Milieu in Dental School and Practice

Restorative Dentistry Productivity of Senior Students Engaged in Comprehensive Care


Abstract: In dental education, various clinical delivery models are used to educate dental students. The quantitative and qualitative measures used to assess the outcomes of these models are varied. Georgia Health Sciences University College of Dental Medicine has adopted a version of a general dentistry comprehensive care dental education hybrid model. Outcome assessments were developed to evaluate the effectiveness of this delivery model. The aim of this study was to compare the number of restorative procedures performed by senior dental students under a discipline-based model versus senior student productivity engaged in comprehensive care as part of a hybrid model. The rate of senior students’ productivity in performing various restorative procedures was tracked over four years, and a comparison was made. In the first two years, the seniors operated in a discipline-based model, while in the last two years the seniors operated in a comprehensive care hybrid model. The results showed that there was a significant increase in productivity by the students in terms of direct and indirect restorations. This increase in productivity may indicate that the comprehensive care model may be a more productive model, thereby enhancing clinical experiences for the students, improving operating efficiency for the schools, and ultimately increasing clinical income.

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Dental education today faces many challenges, such as funding, recruiting and retaining faculty, and measuring outcomes. Most would agree that budget issues are at the forefront of many of these challenges and the cost of educating students is continuing to rise. According to Pyle et al., “Financing of higher education will remain a challenge for the foreseeable future, which is critical because dental education is among the most expensive of university programs.” In fact, some feel these problems or challenges mentioned are reaching crisis proportion. The dental profession and dental schools are finding they must be very creative in order to maintain the degree of prestige and excellence they have typically enjoyed. It is certainly recognized that dental schools are being forced to become more efficient and develop programs that help combat some of the financial challenges. In “The Macy Study: A Framework for Consensus,” the authors noted that finding new models of dental education that are educational and financially feasible will be challenging, but several models should emerge to serve all of the schools.

Dental education in the United States typically takes four years of intensive studies, and the clinical aspect of the curriculum has usually been delivered in one of the following three generally accepted approaches: a discipline-based approach, a comprehensive care approach, or a hybrid of the two. The discipline- or specialty-based approach is the method Georgia Health Sciences University (GHSU) had used from its founding some thirty-five years ago until recently. In this method, the dental student treats his or her patient in the discipline-specific clinic under faculty specific to that discipline. Junior and senior students share the same clinical spaces, are covered by the same faculty, and often compete for a limited number of chairs. For example, if a patient is in need of an indirect restoration, the student will have to schedule the patient in a limited number of
chairs in the fixed prosthodontic clinic covered by a prosthodontist. In the comprehensive care approach, on the other hand, the student performs all procedures in the comprehensive care clinic(s), usually under the supervision of a generalist and in most cases with support from the faculty of the various specialty disciplines. Lastly, in the hybrid approach, a combination of the two methods above is used. Typically, the junior-level students will perform their duties in the specialty clinics while the senior students will perform their duties in the comprehensive care clinics. The hybrid model can act as a transition from the discipline-based model to the general dentist private practice model. Specific accreditation standards expect students to have comprehensive care experiences to adequately prepare them for all aspects of general dental practice. Additionally, many schools are experiencing an increase in the number of hours a student spends participating in off-site clinical rotations. The comprehensive care model will more closely match and possibly better prepare the student for those experiences.

The GHSU College of Dental Medicine (CDM) recently examined its patient care delivery system and looked for ways to improve it. We envisioned developing a program that would enhance patient care, increase productivity and revenues, educate students, utilize faculty efficiently and effectively, and better serve the citizens of the state. Students’ clinical experiences begin at GHSU during the sophomore year in a block format. These experiences are limited to adult scaling and polishing and simple operative dentistry. Significant patient care begins during the junior year. After many months of feasibility studies and due diligence, it was determined that the clinical program at GHSU CDM was going to change to a hybrid model. The sophomore and junior years would operate very similarly to what had been done in the past, utilizing a discipline-based approach, and emphasis would be placed on the senior class and the structure of the comprehensive care general dentistry model. This decision accomplished two major goals. First, it gave the beginning clinical student the attention of the specialist, and second, it gave the specialist the security that he or she would control the early clinical education of the students. Furthermore, the specialists set benchmarks the students had to reach in order to be credentialed to the new senior year comprehensive care general dentistry program. The aim of the study reported in this article was to compare the number of restorative procedures performed by senior dental students under the prior discipline-based model versus senior student productivity engaged in comprehensive care as part of the new hybrid model.

