportunity to enhance their clinical skills and expand their understanding of the cultural and socioeconomic differences of their patients while providing needed dental services to underserved populations. Dental schools are also motivated by the opportunities community-based clinical education programs offer as they face increasing financial
difficulties to maintain the faculty, space, and equipment required for their clinical education programs. Given today’s tough economic environment, these problems are not likely to diminish soon. In addition, there has been increasing societal pressure on dental schools to provide dental care for the underserved as well as growing demand from students for real clinical experiences.

The training students receive at community-based sites has been found to be as effective as the training they receive in traditional dental school-based clinics. Through the Pipeline, Profession, and Practice: Community-Based Dental Education program, the Robert Wood Johnson Foundation and The California Endowment, with supplemental funds from the W.K. Kellogg Foundation, have encouraged dental schools to seek ways to reduce disparities in access to dental care by providing opportunities for senior dental students to rotate through community settings and recruit more low-income and underrepresented minorities to the dental profession. These experiences help students to develop skills for treating underserved populations as culturally competent dentists in a multicultural world.

Evaluation of the clinical productivity at dental schools and community health centers may provide a better understanding of programs that allow schools to make the changes necessary to move toward a more productive and efficient teaching practice. At the same time, community-based dental education can enhance students’ educational experience, maximize revenue, and increase access to dental care.

The primary objective of our study was to measure the clinical productivity and assess the scope of services provided by senior dental students during their teaching practice at the Harvard School of Dental Medicine (HSDM) and externship rotations at community health centers. A secondary objective was to examine if any student-related factors including age, gender, and race were associated with clinical productivity at HSDM and the externship sites.

Study Participants

The study was designed to be a retrospective data analysis of clinical productivity of fourth-year D.M.D. students who graduated from HSDM in 2006, 2007, and 2008, comparing their performance in the teaching practice at the school with their performance during an externship rotation at the affiliated community health centers. The fourth-year curriculum at HSDM is mainly a clinical year with students required to complete a three-month rotation at a community health center, a two-month general dentistry (Advanced Dentistry Core) rotation at HSDM, and a one-month oral and maxillofacial surgery rotation at a hospital. The remaining time is scheduled for students to continue providing care to patients at HSDM (Advanced Dentistry Module). Students can ask to be excused from the Advanced Dentistry Module to do research or other electives if they are deemed to have completed their clinical requirements. Several students take advantage of this curriculum design to do research, community service locally or abroad, or electives in specialty areas in their home or other institutions.

Forty-seven students in the graduating classes of 2006, 2007, and 2008 out of a pool of approximately ninety were included in the study (twenty-two male and twenty-five female students). The students were selected based on the ability of the externship site to provide the required data. At HSDM, the students are required to spend twelve weeks at one of the participating community health centers throughout Massachusetts and New Hampshire during their fourth year. Students also treated their patient pool in Advanced Dentistry Core and Module at the teaching practices at HSDM. For the purposes of this study, the differences in time spent at each site/rotation were normalized to allow a comparison to be made. Students were required to track daily productivity in both settings, utilizing the school’s web-based evaluation system for educational credit. The billing claims were obtained utilizing the Dentech system at HSDM and from the billing department of the participating community health centers.

The students in this study provided comprehensive care to their patients at HSDM in the required rotations called Advanced Dentistry Rotations (includes both core and module rotations). As a part of these rotations, students are required to reach certain “thresholds” in each specialty area for graduation. Students make their own appointments at HSDM and can provide all levels of care including endodontics

Materials and Methods

This study was reviewed by the director of the Office for Research Subject Protection and the Harvard Medical School/Harvard School of Dental Medicine’s Committee on Human Studies and granted exempt status based on 45 CFR 46.101(b) (4) and waiver of informed consent.
and basic surgical services. Students at HSDM typically have a chair-side assistant/student assistant for complex restorative or surgical procedures.

At their community rotations, students typically treat their patients according to patient needs with relatively little financial constraints on a treatment plan. There are no real thresholds/numerical requirements for students at these sites. HSDM works with a site director to make sure the faculty at the off-site facilities are familiar with the HSDM curriculum and the school’s clinical/didactic expectations. Calibration exercises are held at HSDM on an annual basis. The other faculty members at these sites might have HSDM appointments as requested. Students at these sites usually use public transport or their personal transportation with no reimbursement from the school. If they are at distant sites, accommodations are provided. Students are required to be present at the site for five working days a week, seeing patients as appointed by the site. Students mostly provide basic restorative care (operative and fixed and removable prosthodontics) and nonsurgical periodontics, but can on occasion perform endodontics or basic surgical services depending on the site. Some sites provide a full-time chair-side assistant, while others do not. There are no didactic requirements for students who are off-site although at certain times of the year they are required to return to HSDM for a limited number of days for required comprehensive exams. Site directors do allow for some time away for interviews, although if the time away is more than five days, students are required to make up the time.

