Clinical and Community-Based Education in U.S. Dental Schools

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Abstract: This review of U.S. dental schools' clinical curricula suggests that the basic structure of clinical education has not changed significantly in the past 60 years, although important developments include the introduction of competency-based education and community-based clinical education. Most dental schools still have a two-year preclinical curriculum and a two-year clinical curriculum, and most schools still operate a large clinical facility where students receive the bulk of their clinical education and assessment for graduation. In those clinics, dental students are the main providers of patient treatment, with faculty serving in supervisory roles. In addition, a major portion of the entire dental curriculum continues to be dedicated to student education on the restoration of a single tooth or replacement of teeth. This article was written as part of the project "Advancing Dental Education in the 21st Century."

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This article about DDS/DMD clinical curricula in U.S. dental schools will 1) review survey data on preclinical and clinical curricula; 2) examine preclinical education and student care of patients in dental school-based clinics and community clinics; and 3) provide an overview of evaluation methods used to assess students' clinical competence during dental school and for licensure after graduation. This article was written as part of the project "Advancing Dental Education in the 21st Century."

Preclinical and Clinical Curricula

In 1926, the Gies report described instruction in clinical dentistry this way: "In most dental schools, the instruction in clinical dentistry is notably successful, but it should be improved by an increase in the number of whole-time teachers and in both the applications of the medical sciences and the correlations with clinical medicine. A suitable extension of time for these betterments, and the subtraction of the corresponding hours from the large number ordinarily reserved for manual training, could have no perceptible effect on the digital dexterity of the student, but would certainly bring about pronounced improvement of his medical comprehension."[1]

The Commission on Dental Accreditation (CODA) each year requires accredited dental schools to complete the American Dental Association (ADA) Survey of Dental Education. Until 2012, the curriculum part of those surveys assessed the number of clock hours devoted to specific subject areas. Since 2013, the surveys have focused on program assessment outcomes as they relate to specific CODA standards. The 2010-11 survey found that the average dental school curriculum consisted of 4,910 total clock hours of instruction.[2] On average, there were 813 clock hours (16.6% of the entire curriculum) dedicated to biomedical sciences instruction, 352 clock hours (7.2%) dedicated to behavioral sciences instruction, and 3,743 clock hours (76.2%) dedicated to clinical sciences instruction. In the clinical sciences, dental curricula devoted an average of 915.8 hours (24.1%) to clinical didactic courses, 670 hours (17.7%) to preclinical laboratory courses, 1,915.4 hours (50.5%) to dental school-based clinic experiences, and 278.8 hours (7.6%) to community-based clinical experiences.

Preclinical and clinical sciences curricula can also be broken down into courses that teach the restoration of a single tooth or missing teeth and all other clinical courses, such as oral medicine, oral pathology, oral surgery, orthodontics, pediatric dentistry, and periodontics. On average, in 2010-11, dental curricula devoted 2,246 clock hours (60% of the clinical curriculum or 45% of the overall curriculum) to instruction in the restoration of a single tooth or replacement of teeth.[2] The 2015 American

Dental Education Association (ADEA) Survey of Dental School Seniors found that an overwhelming percentage (>93%) of graduating students responding to the survey reported feeling that the time devoted to courses associated with the restoration of a single tooth or replacement of teeth was appropriate.[3] In contrast, only 68% of those respondents felt that instruction in both practice management and orthodontics courses was appropriate.

With so much of the dental curriculum already devoted to clinical sciences, it seems that dental schools have a difficult time making substantive curriculum changes, especially in the addition of new technologies, interprofessional education/practice, evidence-based dentistry, and critical thinking. Even in the clinical sciences curriculum, we have observed that most schools struggle with decisions that require a reduction in curriculum hours devoted to one subject area to make room for hours in a new area. As a result, there has been only a small increase in the overall average number of curriculum clock hours: from 4,860 in 1999-2000 to the 2011-11 average of 4,910.[2,4] An example of this can be found in the difficulty that dental schools have had in adjusting to the expected additional need for general dentists to provide care for pediatric patients as a result of the Affordable Care Act and for special needs patients. Casamassimo and Seale as well as Clemetson et al. found that students were not getting adequate patient care experiences in all areas of pediatric dentistry and special patient care.[5,6]

