Measuring Clinical Productivity in Community-Based Dental Education Programs


Abstract: Community-based dental education programs (CBDEPs) are an important part of the curriculum in many dental schools. This article describes the redesign of the CBDEP at the University of Kentucky College of Dentistry. As part of the formative evaluation of this CBDEP, information on clinical productivity was collected in order to educate intramural faculty members about the scope and extent of services provided in extramural sites; develop an understanding of the productivity expected; complement the intramural education by placing dental students in particular settings where they could enhance certain clinical disciplines; and serve as a decision making tool in the selection of sites that provide the richest clinical experiences. A total of 158 students participated in the CBDEP during the three years of our study (2006–08). Productivity per site was calculated based on total, mean, and median number of services provided, billing (utilizing Kentucky's Medicaid fees for 2006), and Relative Value Units (RVUs). A total of 26,202 services, $972,109 in billing, and 43,053 RVUs was generated by the students, with an average of 175 services, $6,481, and 287 RVUs per student. Four categories (restorative, oral surgery, preventive, and diagnostic) accounted for 88 percent of total RVUs for all sites and all years. Productivity measured with RVU was the highest at private practices. Students spent most of their time providing restorative and oral surgery services. Measuring clinical productivity can be an effective tool to establish benchmarks, improve the site selection process, and educate those skeptical about the benefits of extramural education. Such an evaluation will enable faculty and program administrators involved in CBDEP to make continuous improvements.

Keywords: access to care, clinical education, clinical productivity, community-based dental education, community dentistry, dental education, public health dentistry, service-learning

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Various studies have identified large disparities in access to dental care and poor oral health outcomes in the state of Kentucky.1–5 In responding to these disparities, the University of Kentucky College of Dentistry (UKCD) has committed to addressing the needs of the underserved through extensive outreach programs, including mobile dental units and statewide school-based sealant and fluoride varnish programs. In addition, as part of its teaching mission, the UKCD promotes the involvement of dental students in programs designed to improve the oral health of Kentuckians and challenges them to become community leaders.

In 1970, the UKCD developed a course that provided dental students with the opportunity to participate in community-based field experiences. Since its inception, this course has undergone several changes that have geared its focus to serving the Medicaid population. By 2006, the course had become an opportunity for dental students to explore potential professional opportunities including graduate programs, private practice associateships, and public health careers. However, the number of students selecting public health opportunities had decreased drastically.6

In recent years, a number of reports have emphasized the importance of revising the dental school curriculum to make it more community-oriented.7–10 In 2006, the UKCD community course underwent a major change following the objectives of the Pipeline, Profession, and Practice: Community-Based Dental Education program.11 This national initiative sought to help dental students become more responsive to the needs of the underserved, while maximizing their clinical experience and increasing access. The newly named UKCD Community-Based Dental Education Program (CBDEP) was expected to have an instantaneous impact on increasing care to underserved
individuals. The rationale for the CBDEP is that dental students are able to treat more patients and provide more services in patient-centered delivery systems than in the traditional teaching-centered dental school clinics. In addition, the incorporation of field experiences during dental school exposes students to varied types of patients, procedures, and settings that they may not experience within their own institution.

Some educators have expressed skepticism about the benefits of a clinical experience provided off-site versus that in the traditional dental school clinic. However, a survey of faculty members at dental schools involved in the dental pipeline program found that a majority (57 percent) strongly agreed that extramural rotations should continue as an integral part of students’ education. Therefore, at the inception of the new course at UKCD, it was determined that clinical productivity would be collected and analyzed as part of the formative evaluation. This information would serve multiple purposes: it would 1) educate the intramural faculty about the scope and extent of services provided in extramural sites; 2) help the faculty develop an understanding of student productivity expected during the CBDEP; 3) show how the program complements intramural education by placing dental students in settings where they could enhance certain clinical disciplines; 4) serve as a decision making aid in the selection of sites that provided the richest clinical experiences; and 5) help to increase acceptance and credibility for the program.