**Outcome and Independent Variables**

Twelve procedure groups (diagnostic, preventive, operative, restorative, endodontic, periodontic, periodontal surgery, fixed prosthodontic, removable prosthodontic, implant services, oral surgery, general services) performed by students at the HSDM dental center and their externship sites were the main outcome variables of interest in this study. Sixty of the most common ADA dental procedure codes were evaluated by grouping them by specialty or type of service. Each student spent 408 hours at the HSDM dental center (this includes time spent by the students in both core and module rotations) and 420 hours at the externship site. Since the exposure times in the clinics were different at the HSDM and externship sites, the outcome data (number of procedures) were normalized to one hour by dividing the total procedures in each category by the total number of hours at each site.

The demographic characteristics of study participants that were of interest were age, gender, race, and graduating year. Age of the subjects was treated as a continuous variable while gender, race, and graduating year were treated as categorical variables. With regards to race, we used three broad categories: white non-Hispanic, Asian/Pacific Islander, and other/unknown races.

**Statistical Approach**

Simple descriptive statistics (including mean, standard deviation, median, interquartile range, and range) were used to describe the distribution of the outcome variables. Frequency distributions and mean/standard deviation were used to describe the distribution of the independent variables. A one-sample Kolmogorov-Smirnov test was used to examine if the outcome data were normally distributed. A majority of the outcome variables were not normally distributed. The differences in normalized outcome data between HSDM and externship sites were compared using the Wilcoxon signed rank tests. Nonparametric tests were used since the data were not normally distributed.

For the second part of the study, the simultaneous association between the outcome variables and all independent variables (age, gender, race, and graduation year) were examined by using multivariable linear regression analysis. Twenty-three regression models were built for examining this association for each outcome variable at the HSDM and externship sites. For one procedure (implant services), there were none performed at externship sites; hence, regression analysis was not performed. All the multivariable linear regression models were built using ordinary least squares approach.

All statistical tests in this study were two-sided, and a p-value of <0.05 was deemed to be statistically significant. Whenever multiple testings were performed, Bonferroni corrections were made to account for Type 1 errors. All statistical analyses were performed using SPSS Version 16.0 software.

**Results**

During the period of July 1 through May 30 of each year, fourth-year dental students from HSDM spent an average of 105 sessions (four hours each)
treating patients at community health centers and an average of 102 sessions (four hours each) in the teaching practice clinics at HSDM (including both core and module rotations). Data regarding completed dental procedures performed at the HSDM teaching clinic and the externship sites by forty-seven fourth-year students from the graduating classes of 2006, 2007, and 2008 were included in this study. The baseline demographic characteristics of the study subjects are summarized in Table 1. Four demographic characteristics were considered: age, gender, race, and graduating year. Female students make up 53.2 percent of the participants, while males were 46.8 percent. The students’ ages ranged from twenty-five to thirty-five years, with a mean of 27.38 (standard deviation 2.08). The percentage of white non-Hispanic students was significantly highest, at 42.6 percent, closely followed by Asian or Pacific Islander students at 31.9 percent. The remaining 25.5 percent was divided among other ethnic groups.

Data regarding the distribution of procedure groups performed at HSDM and at the externship sites are summarized in Figure 1. Results from the Wilcoxon signed rank tests (nonparametric paired sample test) revealed that, among the twelve services examined in this study, five (restorative services \( p<0.0001 \), periodontal surgery \( p<0.0001 \), periodontics \( p<0.0001 \), implant services \( p<0.0001 \), and fixed prosthodontic services \( p<0.0001 \)) were performed in significantly more numbers by the students at HSDM teaching clinics than at the externship sites. Five services (diagnostic services \( p<0.0001 \), preventive services \( p<0.0001 \), operative services \( p<0.0001 \), oral surgery \( p<0.0001 \), and general services \( p=0.01 \)) were performed in significantly more numbers by the students at externship sites than at the HSDM teaching clinic.

A separate model was built for each procedure (at HSDM teaching clinics and externship sites). The results suggest that when compared to white non-Hispanic students, Asian/Pacific Islanders performed fewer preventive services at HSDM \( (p=0.035) \), fewer operative services at HSDM \( (p=0.015) \), more preventive services at externship sites \( (p=0.024) \), and fewer removable prosthodontic services at externship sites \( (p=0.024) \). An increase in the age of subjects was significantly associated with increases in the number of restorative services at HSDM \( (p=0.027) \), periodontal services at HSDM \( (p=0.026) \), and fixed prosthodontic services at HSDM \( (p=0.041) \). When compared to male students, female students performed fewer restorative services at externship sites \( (p=0.03) \), fewer oral surgery services at HSDM \( (p=0.043) \), and fewer general dentistry services at externship sites \( (p=0.012) \). When compared to students who graduated in 2008, the students who graduated in 2007 performed more diagnostic services at externship sites \( (p=0.006) \). When compared to students who graduated in 2008, students who graduated in 2006 performed fewer removable prosthodontic services at HSDM \( (p=0.017) \), more general dentistry services at HSDM \( (p=0.036) \), and more periodontal services at