### Design and Implementation of the Program

The program leadership conducted site visits at the University of Texas Health Science Center at San Antonio Dental School and at the University of Missouri-Kansas City School of Dentistry—schools that have experienced long-term success with their comprehensive care clinical models. We observed and studied these other programs, gaining much insight from their varied successes as well as their much appreciated sharing of unsuccessful experiments. After considerable deliberation, it was determined that our hybrid model of maintaining specialty supervision during the junior year, accompanied by comprehensive care the senior year, was the appropriate approach for our institution. With this concept in mind, numerous resources were expended to bring the program to fruition: structuring the program, remodeling facilities, identifying faculty, hiring faculty, training faculty, training staff, identifying and ordering supplies, adjusting the curriculum, writing operations manuals and course syllabi, etc.

At GHSU CDM, the senior class consists of approximately sixty students, and it was decided that the class would be divided into two teams of approximately thirty students each. Each team would remain constant throughout the year. Each team would be supervised by five faculty members who remained constant throughout the year as well. This would enable the faculty to better monitor both the progress of the students on their team and the care being provided to the patients assigned to the team’s students. It was hoped that these smaller fixed groups would better serve the interests of the patients and also the needs of students. This group model would allow the student to have consistent coverage on the individual patient procedures while at the same time benefiting from the experience and strengths of the individual faculty member. In recruiting faculty for the new program, we recruited from both within and outside the institution, from practitioners within academia and from the private sector as well. Calibration of faculty members to the standards expected by the institution is a difficult task and a constant
challenge. By selecting faculty for this program from within the dental school, we were able to maintain the established standards. The experienced faculty members could train the new faculty members to the expected standards.

GHSU CDM’s new clinical delivery program began in 2006, with the 2007 graduating class. In the new system, the majority of the senior’s patient care is delivered in general dentistry clinics supervised by experienced generalists. Appointments and operatories were made readily available. Additionally, the faculty was encouraged to take a more active role in each patient’s treatment in hopes of improving the timeliness of care for the patients by making the students more efficient.

With this change in the clinical education model, there were several outputs that needed to be measured to gauge the success of the curricular changes. The concept of measuring outputs is not limited to the dental profession and certainly not limited to GHSU. Moreover, the need to document and track the outcomes, successful or otherwise, is vital to the success of all educational programs. Members of the public are aware of what they contribute to education, and now they are demanding to see what their investment is returning. Higher standards for student learning are being expected, and the public is holding schools accountable. As Clark et al. stated, “Learning outcomes focus on the end product and define what the learner is accountable for. The approach is equally applicable throughout the educational continuum in dentistry from undergraduate to postgraduate training.”

Of the many assessment outcomes that have been identified, some are easily assessed, and others are much more difficult to evaluate. The assessment of learning outcomes is a complex subject that has not kept pace with curriculum change, and there is still much research to be carried out. In the dental profession, there is an array of methods to assess outcomes. Several objective, quantitative measures can be used to assess the outcomes of the educational system quite easily. Some of these measures include revenues generated, dental procedures performed, clinical board pass rates, and on-time graduation rates. Other more subjective and qualitative measures are not as easily determined or calculated. Some of these include patient satisfaction and the quality of students graduating. It is impossible to find a single assessment method that is fully valid, reliable, feasible, and appropriate, so a range of techniques is required to match the outcome being assessed. Many techniques have been employed to measure the outputs of the comprehensive care models, and the research described in this article mostly supports the effectiveness of the comprehensive care models in regards to the quantitative and qualitative measures mentioned.

Licari and Knight stated the following concerning comprehensive care at their institution:

To date, the results from the first full year of the program have been encouraging and supportive of the continuation of the model. On-time graduation rates have increased from the 60 to 70 percent range to 96 percent. Regional board pass rates have remained high (92 percent pass rate on the first attempt). When corrected for a 3 percent fee increase for 2002–03, clinical productivity has increased by over $300,000.00 (from $1,433,000.00 to over $1,750,000.00).7

In an additional study, Pousson and McDonald described a model that was developed and instituted at Louisiana State University School of Dentistry in a class of fifty-two senior dental students.8 Monetary goals were set, teams were created, incentives were put in place, and evaluation forms were introduced. The dollars generated and number of charged visits per student were compared to previous years, and a survey instrument was used to determine the students’ attitudes. Pousson and McDonald found the introduction of the team approach model utilizing business principles was effective in enhancing patient care activities and provided senior students an opportunity to apply business principles to their senior-year clinical experience.

The purpose of our study was to concentrate on one of the goals previously mentioned as an outcome of the comprehensive care model of clinical education: increasing the productivity of dental students. This element was measured by comparing the number of restorative procedures performed under a comprehensive care general dentistry model to that of those performed under a discipline-based model. The hypothesis was that the comprehensive care model would lead to an increase in restorative dentistry productivity as compared to a discipline-based model.