Community-based dental education programs have been examined from multiple perspectives, including design and feasibility, financial impact, curriculum, managerial and legal issues, and attitudinal changes among students. A few studies have also examined extramural experiences from a clinical productivity angle. DeCastro et al. determined that dental students who participated in a service-learning program treated 2.5 more patients and provided over twice the amount of care compared to their classmates in the traditional curriculum. Mascarenhas et al. found that the productivity of the students and complexity of the services provided increased according to the length of time spent in service-learning experiences. Bean et al. found that fourth-year dental students completed as many procedures and generated similar revenue-equivalents in community sites as they did in a dental school clinic in half the time.

Our study differs from previous ones in that it examines the clinical productivity of UKCD students in their CBDEP across externship sites by analyzing service mix and productivity by site. We believe our study will be a useful tool for academicians, faculty preceptors, and those involved in the development and implementation of CBDEP.

Methodology

This study was approved under exempt review by the University of Kentucky Institutional Review Board on July 9, 2007.

The current course, a six-credit-hour required course, takes place during the eight-week summer session between the third and fourth years of dental school. Students must complete a four-week rotation and are able to utilize the rest of the summer to explore professional opportunities. CBDEP partners include sites serving a large number of individuals who are uninsured, underinsured, or living in poverty. These settings include community health centers (CHCs); private practices (PPs) serving a large percent of Medicaid patients; a federal prison (FP) dental clinic in Lexington; Indian Health Service (IHS) dental facilities throughout the United States; a Department of Veterans Affairs (VA) hospital; and the Urgent Care Clinic (UCC) at the UKCD. Students are assigned to the first five sites with a lottery system. Based on a number randomly selected by the students, assignments to clinical sites are filled in the order above. Assignment to the UCC is reserved exclusively for those dental students who, for personal or family reasons, are unable to relocate to a remote area for four weeks.

Students are evaluated based on reports from the faculty preceptor who judges the student’s knowledge and quality in clinical treatment as well as clinical activities, a reflective learning assignment, and submission of a productivity report. This article focuses on the productivity aspect. The productivity report consists of a spreadsheet in which students record the dental procedures rendered on a daily basis. Dental procedures are organized into eight categories: diagnostic, preventive, restorative, oral surgery, endodontic, periodontal, orthodontic, and adjunctive services.

Faculty preceptors at the extramural sites are instructed to review the information entered into the spreadsheet and sign on a daily basis to ensure accuracy of the information. Students are aware that
the information is not utilized for grading purposes but rather as a tool to measure and compare clinical experiences across the different sites. At the end of the CBDEP, students are required to submit both a hard copy that includes the daily signature of the faculty preceptor as well as an electronic file to facilitate data entry and analysis.

Data utilized for this article reflect clinical productivity for the dental students completing their four-week CBDEP in 2006, 2007, and 2008. Data were compiled in SPSS v. 17 (SPSS Inc., Chicago, IL). In those instances in which students’ electronic spreadsheets were missing or data inconsistencies were found, the information on the physical copy of the productivity report was used to acquire the information.

Productivity per site was calculated based on total, mean, and median number of services provided, billing (utilizing Kentucky’s Medicaid fees for 2006), and Relative Value Units (RVUs). Since mix of services varied from site to site, we needed a measuring scale that would translate a range of dissimilar services into a common scale. Therefore, service mix data were converted to RVUs. Although RVUs were developed primarily to expand and update fee schedules, the scale can be used for contract development and negotiation, productivity measurement, and income projections. Various RVUs have been developed to standardize clinical procedures in dentistry.\textsuperscript{32-34} However, their common denominator is the use of attributes such as time, complexity, skill, and knowledge required to complete the procedure. In our particular scenario, we used the RVU scale developed by Relative Value Studies, Inc. (Denver, CO).

Our preliminary analysis examined the service categories with the greatest total RVUs (productivity). The top four categories (restorative, oral surgery, preventive, and diagnostic) were used for comparative pairwise analyses between sites because they accounted for 88 percent of total RVUs for all sites and all years. A Total RVUs category was also included in the pairwise analysis to provide a general understanding of the differences between sites. The other four service categories (orthodontics, periodontics, endodontics, and adjunctive services) had too few RVUs for us to find statistical differences between sites. A test of homogeneity of variances among the top four RVU and Total RVUs categories found that the null hypothesis was rejected (i.e., the variances were not equal). Since analysis of variance (ANOVA) assumes equal variances, we used Tamhane’s T2 test for multiple pairwise comparisons. Tamhane’s T2 test was also used because of differing sample sizes among sites.