Preclinical education focuses mainly on development of the physical skills necessary to prepare students to safely treat patients in the clinical years. Schools have created dental simulation facilities that use manikins as a simulated patient and recreate as much as possible the chairside delivery environment that students will experience in the clinic. Typically, students begin preclinical coursework during their first year of the curriculum and continue through their second year. The preclinical curriculum consists of a succession of progressively more complicated manikin-based assignments, challenging students to develop their skill levels to meet the patient care experiences they will encounter in the third and fourth years. In most schools, we have observed that the preclinical curriculum parallels the clinical curriculum. If students are expected to work only with specialists in the clinic, then they are taught in the preclinical courses in the same discipline-specific manner. Schools attempt to calibrate to the same standard all faculty members of the specialty department that teaches the preclinical and clinical courses. The specialty department defines the curriculum and the level of patient difficulty students will be educated to treat. In our experience, preclinical teaching labs are usually staffed with a ratio of one faculty member to eight to ten students.

It is our observation that even the most technologically advanced simulation laboratories still provide inadequate experience for the wide diversity of patient care treatment procedures that students will perform in the clinic. The silicone rubber and plastic teeth used in dental school simulation facilities do not adequately simulate a carious tooth, swollen or bleeding gingivae, saliva, tooth fractures, oral mucosa pathologies, or even the physical properties of enamel and dentin. Manikin teeth cannot be adequately etched or bonded with adhesives, and most impression materials used in the simulation lab are formulated to set best at body temperature, not room temperature. Faculty and students must use non-realistic modifications of treatment procedures to compensate for this lack of "high-fidelity" simulation. In addition, students are usually taught to treat only ideal conditions, typically preparing and restoring manikin teeth that have no previous restorations or caries. Students usually prepare manikin abutment teeth for fixed partial or removable partial dentures that are in perfectly aligned anatomic arch position. Because the simulated environment is usually focused on ideal treatment, students often find the variations that they encounter with their first clinic patients confusing and they are unprepared to adapt to the new condition.

According to Cederberg et al.'s study, some dental schools have added virtual patients to their preclinical curricula.[7] Cederberg et al. found in their 2011 survey that 63% of the 30 responding U.S. and Canadian dental schools utilized virtual patients, and 91% of those that used virtual patients perceived it was an important or very important addition to the curriculum. Reported virtual patient experiences ranged from patient scenarios as adjuncts to preclinical manikin exercises to computer-generated avatars that interact with students. Regardless of the method, the goal was to integrate behavioral, biomedical, and clinical sciences skills into realistic patient encounters. Virtual patients were also used to evaluate students' interpersonal skills, especially in interviewing patients and understanding ethnic and cultural issues. Table 1 shows the areas found in the Cederberg et al. study being used with virtual patients and percentages of the responding schools that used them.

We have also observed a recent development in which dental schools modify their curricula to allow for earlier clinic entry of students to more directly relate the simulation environment to actual patient care experiences. As a result, those students are having some clinical experiences in their first year. Advances in technology allow for live patient demonstrations that can be broadcast via video to all students simultaneously in the simulation laboratory. A multitude of demonstration videos, animations, narrated PowerPoint presentations, self-paced exercises, and other information from faculty, dental product manufacturers. and fellow students are available to students at the click of a mouse. However, in 2006, Victoroff and Hogan found that students at one school reported they learned more by watching a faculty member demonstrate a procedure one-on-one than from e-resources.[8]

Table 1. Areas in which virtual patients were utilized in 15 U.S. and Canadian dental schools in 2011

Area	Percentage
Demographics	73.3%
Medical history	93.3%
Dental history	93.3%
Vital signs	80.0%
Medications	93.3%
Radiographs	100.0%
Photographs	80.0%

Note: Question was worded as follows: "What parameters or patient descriptors have you used with virtual patients? (Please check all that apply)." Fifteen of the 30 responding schools answered this question.

Source: Cederberg RA, Bentley DA, Halpin R, Valenza JA. Use of virtual patients in dental education: a survey of U.S. and Canadian dental schools. J Dent Educ 2012;76(10):1358-64.