**Methods**

In this study performed at GHSU, student clinical productivity was tracked over four years. Since
the comprehensive care (hereafter referred to as comp care [CC]) program was instituted with the class of 2007 and comp care only occurred in the senior year, productivity was easily analyzed, and a comparison of the different delivery models could be made. The class of 2005, which consisted of fifty-five students, and the class of 2006, which consisted of fifty-seven students, represented pre-comp care. The class of 2007, which consisted of fifty-nine students, and the class of 2008, which consisted of sixty students, represented post-comp care.

Selected clinical procedures performed were tracked and recorded in the axiUm electronic record (Exan Enterprise Inc., Las Vegas, NV). The procedures were identified from the CDT codes and grouped into like categories (Table 1). For example, a one-surface amalgam, which has a CDT code of D2140, and a two-surface amalgam, which has a CDT code of D2150, were grouped into one category, which was termed “direct restorations.” The junior-year production was recorded for each class, and the senior-year production was recorded for each class. Clinical productivity for the classes of 2005, 2006, 2007, and 2008 in each year of education was grouped together. As an example: the junior year’s clinical productivity for the graduating class of 2005 was combined with the junior year’s clinical productivity for the graduating class of 2006, resulting in the figures recorded for pre-comp care junior data. Similarly, the junior year’s clinical productivity for the graduating class of 2007 was combined with the junior year’s clinical productivity for the graduating class of 2008 to provide the figures recorded for post-comp care junior data.

For the purpose of comparison, all results are presented as number of procedures per student per hour of available clinic time (Table 2). Separately for pre-comp care and post-comp care, the number of procedures in each category for each class was aggregated to form the numerator of the procedure rate. For the denominator, the total number of student-hours was calculated by multiplying the number of students in the class by the total number of available clinic hours. The total student-hours for each class were then aggregated to form the denominator of the procedure rate. The rate calculated in this way was then multiplied by a factor of 1,000 for ease of interpretation. For example, to calculate the pre-comp care rate for the seniors for direct restorations, the number of all such procedures performed by the senior class of 2005 (3,311) was added to the number of all such procedures performed by the senior class of 2006 (2,681). Then, the number of students in the senior class of 2005 (54) was multiplied times the number of clinic hours available to the senior class of 2005 (1,072), and this was added to the product of the number of students in the senior class of 2006 (52) times the number of clinic hours available to the senior class of 2006 (1,093). The total number of procedures (5,992) was then divided by the total number of student-hours (114,724) to calculate the rate (0.0522). Multiplying by 1,000 yielded 52.2 (Table 3). Exact methods for the comparison of Poisson rates were used to test for statistically significant differences between the pre-comp care and post-comp care rates separately for the junior and senior classes. Because of the exploratory nature of this study, no adjustment was made for multiple testing, and a significance level of 0.05 was used for all statistical comparisons. This study was approved

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**Table 1. Grouped procedures**

<table>
<thead>
<tr>
<th>Indirect Restorations</th>
<th>Direct Restorations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Bridge Anchors: Crowns</td>
<td>Restorative: Amalgams</td>
</tr>
<tr>
<td>Restorative: Crowns</td>
<td>Restorative: Resins</td>
</tr>
<tr>
<td>Restorative: Veneers</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Available clinic hours**

<table>
<thead>
<tr>
<th>Class</th>
<th>Period</th>
<th>Number of Students</th>
<th>Available Clinic Hours</th>
<th>Student-Clinic Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniors</td>
<td>Pre</td>
<td>106</td>
<td>2,165</td>
<td>114,724</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>118</td>
<td>2,258</td>
<td>133,248</td>
</tr>
<tr>
<td>Juniors</td>
<td>Pre</td>
<td>107</td>
<td>1,402</td>
<td>75,004</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>118</td>
<td>1,447</td>
<td>85,374</td>
</tr>
</tbody>
</table>

*Note:* Student-hours were calculated separately for each year and then combined for the pre-comp care and the post-comp care periods.

Pre=combined classes of 2005 and 2006
Post=combined classes of 2007 and 2008
Results

The estimated rates for direct restorations are shown in Table 3 and presented graphically in Figure 1. For the seniors, the post-comp care rate was significantly greater than the pre-comp care rate (p<0.001). For the juniors, the post-comp care rate was significantly lower than the pre-comp care rate (p<0.001).

The estimated rates for indirect restorations are shown in Table 4 and presented graphically in Figure 2. For the seniors, the post-comp care rate was significantly greater than the pre-comp care rate (p=0.002), as was the case for the juniors (p=0.004).