### Results

A total of 158 students participated in the CBDEP during the three years of our study: fifty-two in 2006, forty-eight in 2007, and fifty-eight in 2008. Due to inconsistencies and reliability issues, only data for forty-four students were utilized for the 2007 analysis. Most of the students were placed at CHCs (44 percent), followed by PPs (16 percent) and the FP (13 percent) (Table 1). A total of 26,202 services was provided by the students in the three years of the CBDEP, with an average of 175 services per student (Table 2). The mean number of services per student was the highest at PPs (238), followed by the IHS (192) and the VA (182). The lowest productivity per student was at the UCC at the UKCD (138).

A total of $972,109 of billing was generated by the dental students, with an average of $6,481 per student. Mean billing per student was the highest at PPs ($10,012), followed by the VA ($8,621) and the IHS ($6,523). Mean billing per student was the lowest at the UCC ($4,505). When the service mix was converted to RVUs, a total of 43,053 units was produced by the dental students, with an average of 287 units per student. The mean RVU per student was the highest at PPs (447), followed by the VA (373).

| Table 1. Student distribution by clinical site, 2006–08, by number and percentage of yearly total |
|-----------------------------------|---|---|---|---|---|---|---|
| CHCs    | IHS   | FP    | PPs   | UCC   | VA    | Total |
| 2006    | 25 (48%) | 4 (8%) | 6 (12%) | 7 (13%) | 8 (15%) | 2 (4%) | 52   |
| 2007    | 21 (44%) | 5 (10%) | 6 (13%) | 7 (15%) | 7 (15%) | 2 (4%) | 48   |
| 2008    | 24 (41%) | 9 (16%) | 8 (14%) | 12 (21%) | 3 (5%) | 2 (3%) | 58   |
| Total   | 70 (44%) | 18 (11%) | 20 (13%) | 26 (16%) | 18 (11%) | 6 (4%) | 158  |

Note: Row percentages may not add up to 100% because of rounding.
Table 2. Total, mean, and median services, billing, and Relative Value Units (RVUs) by clinical site, 2006–08

<table>
<thead>
<tr>
<th>Clinical Site</th>
<th>Total Services</th>
<th>Mean Services</th>
<th>Median Services</th>
<th>Total Billing</th>
<th>Mean Billing</th>
<th>Median Billing</th>
<th>Total RVUs</th>
<th>Mean RVUs</th>
<th>Median RVUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHCs</td>
<td>10,225</td>
<td>157</td>
<td>148</td>
<td>$351,938</td>
<td>$5,414</td>
<td>$4,940</td>
<td>15,547</td>
<td>239</td>
<td>224</td>
</tr>
<tr>
<td>IHS</td>
<td>3,459</td>
<td>192</td>
<td>196</td>
<td>$117,413</td>
<td>$6,523</td>
<td>$5,912</td>
<td>5,342</td>
<td>297</td>
<td>273</td>
</tr>
<tr>
<td>FP</td>
<td>3,261</td>
<td>163</td>
<td>130</td>
<td>$128,655</td>
<td>$6,433</td>
<td>$5,897</td>
<td>5,965</td>
<td>298</td>
<td>285</td>
</tr>
<tr>
<td>PPs</td>
<td>5,959</td>
<td>238</td>
<td>210</td>
<td>$250,293</td>
<td>$10,012</td>
<td>$9,265</td>
<td>11,184</td>
<td>447</td>
<td>381</td>
</tr>
<tr>
<td>UCC</td>
<td>2,205</td>
<td>138</td>
<td>127</td>
<td>$72,083</td>
<td>$4,505</td>
<td>$4,255</td>
<td>2,778</td>
<td>174</td>
<td>171</td>
</tr>
<tr>
<td>VA</td>
<td>1,093</td>
<td>182</td>
<td>176</td>
<td>$51,727</td>
<td>$8,621</td>
<td>$7,194</td>
<td>2,239</td>
<td>373</td>
<td>296</td>
</tr>
<tr>
<td>Total</td>
<td>26,202</td>
<td>175</td>
<td>155</td>
<td>$972,109</td>
<td>$6,481</td>
<td>$5,544</td>
<td>43,053</td>
<td>287</td>
<td>243</td>
</tr>
</tbody>
</table>