| Table 1. Demographic characteristics of study participants, by number and percentage of total |
|-----------------|--------------------------|
| **Characteristic** | **Frequency**            |
| Gender           |                          |
| Female           | 25 (53.2%)               |
| Male             | 22 (46.8%)               |
| Race             |                          |
| Asian or Pacific Islander | 15 (31.9%) |
| Other races (includes black [Non-Hispanic], Hispanic, Puerto Rican, and other races) | 9 (19.1%) |
| Unknown          | 3 (6.4%)                 |
| White non-Hispanic | 20 (42.6%) |
| Graduating year  |                          |
| 2006             | 18 (38.3%)               |
| 2007             | 10 (21.3%)               |
| 2008             | 19 (40.4%)               |
| Mean (Standard Deviation) | 27.38 (2.08) |
externship sites (p=0.014). Even though these results are statistically significant at a p value of <0.05, once adjustments for multiple testings were conducted, these were not statistically significant.

The diversity of community sites and their various fee schedules made it almost impossible to assign a true value to the procedures performed by the students off campus, so we assigned the 2008 Masshealth fee schedule to equalize the revenues for discussion purposes. Distribution of the monetary productivity of students at HSDM and externship sites is summarized in Figure 2.

In the collective, the HSDM dental students completed 8,365 procedures at the externship sites during their community experience. This translates to an average of 178 procedures per student and revenue of $17,486. In comparison, the same students completed 3,640 procedures during an equal amount of time at the school’s teaching practice clinic. Each student completed an average of seventy-seven procedures and generated $16,802 in revenue. Fourth-year dental students completed more than double the number of procedures at community sites when compared to the teaching practice; however, the revenue generated was similar at the two sites. Only a 4.07 percent higher monetary productivity was noted at the externship sites due to the procedures performed. The type of procedures performed by students at externship sites was simpler than the complex and more specialized procedures performed at HSDM clinics (which included fixed and removable prosthodontics, periodontal surgery, and implantology). When comparing income generated at both sites utilizing HSDM versus community health centers’ fee schedules, the results showed a difference of 32.06 percent higher production at the externship sites.

The lowest individual dollar amount of productivity for the participants in this study during the past three years for HSDM was $6,231, and the highest was $24,468 for procedures completed during 408 hours of clinical time. The lowest individual dollar amount of productivity for the externship site was

Figure 1. Distribution of procedures performed by students at HSDM and externship sites

Notes: Data collected for D.M.D. students from HSDM Classes of 2006, 2007, and 2008 (normalized to 1 hour). Following services are statistically significantly different (at p<0.05) between HSDM and externship sites (Wilcoxon signed rank test):

- Diagnostic (p<0.0001)
- Preventive (p<0.0001)
- Operative (p<0.0001)
- Restorative (p<0.0001)
- Periodontics surgical (p<0.0001)
- Periodontics (p<0.0001)
- Fixed prosthodontics (p<0.0001)
- Implant services (p<0.0001)
- Oral surgery (p<0.0001)
- General services (p=0.017)
$9,489, and the highest was $38,407 during the same amount of clinical time.

**Discussion**

The results of this study show that students at the community health centers, working under the supervision of adjunct faculty, completed more procedures and performed more efficiently than those at the HSDM teaching practice clinic. Dental students were twice as productive in completing numbers of procedures in the community centers as they were at the HSDM clinics. However, the procedures performed by the students at the externship sites tended to be less complex compared to the procedures performed at the HSDM clinics. Bean et al. conducted a study to examine the productivity of fourth-year dental students at school-based clinics and at externship sites. Similar to that study, we found that students at externship sites performed more procedures than at school-based clinics, but contrary to our findings, Bean et al. found that the students generated more revenue at the externship sites than at the school-based clinic. The results of our study also suggest that demographic characteristics of students including age, gender, and race are not consistently associated with productivity at teaching practice clinics or at the externship sites. Twenty-three multivariable regression models were built to examine these associations, and we found statistically significant associations for very few variables. However, once we adjusted for multiple testings using Bonferroni corrections, none of the independent variables were associated with productivity at either the HSDM teaching practice clinic or externship sites.