Education in Dental Schools' Clinics

The Gies report described clinical education this way: "Every dental school has an infirmary, which is the analogue of the hospital and dispensary in medical education. Direct chair-side treatment of patients, under conditions closely similar in all significant respects to those of private practice, has been a fundamental procedure in dental education since the establishment of the first dental infirmary in the Baltimore College of Dental surgery in 1846."[1]

From then until now, all dental schools operate a large dental clinic in which students receive the majority of clinical experiences that they need to become competent practitioners. In 2010-11, clinical care in dental school clinics represented about 2,000 hours of the overall curricula.[2] These clinics provide patient care by allowing dental students to exclusively provide, with varying levels of supervision, nearly 100% of the treatment.[9] This model results in an inefficient delivery of patient care and requires a significant subsidy from tuition and, in some cases, state support, to remain solvent. Faculty members act only as supervisors or "checkers" of the care provided by students.[10] A faculty member typically supervises six to eight students during a clinical session. With students as the main provider of care, many patients with complicated treatment or medical conditions are deemed inappropriate for dental students and are screened out as being unacceptable for care in the clinic. In contrast, in medical education, patients are assigned to an attending faculty member, and then medical students, residents, and attending physicians collaborate to provide care for the patient, with each doing so at the level of his or her preparation and ability.[11]

Holmes et al. reported, in 2003, that in most dental schools the clinical curriculum was taught by specialists in discipline-based courses or clinic sessions.[12] While comprehensive patient care was provided at most schools, patient care typically within the scope of a general dentist (prophylaxis, periodontal examinations, uncomplicated extractions, single canal endodontics, and removable and fixed prosthodontics) was often supervised by specialists. The majority of general dentistry faculty members supervised restorative dentistry care, sometimes limited to the direct restoration of teeth. We have observed that only a few dental schools (most of which were established after 2000) have general dentists as the majority of their clinical faculty and utilize them as the primary supervisors of all areas of comprehensive care.

Faculty members in dental schools typically supervise patient care provided by students through a laborious process of sequentially reviewing and approving a series of steps that lead to the completed procedure. Having a faculty member review and approve each step of a procedure extends the chair time and number of visits that patients must spend in the clinic to complete their dental treatment. Makarem and Coe found that only 42% of patients at one dental school clinic who had an initial examination remained a patient after two years.[13] Cost and

the inability to contact the patient were the most frequently cited reasons they found why treatment was discontinued.

Models of increased dental school clinic efficiency exist but appear to us to have made little penetration into dental schools. Two such alternative models are the Pennsylvania Experiment, which combined faculty, residents, and dental students, all practicing at the same time in the same clinic,[14] and Columbia University's New Provider Program that brought together third-year dental students with Advanced Education in General Dentistry (AEGD) residents.[9] In the Pennsylvania Experiment model, faculty members who supervised dental students also treated patients at the same time.[14] Formicola et al. outlined the benefits of utilizing community-based clinics as a more cost-efficient model of clinical education.[9] They found that students treated four to five times more patients on average at community-based clinics and were often more productive when they returned to the dental school clinic.

To compensate for inefficiencies in clinical operations and to attract an adequate volume of patients for students to attain competence, some dental schools have had to reduce procedure fees by 50% or more of Usual, Customary, and Reasonable (UCR) as reported, for example, by the University of Maryland and the University of Iowa.[9,15,16] This fee reduction leads to lower clinic revenues and widens the loss margin of dental school clinics. However, by offering lower fees, dental school clinics also play an important role in providing care to patients unable to afford treatment in private practices due to higher fees. For many of these patients, the dental school clinic has become their "dental home." This has created, in our experience, a shift in patient care at dental school clinics, from only utilizing patients for students to meet their clinical requirements for graduation to providing patients with preventive and comprehensive care over a lifetime.