With regard to pre-comp care versus post-comp care comparisons for the seniors, there was a significant increase in terms of indirect restorations and a significant decrease in direct restorations. With regard to pre-comp care versus post-comp care comparisons for the juniors, there was a significant increase in terms of indirect restorations and a significant decrease in direct restorations.

Discussion

An integral component of the comprehensive care concept is the development of a phased and sequenced treatment plan. Ideally, urgent needs and general operative dentistry procedures are completed prior to indirect restorations or replacement of missing teeth. This approach is common to both the junior and senior clinics at GHSU. Clinical productivity can be measured in various ways: the number of actual procedures, clinical revenue generated, and relative value units (RVU points). One of the determining

Table 3. Pre-comp care and post-comp care rates for direct restorations

<table>
<thead>
<tr>
<th>Class</th>
<th>Period</th>
<th>Rate for Direct Restorations</th>
<th>Number of Students</th>
<th>Available Clinic Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniors</td>
<td>Pre</td>
<td>52.2</td>
<td>106</td>
<td>2,165</td>
</tr>
<tr>
<td>Seniors</td>
<td>Post</td>
<td>57.3</td>
<td>118</td>
<td>2,258</td>
</tr>
<tr>
<td>Juniors</td>
<td>Pre</td>
<td>77.1</td>
<td>107</td>
<td>1,402</td>
</tr>
<tr>
<td>Juniors</td>
<td>Post</td>
<td>71.3</td>
<td>118</td>
<td>1,447</td>
</tr>
</tbody>
</table>

Note: Rate for direct restorations=1000 x number of procedures per student-hour.
semester grade is partly determined by the number of production units earned during available clinic hours. Providing comprehensive care for his or her patients enables each student to accumulate the requisite number of points for the commensurate grade. Whether measured by RVU points, number of clinical procedures, or clinical revenue, the increases experienced by our comp care program were also realized by similar programs initiated at other institutions. This may prove to be one of the “educational and financially feasible” emerging models applicable to many other dental schools.

The seniors are encouraged, via this point system based on clinical production, to continue to work in the clinic right up to graduation. These factors in harmony with their developing confidence and clinical skills help to make their final days in dental school more productive, particularly in the area of restorative procedures. When evaluating the

<table>
<thead>
<tr>
<th>Class</th>
<th>Period</th>
<th>Rate for Indirect Restorations</th>
<th>Number of Students</th>
<th>Available Clinic Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniors</td>
<td>Pre</td>
<td>12.8</td>
<td>106</td>
<td>2,165</td>
</tr>
<tr>
<td>Seniors</td>
<td>Post</td>
<td>14.2</td>
<td>118</td>
<td>2,258</td>
</tr>
<tr>
<td>Juniors</td>
<td>Pre</td>
<td>4.6</td>
<td>107</td>
<td>1,402</td>
</tr>
<tr>
<td>Juniors</td>
<td>Post</td>
<td>5.7</td>
<td>118</td>
<td>1,447</td>
</tr>
</tbody>
</table>

Note: Rate for direct restorations = 1000 x number of procedures per student-hour.

Figure 2. Trend in procedures completed: indirect restorations

Factors for the cost of providing treatment is the time it takes to perform the service. In previous studies, the clinical revenues generated were cited as one of the determinants of clinical productivity, and these revenues were directly related to the time taken to perform the procedures.

To ensure that all students receive a broad-based clinical education at GHSU CDM, some quantitative, procedural-specific criteria do exist. They are, however, minimal expectations and do not compromise comprehensive patient care. In the comprehensive care clinics, a more broad-based quantitative point system is used to encourage clinic attendance and promote comprehensive care of the students’ patients. This system is tied to CDT codes with points being awarded based on the type of procedure and the time expected to successfully complete that procedure. Points are intended to reward the comprehensive care of each patient. Each

Table 4. Pre-comp care and post-comp care rates for indirect restorations, by class

<table>
<thead>
<tr>
<th>Class</th>
<th>Period</th>
<th>Rate for Indirect Restorations</th>
<th>Number of Students</th>
<th>Available Clinic Hours</th>
</tr>
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<tr>
<td>Seniors</td>
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Note: Rate for direct restorations = 1000 x number of procedures per student-hour.
efficiency of the newly implemented CC program, the question is this: Can the increase in clinical efficiency be attributed to the CC program itself or to the cumulative steps taken in order to turn the concept into reality? As mentioned, the specific steps taken to implement the CC program include acquisition of additional faculty members devoted to the CC program with a closer mentoring of each student’s progress, the introduction of numerical clinical procedural requirements (credentialing) for entrance into the CC program, the addition of operatories available to the students, and the structuring of the teams.