Figure 1. Mean RVU per student for the top four categories (diagnostic, preventive, oral surgery, and restorative dentistry) by clinical site, 2006–08

The multiple pairwise analysis per site (Table 3) found a significant mean difference of 122.6 RVUs ($p<0.01$) between the IHS and the UCC; 124.2 RVUs ($p<0.01$) between the FP and the UCC; and 274.3 RVUs ($p<0.01$) between PPs and the UCC for total RVUs. There was a significant mean difference of 42.7 RVUs ($p<0.05$) between the FP and the UCC for total oral surgery RVUs. There were multiple significant differences in preventive and restorative RVUs per site, with the differences being the largest when comparing CHCs with the FP, CHCs with the UCC, IHS with the UCC, and PPs with the UCC. There were not statistically significant differences when comparing diagnostic RVUs per site.
Discussion

The clinical productivity of dental students in the CBDEP can be measured using various mechanisms such as total number of patients, patient visits, services, billing, collections, etc. In our analysis, we utilized RVUs as a standardized tool for measuring clinical productivity, which allowed us to make comparisons between different types of clinical settings. The results of our study show that the average clinical productivity of dental students participating in the CBDEP at the UKCD was highest for students placed at private practices followed by those placed at the VA hospital dental clinic.

Explanations for the differences may be multiple. Private practices, by definition, are for-profit enterprises and, as such, they are productivity- and revenue-oriented. The delivery system is set up in such a way that there are an adequate number of well-trained dental assistants and administrative personnel. This support facilitates dental students’ work process: by focusing solely on delivering treatment, students’ productivity is maximized. Mean RVU productivity per student was the second highest at the VA. Although the VA hospital operates on a nonprofit basis, the faculty preceptor at this site encourages maximum productivity and strives to provide dental students with a comprehensive and real-life experience. Therefore, although the profit-driven principle does not hold true in this setting, the teaching style yielded high productivity.

CHCs are important partners in the CBDEP as they allow us to expose dental students to a true clinical public health experience. When the program was redesigned, a strong emphasis was placed on the assignment of dental students to these settings, resulting in a majority (44 percent) of our students completing their CBDEP at CHCs. However, mean RVU productivity per dental students at the CHCs was lower than at PPs, the VA, the IHS, and the FP. The difference was statistically significant for restorative services. This finding was particularly interesting as restorative dentistry comprises a large part of the curriculum as well as a significant part of the requirements for graduation. Therefore, students might expect to spend a significant amount of time providing these types of services. However, this clinical shortcoming may discourage students from completing their CBDEP at these sites as well as those

Table 3. Multiple pairwise comparisons of mean RVU productivity by clinical site, 2006–08