Community-Based Dental Education

Dental schools have had a long history of placing students at community-based clinics for a portion of their clinical education.[9] For some schools, that reflected a need to enhance students' curriculum experiences in clinical areas such as pediatric dentistry or care for the elderly, another population group that could best be accessed by the dental school through outreach into the surrounding community. Other schools utilized community-based clinics as a necessity, in order to deal with class size expansion and the lack of additional dental school clinic capacity. As a result, these external clinical sites may have been recognized and accepted in their local geography as being part of the fabric of the community. In other situations, that recognition was not achieved or even sought after, and the sites were simply known as an extension of the dental school, located at a community site. More recently, we have seen new dental schools developed and constructed based on a plan of placing students in sites other than the school to receive a significant portion of their clinical experience.

From 2001 through 2010, community-based dental education was enhanced in 16 dental schools through the Pipeline, Profession, and Practice program, supported by the Robert Wood Johnson Foundation, with additional support provided by the California Endowment and the W.K. Kellogg Foundation.[17] This $25 million project sought to help dental schools establish community-based clinical education programs; integrate community-based experiences into their educational programs; strengthen course offerings in cultural content; and implement programs to increase recruitment and retention of underrepresented minority and low-income students. As a result, schools in this national program developed relationships with community-based health service entities, with students providing care at those sites. The sites involved in these collaborations were varied and included Federally Qualified Health Centers (FQHCs), hospitals, philanthropic and civic organizations, Department of Veterans Affairs health centers, and faith-based care centers. In their assessment of the Pipeline program, Atchison et al. found that the dental schools had developed collaborations with a wide range of health entities located in urban, suburban, and rural settings, serving a mix of ethnic, racial, and cultural cohorts.[18]

Reflecting this growing movement in clinical education to include community-based sites, in 2013 CODA adopted Standard 2-25, which states, "Dental education programs must make available opportunities and encourage students to engage in service-learning experiences and/or community-based learning experiences."[19] The intent statement endorsed the value of these experiences, noting "Service-learning experiences and/or community-based learning experiences are essential to the development of a culturally competent oral health

care workforce." These requirements are based on the idea that "interaction [with] and treatment of diverse populations in a community-based clinical environment" deepen students' clinical learning experience and can develop "a lifelong appreciation for the value of community service."

In this standard, the expectation that dental schools must make community experiences available for students is clear. However, the standard stops short of a mandate by only requiring that students be encouraged to engage in service-learning or community-based activities. Nevertheless, in the ADA's 2015-16 Survey of Dental Education, 92.3% of schools responded yes to the item "the institution requires community-based patient care experiences as a required component of the dental curriculum."[20] The same survey found that the mean number of days seniors spent in "community-based patient care" was 28.4.

The ADEA survey of the 2013 graduating class found that 82% "agreed or strongly agreed that the level of access to oral health care is a major problem in the United States."[21] A similar percentage of those seniors reported being satisfied or very satisfied with their extramural experiences. In 2000, U.S. Surgeon General David Satcher noted that "There are profound and consequential oral health disparities within the U.S. population."[22] That observation is still valid today. In this context, it is not clear what difference community-based education has made overall in the professional dental practice environment in alleviating the problems of access to care. One of the potential values of community-based education for students, however, is their exposure to populations that face challenges regarding access to care. In this way, students may see more clearly a common dichotomy in dental care: population cohorts least in need of care receive the most care, while cohorts most in need of care receive the least care.

Evaluating Student Competence for Graduation and Licensure

The ADEA competencies for the new general dentist, adopted in 2008, define a competency as "a complex behavior or ability essential for the general dentist to begin independent, unsupervised dental practice."[23] The notion of "competence" furthermore "assumes that all behaviors are performed with a degree of quality consistent with patient well-being and that the general dentist can self-evaluate treatment effectiveness."

The ADEA competencies for the new general dentist are designed as a guide for dental schools to the specific competencies needed to enter the profession. In this guide, 39 competencies are organized into six domains: 1) critical thinking, 2) professionalism, 3) communication and interpersonal skills, 4) health promotion, 5) practice management and informatics, and 6) patient care including a) assessment, diagnosis, and treatment planning and b) establishment and maintenance of oral health.[22] It is our impression that most dental schools have adopted these competencies either in their entirety or with some modification.