In other words, if the steps listed above were applied to the already existing discipline-based program, could we expect to see a similar increase in clinical efficiency? It is logistically challenging and financially impractical to try and operate both systems simultaneously within a given class, be it junior and/or senior year, and there are too many additional variables that must be taken into account before coming to a reasonable conclusion. The real question then becomes this: How is a CC program better suited to maximize the benefits of these resources and strategies when compared with an enhanced discipline-based program?

One of the intended benefits of the team concept is that the faculty members of each team become very familiar with the students on their team. The faculty members of the CC program are dedicated to clinical activities and are not assigned to any pre-clinical courses. This provides them the opportunity to direct their undivided attention and concentrated efforts toward the student’s clinical activity. In addition, it is becoming increasingly more difficult to acquire and retain the number of specialists necessary to adequately sustain a purely discipline-based program. Additionally, through this concentrated exposure, faculty members more quickly learn the attention level each student requires, enabling them to devote more time to those with greater need. This in turn enables the slower student to improve his or her productivity in a shorter period of time. Mentoring is not unique to a CC-based program. However, this concept provides the opportunity for each faculty member to become better acquainted with the particular needs of his or her mentees. It further enables them to help track students’ clinical progress and to guide them in their professional development. This personalized attention also permits the advanced student to tackle more varied and complex treatment plans, which often contain more indirect restorations. The median number of indirect restorations increased in the post-comp care groups, indicating that students of all abilities gained more experience than the pre-comp care classes.

Another factor that could have contributed to this increase in productivity is the credentialing process. Since benchmarks were established in order for the students to credential into the comprehensive care senior year, the junior students may have been more productive, leading to their gaining more experience and improved clinical skills. The implementation of the credentialing process provided assurance of a certain level of clinical competence of each student prior to entry into the CC program. Of equal significance, it proved to be a motivation for students to increase the number of indirect restorations completed prior to their senior year. However, the junior students were not able to sustain the rate of direct restorations recorded preceding the implementation of the CC program. Due in part to the less efficient discipline-based program of the junior clinic, the increase in the number of indirect procedures came at the cost of a decrease in the rate of completion of direct procedures. The seniors involved with the CC program far exceeded the rate of productivity of the pre-CC seniors on indirect and direct procedures alike. Generally, one would expect a more experienced senior student to be able to complete all types of procedures more quickly than a junior student. The increased efficiency is therefore evidenced through comparing the pre-CC completion rate to that of the post-CC completion rate of the senior class.

Another variable that led to a productivity increase was the availability of chairs. In the old model, junior and senior students worked side by side, often competing for a limited number of chairs in the discipline-specific clinic. In the new model, chairs were readily available for the senior students with few exceptions. Given an increase in the number of chairs available to the students, and assuming one was able to acquire the correct mix of faculty members required to adequately cover each specialty area with a discipline-based program, students are still restricted as to what procedures can be accomplished in any given area. The ability to perform multiple types of procedures in the same operatory, which is the case in a CC-based program, cannot help but increase efficiency.

Additionally, since the senior class was divided into two teams, faculty members were able to work more closely with fewer students, thereby offering more individualized attention and mentoring. Every student in the senior class is assigned to either Team
A or Team B. Each team has specific faculty members assigned to it. These assignments remain unchanged throughout the year. This arrangement increases the faculty familiarity with the students on their team and the patients of each student. In conjunction with this concept, when students are assigned a patient with complex restorative needs, they are advised to select two faculty members to work with on these cases. The continuity thus achieved greatly increases the efficiency of treatment. It is very difficult to make these assignments and thus achieve similar results with a discipline-based program.

Other curricular changes, such as off-site rotations and increases in class size, could lead to decreases in available on-campus clinic time for students to treat patients. A more efficient clinical delivery model could help offset this decrease in clinic time. Additionally, many dental schools are relying on increased clinical productivity to offset ever-increasing budget reductions. A cost analysis could be performed to determine which procedures are most profitable. It may be that indirect restorations are far less profitable, so to see a substantial increase in indirect restorations may not be best for the overall budget. Of course, students need these experiences, and our curriculum should not be dictated by dollars. However, it should certainly be a factor, and more studies are needed to address these challenges.

Conclusions

The hypothesis that the comprehensive care general dentistry model would lead to an increase in the number of restorative procedures performed as compared to a discipline-based model was supported. The comprehensive care model coupled with several other contributing factors led to an increase in senior students’ restorative dentistry productivity and appears promising for the future.

Acknowledgments

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REFERENCES