Preserving the Pipeline: A Model Dental Curriculum for Research Non-Intensive Institutions

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Abstract: Current advanced degree and research training programs no longer attract adequate numbers of students. The present system of dental education severely limits the appeal of these programs due to overcrowded curricula and clinical components that operate in an environment segregated from the academic/research enterprise. To make research-oriented education/training programs more accessible and increase the number of interested students, the culture of dental schools and dental education must change. Programs for future dental researchers and academicians must be supported by curricula that foster an appreciation of research/discovery, an interest in academic/research careers, and the application of biomedical/clinical advances to practice. The Marquette University School of Dentistry has designed a comprehensive new curriculum that supports student research and scholarly activity throughout all four years of dental education. The curriculum minimizes discipline-based courses and is structured into interdisciplinary content tracks that integrate biomedical, behavioral, and clinical sciences while emphasizing the application of science to patient care. A specific research/scholarly track represents dedicated didactic time that exposes all dental students to material not traditionally included in dental curricula. This track includes mentored research/scholarly experiences at local and national sites that are individually structured for each student. Customized student schedules facilitate participation in these experiences without hardship or penalty. This curriculum structure may serve as a model for research non-intensive institutions seeking to increase student interest in academic and research careers.

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There are many opinions regarding the future of dental research and the role of research/scholarship in dental education.1-6 Many researchers and academicians contend that current funding and research training approaches maintain an adequate amount of research/research quality and provide opportunities to develop highly skilled faculty. However, most would also admit that some potentially serious problems have developed including: 1) numbers of current research/academic faculty and qualified future faculty in the pipeline; 2) integration of dental research into the larger world of science; 3) application of research to clinical practice; and 4) acceptance/ownership of research by the entire dental community.1-6 No data are available to determine the degree to which the current system has contributed to these problems. However, recent approaches have maintained traditional narrowly focused definitions of research/scholarly activity, the purpose of research, strategies for increasing the number of future dental researchers/educators, and methods of producing dental graduates who incorporate evidence-based philosophies into their practices.2,6

Until recently, the approach of the National Institute of Dental and Craniofacial Research (NIDCR) has been to increase resources and support for elite researchers and established research institutions in order to produce the “best science.” Funding for advanced degree and research training programs tends to favor “research-intensive” dental schools with large cores of funded investigators.2,5,6
Other dental schools are designated as “research non-intensive” and largely ignored. However, research non-intensive dental schools may be able to contribute to the national research/training agenda by operating educational programs that produce highly motivated students and function as significant “feeder sources” for advanced education/training programs located at research-intensive institutions or the NIDCR. To produce a dental school environment and culture in which new information is applied to patient care, support for science and discovery must be linked to the educational processes necessary to integrate new advances into clinical education.

The environment surrounding dental education has changed dramatically during the past twenty years. Contrary to many clinical specialty programs, current advanced degree and research training programs no longer attract adequate numbers of students. To make these education/training programs more accessible and increase the number of interested students, the culture of dental schools and dental education must change. The present system of dental education severely limits the appeal of these programs due to overcrowded curricula, lack of integration of biomedical and clinical sciences, and a clinical component that operates in an environment completely removed from the academic/research enterprise. Within this context, research and scholarship become an afterthought or something that is reserved for “warriors” who are willing to sacrifice their nights and weekends. There is no time for thoughtful reflection or application of science to practice. This is not an effective way to introduce students to the world of research/scholarship and does not foster an appreciation or desire for academic careers. Most successful researchers and academicians work long hours making many personal sacrifices; however, their primary motivation comes from a respect and desire for knowledge and/or discovery. This respect and desire must be nurtured in students before they will consider making any commitments regarding research and academic careers. Thus, the environment surrounding the career development and training system needs to be changed, not to improve the science, but to improve access, acceptance, and applicability of the science. These are primarily educational, institutional, and faculty development issues related to existing curricula and cultures.

The current NIDCR R25 Oral Health Research Curriculum grant mechanism represents an incentive to think differently by providing new opportunities for research non-intensive schools to contribute to the scientific future of the profession. Schools without large research infrastructures may be able to make significant contributions to the national agenda by establishing specific curricular elements that change the culture of dental education in such schools. This new model of dental education must incorporate research into the daily routine, integrate dental research and/or models into research disciplines within the larger university environment, persuade faculty to participate in more broadly defined scholarly activity, encourage faculty/students to monitor and embrace the latest science, provide students with hands-on training and appreciation for research, and produce graduates likely to apply evidence-based strategies to their practices. Within this context, the notion of scholarly activity is extended broadly to encompass innovation in educational methodology, curricular content/organization, evidence-based clinical approaches, and use of new technologies. The goal is to create an environment that facilitates entry into academic and research careers by providing time for meaningful research training as well as integration of basic/clinical sciences and evidence-based approaches into the four-year dental curriculum. This approach represents a national strategic advantage because it provides a very defined and important role for research non-intensive institutions. Every dental school should play a part in setting up a national infrastructure that attaches value to research, evidence-based practice, and career development/training programs.