Traditionally, dental schools evaluated students' readiness for graduation by having them complete a minimum number of procedures in a variety of clinical areas.[24] The actual minimal number of required procedures varied from program to program and was determined by the faculty without any empirical evidence that the chosen number ensured competence. The major paradigm change from "counting procedures" to a competency-based curriculum required that dental schools shift away from requiring students to perform a minimal number of procedures and adopt authentic evaluation methods based on faculty judgment to assess independent performance in a realistic environment. A 2005 survey had found that most dental schools were still using a minimal number of required procedures combined with "competency exams" (test cases) as a determining factor for graduation. However, a 2009 survey, a year after the ADEA competencies were adopted, found sufficient evidence across the 50 U.S. dental schools participating in the study to conclude that "competency-based education is the accepted norm in dental education."[25]

In addition to graduating from an accredited dental school and passing Parts I and II of the National Board Dental Examination (NBDE), in order to obtain a license to practice dentistry in the 53 U.S. jursidictions (50 states, District of Columbia, Puerto Rico, and U.S. Virgin Islands), graduates are required in 46 jurisdictions to pass a patient-based examination (California, Colorado, Delaware, Minnesota, New York, Ohio, and Washington offer alternative examination or PGY-1 training for licensure).[26] Most states no longer administer their own licensure examination, but rather rely on one of five regional testing agencies to examine candidates. The five regional

examining agencies are the Central Regional Testing Service (CRTS), Council of Interstate Testing Agencies (CITA), Commission on Dental Competency Assessment (CDCA), Southern Regional Testing Agency (SRTA), and Western Regional Examining Board (WREB).

Despite recent efforts by the ADA, ADEA, and the American Student Dental Association (ASDA) to discontinue the patient-based licensure examination, it remains the primary pathway to licensure.[27-29] As a result, a significant amount of clinic time and student effort is dedicated to finding patients who will be approved for the exam and preparing for mock board and regional board exams. We have observed that the specificity of a narrow range of procedures for the exam often disrupts the continuity of comprehensive care for dental school patients and reinforces unnecessary delays in treatment.

Conclusion

A number of trends are evident in the clinical sciences education provided by dental schools. Clinical education accounts for over three-quarters of the entire dental curriculum, and most of the clinical curriculum focuses on developing the psychomotor skills necessary to restore and replace teeth. In preclinical education, students continue to spend a large amount of time and effort in lecture and laboratory courses taught by specialists, limited in the ability to simulate all areas of patient care that students will encounter and focused on restoring "ideal" situations that are not realistic examples of patient care. Dental schools have widely adopted attainment of competencies as criteria for graduation, but still struggle with the best methods to assess competence. As a guide for programs, CODA will need to continue to redefine which assessments are sufficient and appropriate to determine competence.

Patient care clinics remain inefficient in providing comprehensive care. Students act as primary providers with faculty acting only as supervisors of care. As a result, patients become frustrated with the multiple, long appointments to complete care and may terminate treatment prior to completion. The implementation of community-based education experiences has been found to have a positive effect on student productivity levels and provide a deeper understanding of access to care issues. However, the influence of these experiences on the practice choices of future practitioners has yet to be documented.

In addition to being inefficient in the delivery of patient care, there is evidence that dental school clinics are inefficient in providing education for dental students. The educational model these clinics use with faculty acting only as checkers is based more on teaching the technical aspects of performing a series of procedure steps and less on diagnosing, treatment planning, and understanding the outcomes of patient care. Students and faculty members tend to focus their attention more on the esthetic needs of their patients who are willing to accept treatment plans with implants, laminates, and multiple units of fixed prosthetics and less on patients who require primary care (preventive therapies, prophylaxis, extractions, and endodontics).

The outcome of the dental curriculum should be to graduate competent oral health care practitioners who can provide primary care services for a wide variety of patient needs and have the ability to adapt to whatever challenges they will encounter over their careers. We have the opportunity to make the next generation of dentists a cohort that leads an effort to have all Americans value and have access to oral health care services, not just those who can afford it or are seeking relief from pain. In order to do that, we will need to focus the efforts of the dental school curriculum on graduating dentists who utilize research, evidence-based science, and the health needs of the patient to determine patient care, not expert opinion and reimbursement patterns. Dental educators who are dedicated to graduating students with these attitudes and competencies will make a very worthwhile contribution to the oral and general health of all Americans.

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