<table>
<thead>
<tr>
<th></th>
<th>Total RVUs</th>
<th>Diagnostic RVUs</th>
<th>Preventive RVUs</th>
<th>Oral Surgery RVUs</th>
<th>Restorative RVUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHC-IHS</td>
<td>56.6 (-18.2, 131.4)</td>
<td>2.1 (-15.6, 19.7)</td>
<td>11.7 (-22.5, 45.9)</td>
<td>14.7 (-17.0, 46.3)</td>
<td>23.4 (-29.0, 75.7)</td>
</tr>
<tr>
<td>CHC-FP</td>
<td>58.2 (-27.6, 144.0)</td>
<td>9.7 (-8.7, 28.0)</td>
<td>32.0 (11.0, 53.0)***</td>
<td>12.8 (-24.0, 49.6)</td>
<td>78.9 (13.7, 144.2)***</td>
</tr>
<tr>
<td>CHC-PP</td>
<td>208.3 (-9.1, 425.7)</td>
<td>9.2 (-22.4, 40.8)</td>
<td>4.6 (-32.4, 41.6)</td>
<td>27.5 (-30.1, 85.2)</td>
<td>151.2 (6.2, 296.3)*</td>
</tr>
<tr>
<td>CHC-UCC</td>
<td>65.6 (-22.6, 154.6)</td>
<td>15.4 (-25.6, 56.4)</td>
<td>35.5 (14.0, 57.0)***</td>
<td>29.8 (-5.3, 65.0)</td>
<td>54.6 (16.0, 93.1)***</td>
</tr>
<tr>
<td>CHC-VA</td>
<td>126.1 (-313.3, 483.4)</td>
<td>7.8 (-6.9, 22.4)</td>
<td>23.8 (-36.1, 83.6)</td>
<td>17.4 (-145, 179.8)</td>
<td>102.2 (-105.4, 309.8)</td>
</tr>
<tr>
<td>IHS-FP</td>
<td>1.6 (-85.9, 89.0)</td>
<td>11.7 (-9.8, 33.2)</td>
<td>43.7 (13.1, 74.3)**</td>
<td>27.5 (-8.7, 63.7)</td>
<td>55.6 (-14.4, 125.5)</td>
</tr>
<tr>
<td>IHS-PP</td>
<td>151.7 (-65.9, 369.3)</td>
<td>7.1 (-26.0, 40.3)</td>
<td>7.1 (-34.6, 48.8)</td>
<td>42.2 (-14.9, 99.3)</td>
<td>127.8 (-18.8, 274.5)</td>
</tr>
<tr>
<td>IHS-UCC</td>
<td>122.6 (32.4, 212.8)**</td>
<td>13.3 (-28.6, 55.2)</td>
<td>47.2 (16.4, 78.1)***</td>
<td>15.2 (-19.4, 49.7)</td>
<td>78.0 (29.2, 126.7)***</td>
</tr>
<tr>
<td>IHS-VA</td>
<td>69.4 (-287.9, 426.8)</td>
<td>9.8 (-8.7, 28.4)</td>
<td>35.5 (-23.9, 94.8)</td>
<td>32.1 (-131.5, 195.6)</td>
<td>78.9 (-124.5, 282.3)</td>
</tr>
<tr>
<td>FP-PP</td>
<td>150.1 (-70.2, 370.4)</td>
<td>18.9 (-14.7, 52.4)</td>
<td>36.6 (3.2, 70.1)*</td>
<td>14.7 (-44.8, 74.2)</td>
<td>72.3 (-77.9, 222.5)</td>
</tr>
<tr>
<td>FP-UCC</td>
<td>124.2 (25.7, 222.6)**</td>
<td>25.1 (-17.0, 67.1)</td>
<td>3.5 (-9.2, 16.2)</td>
<td>42.7 (3.7, 81.6)*</td>
<td>133.5 (71.0, 196.0)***</td>
</tr>
<tr>
<td>FP-VA</td>
<td>67.9 (-282.7, 418.4)</td>
<td>1.9 (-17.3, 21.1)</td>
<td>8.3 (-56.9, 73.4)</td>
<td>4.6 (-155.7, 164.9)</td>
<td>23.3 (-173.7, 220.4)</td>
</tr>
<tr>
<td>PP-UCC</td>
<td>274.3 (53.5, 494.1)**</td>
<td>6.2 (-41.3, 53.7)</td>
<td>40.1 (6.4, 73.8)**</td>
<td>57.4 (-1.2, 116.0)</td>
<td>205.8 (61.9, 349.7)***</td>
</tr>
<tr>
<td>PP-VA</td>
<td>82.3 (-255.4, 419.9)</td>
<td>17.0 (-14.9, 48.8)</td>
<td>28.4 (-31.1, 87.8)</td>
<td>10.1 (-140.5, 160.8)</td>
<td>49.0 (-155.4, 253.3)</td>
</tr>
<tr>
<td>UCC-VA</td>
<td>192.0 (-157.8, 541.8)</td>
<td>23.2 (-18.0, 64.3)</td>
<td>11.8 (-52.8, 76.4)</td>
<td>47.2 (-114.3, 208.8)</td>
<td>156.8 (-55.2, 368.8)</td>
</tr>
</tbody>
</table>

*p<0.05
**p<0.01
***p<0.001

Note: Tamhane’s T2 multiple pairwise comparisons for non-parametric data. Significant relationships are highlighted.
either considering starting their careers at CHCs or pursuing a career in public health. In addition, this fact may become a concern for restorative departments particularly if dental students are granted credits for services rendered in extramural sites. Potential explanations for the low RVU productivity might be lower number of patient visits, reduced chair time, faculty-preceptor delegation criteria, and even level of restorative expertise of dental students. It is also likely that the patients served by CHCs had more complex restorative needs as they might be less likely to visit a dentist regularly, resulting in additional time to provide a unit of restorative care. Despite this shortcoming, CHCs allowed dental students to gain a better understanding of the issues faced by populations not served by the traditional dental care delivery system.