Dental schools traditionally balance off-site rotations with on-site clinical work for a variety of reasons. Typically, schools with large clinical spaces that can accommodate both their third- and fourth-year students see a benefit to keeping their fourth-year students on-site to maximize their productivity. Continuity of care for patients at the dental school is also not interrupted. Students who are on-site can also receive a more standardized didactic curriculum, although distance education using information technology can be used for students who are off-site. The drawback to having students remain on-site is that they are never pushed out of a familiar environment with the same faculty: in essence, they are not challenged to step out of their comfort zone. This could lead to some students providing less care once they have completed their requirements or if the school does not have enough patients.
Schools that incorporate off-site rotations see several advantages. If physical space is a limiting issue at the dental school, then having students off-site allows for a larger dental class. Students also see advantages at off-site rotations. They are introduced to various health care models, meet a diverse set of patients (cultural and medical), and learn about the community they are in. In comparison with their experiences at their dental school, they meet different faculty with different ideas and are required to work in an environment with different materials and different physical spaces. Oftentimes, the students find working in a semi-independent fashion allows them to think for themselves, solve problems semindependently, and be more critical of their own work. They tend to find they have to work more quickly, especially if the site is appointing patients. Sites may also expose students to procedures that are seldom seen in their school-based patient population (for example, complete dentures).

HSDM has found that a three-month rotation seems to be adequate for the dental students to become familiar with their site and that it permits students to complete care for more complex restorative cases that require laboratory work. A study by Mascarenhas et al. found that externship sites that allow students to rotate for ten weeks or longer provide better opportunities for them to perform more procedures as well as more complex procedures compared to externship sites that allow students to rotate for shorter durations.

The results of our study suggest that the students at HSDM performed significantly fewer total numbers of procedures, but produced an equal amount of revenue compared to community health centers. This may be due to a variety of reasons. At HSDM, students may not always have good support in terms of staff-to-student ratios (staff helping to appoint a full day of patients or chair-side assistants). The expectation of students at each site may also differ. While students are expected to be at the community health centers from 8 am to 5 pm every day, the students at HSDM oftentimes cancel patients or are not motivated to schedule patients as efficiently as at the community health centers. Students at HSDM also tend to want to get their thresholds/requirements done and hence schedule patients according to procedures rather than providing more preventive/diagnostic services. Students at HSDM may also have more access to faculty members who can help to cover more specialty services than at community health centers.

Dental educators often question the economics of having students on- or off-site. Some faculty members want to keep dental students on-site when they are most productive (as fourth years), while others feel that off-site facilities should actually reimburse the dental school for having their students produce in off-site clinics. The off-site facilities do see a benefit to having dental students deliver care, but have to balance this based on resources and the amount of supervision they have to provide. For the most part, site directors enjoy having students as part of their health care delivery team, but can on occasion be challenged by the occasional student who is still learning to be efficient/semi-independent. HSDM tries to match students to sites based on their clinical expertise, sending students who are more clinically adept to rotations earlier than others.

Reporting bias was a limitation for our analysis since the students at HSDM do not consistently record all completed dental procedures at the teaching practice, resulting in a large amount of missing information and underbilling. The fact that no credit is given by the school towards the graduation requirements of any procedures performed during the externship rotation causes underreporting by dental students there as well. Community health centers do not always keep separate statistics for dental students, and billing claims are usually processed under the chief dentist. For that reason, only students with complete data were considered for this study. It was not the purpose of this study to comparatively evaluate the quality, supervision, and relative educational value of the community-based programs to our students.

We included all students who had complete records with regards to the numbers and types of procedures performed at the externship sites. Students from HSDM provide care at several externship sites. However, not all externship sites keep track of all the procedures done by the students. Only a few externship sites provided all the required data, and only students who provided care at these externship sites were included in our study. This certainly introduces selection bias into this study.

**Conclusions**

Senior students at Harvard School of Dental Medicine completed a higher quantity of less complex procedures at externship sites than at the teaching practice clinic. Despite their difference in productivity, the revenues generated at HSDM and
community health centers were about the same. However, it should be kept in mind that community-based sites in this study did not provide sufficient educational experiences to support students’ achieving competence in providing more highly complex and specialized procedures.

Evaluation of clinical productivity in these two settings provides a better understanding of the current programs and challenges to enable the school to make necessary changes for a more productive and efficient teaching practice. At the same time, it allows for curriculum adjustments to enhance the educational experience, maximize revenue, and increase access to dental care. The most appropriate externship model is yet to be determined.

Feedback from HSDM students and faculty members suggest that students gain professional confidence and better clinical skills when they come back to the teaching practice after completing their twelve-week extramural rotations. The implementation of community-based dental programs in the curricula of U.S. dental schools remains one of the most valuable experiences for senior dental students, increasing their cultural and socioeconomic awareness.

The faculty-appointed externship directors expressed their satisfaction with interacting with and providing education for Harvard dental students. They also reported being pleased with the treatment provided and the significant contribution made to increasing access for underserved patients, thus improving the oral health of their communities. Awareness of clinical productivity might increase the interest of multiple extramural sites to actively participate in the dental educational development by becoming part of the network.

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REFERENCES