The UCC had the lowest productivity and low values for all outcome measures evaluated except diagnostic. Due to the nature of its operation—i.e., management of patients requiring emergency care due to pain or dental-related problems and triage—students do not have the luxury of charting out a detailed treatment plan and carrying out the phases of treatment in a systematic order. In addition, the level of busyness varies from day to day. On certain days the students might be extremely busy but relatively idle on others, limiting their ability to enhance their clinical skills during the CBDEP. As a result, changes in the clinical experience at the UCC were made in 2010, increasing the scope of services and volume of patients treated by the students. However, data reflecting these changes are not included in our analysis.

In general, most of the care rendered by dental students focused on two categories of services: restorative and oral surgery. This might be the result of the high oral morbidity of Kentuckians because of their low salience for dental care, lack of community preventive programs, and limited dental benefits in the Medicaid program. In addition, the educational and practice paradigm of treating vs. preventing might be a potential explanation.

There are some limitations in this study. As the data are self-reported, there is always the possibility that the number of procedures reported may be over- or underreported. Similarly, although students were asked to enter the information on a daily basis, we could not confirm that was always the case; therefore, there is a chance for recall bias. Similarly, some services may have been performed and not included in the electronic spreadsheet, creating a deflationary effect on services performed and thus on total and mean RVUs. Students could have entered procedures incorrectly on spreadsheets when entering the data, e.g., placed a service in an incorrect category. However, we have no reason to believe students at certain sites did this while others did not. Likewise, students may have had transfer errors when transferring from physical copy to electronic spreadsheet. There is some evidence of this inaccuracy as we found modest inconsistencies when comparing electronic to hard-copy spreadsheets.

A strength of this study is the use of RVUs. The RVU offers a more robust variable for analysis than services performed or billing. Mean RVUs per student for the four-week period were our outcome and comparative variable. A more accurate indicator of productivity would have been RVUs/hour. However, since students did not work similar hours, some may have higher RVUs because of more hours worked. While our expectation was that all settings would operate on forty hours per week, in some instances this was not always the case. When dealing with multiple clinical sites run by different organizations and with different missions (for profit vs. not for profit), operational and logistical issues will vary. In addition, other factors such as the amount of paperwork required in the clinical settings, waiting periods for faculty preceptor evaluation of the procedure, ratio of faculty preceptor to students, and hours of operation of the facility can have an effect on the level of productivity. Finally, as far as busyness, faculty preceptors strived to make the students’ clinical experience meaningful by ensuring high levels of productivity. For instance, faculty preceptors at CHCs utilize double booking. However, just as in any type of setting, there will be variations in patients’ attendance based on geographic and economic issues, level of salience of dental care, and other variables that are particularly relevant for settings that are part of the dental safety net as well as those that serve a large number of patients on Medicaid.

From a didactic standpoint, our outcomes indicate that RVUs can be utilized as an effective tool to compare productivity among clinical sites and provide data to support ways to enhance the clinical experience of dental students during the CBDEP. Placement of dental students at clinical settings, which offer the richest clinical experiences or where students can concentrate on particular clinical procedures, may significantly add to the competence of students about to enter their professional lives.
Previous studies on CBDEP have reported both increased clinical productivity at community sites compared to clinics in the traditional dental setting and augmented productivity as the students go through the program. Measurement of productivity can be used as an effective tool for site selection and to provide evidence to counter skepticism about the benefits of extramural education. These studies make a strong case for the inclusion of CBDEP in the dental school curriculum.

Conclusions

This study introduces the RVU as a practical method of measuring productivity in community-based dentistry. Even though the RVU is not a perfect way to evaluate productivity, it provides a reasonable method of quantitative measurement of dental clinical services. An RVU scale can be an effective tool for formative and summative evaluations, to establish benchmarks, and to measure productivity for academicians and community-based faculty preceptors involved in the CBDEP. Such an evaluation will enable faculty members and administrators to make continuous improvements in their community-based programs.

REFERENCES