A Model Dental Curriculum for Research Non-Intensive Institutions

The Marquette University School of Dentistry (MUSoD) is creating a new curriculum organized around nine educational “tracks” (didactic and clinical) that span the entire four-year program. The tracks represent integrated multidisciplinary/interdisciplinary content sequences and are being developed by utilizing team teaching, bringing together multiple specialties and health sciences to deliver content, and presenting biomedical science principles with relevant clinical correlations. Additionally, there are significant early clinical experiences designed to emphasize the application of didactic material to patient care.
care. The final educational track (Integrated and Applied Sciences) consists of faculty-facilitated small groups where students present cases and defend their diagnosis/treatment decisions based on the best evidence in the literature within a “dental rounds” format. The rounds serve as an ongoing teaching/learning tool that integrates and reinforces material from other curriculum tracks and facilitates comprehensive competency-based student assessment minimizing multiple competing examinations.

The most important part of the curricular design relative to changing institutional culture for support of research and scholarship is a dedicated research/scholarly track. Time for the research/scholarly track has been carved out of the curriculum and fully dedicated to didactic content and mentored student experiences. The didactic portion of this track is not optional and will expose all students to various aspects of research/scholarship throughout all four years of their dental education. The major goals of the dedicated research/scholarly track are to foster an appreciation of research/discovery, stimulate interest in academic/research careers, and facilitate the application of biomedical/clinical advances to practice. Didactic topics include careers in dental research/academia, postgraduate education/training opportunities, informatics/information resources, scientific literature, scientific writing, research design, research ethics/integrity, biostatistics, and genetic testing/risk assessment. Additionally, students receive instruction and complete learning exercises in many areas of biomedical, behavioral, and clinical sciences as they are applied to state-of-the-art patient care. The track provides twenty hours of didactic information for all students during each semester over the entire four-year curriculum (160 total hours).

Mentored student research/scholarly experiences are available to all interested students that maintain satisfactory academic and clinical progress. These experiences range in duration from one to three months and are provided by faculty from MUSoD and other partner institutions. Interested eligible students meet with the associate dean for academic affairs to design a customized schedule that rearranges their participation in all other curriculum tracks such that 100 percent effort can be dedicated to the research/scholarly experience. Research experiences include evidence-based reviews of current controversies in dentistry, development of innovative curriculum elements/teaching approaches, and basic biomedical projects that are part of established research programs. Scholarly experiences include activities associated with certificate or masters degree programs at Marquette University. These experiences are defined within very broad parameters to allow pursuit of targeted areas of interest and development. The new research/scholarly track facilitates access to these areas during regular daytime hours such that coursework is not limited to nights and weekends to avoid conflicts with the dental curriculum.

The research/scholarly experiences are chosen from a menu of local and national mentors. The local mentor network is comprised of faculty from various units of Marquette University (College of Health Sciences, Graduate School, Schools of Dentistry, Engineering, Nursing, and Education) and the Medical College of Wisconsin. Participating national sites include several research-intensive dental schools and the NIDCR intramural research program. The inclusion of a large network of national sites is critical for expansion of the limited research infrastructure at MUSoD. Outsourcing mentorship to take advantage of established investigators and facilities provides MUSoD students with high-quality experiences while the local infrastructure continues to be developed and improved. Fortunately, some research-intensive dental schools and the NIDCR have committed to this collaboration by making these opportunities available to MUSoD students. All students participating in local mentored research experiences are required to attend weekly seminars where students discuss their research projects, problems encountered during the research efforts, and any project data/outcomes.

It is important to note that mentored research/scholarly experiences will continue to be available for one- to three-month periods each academic year. If a student were to pursue a three-month mentored experience every year, one entire year of the four-year dental education program would be devoted to research/scholarship. The total length of the educational program remains at four years regardless of the amount of time spent on mentored experiences. Time for mentored experiences is obtained from other curriculum tracks through customized scheduling based on student performance and clinical abilities. Figure 1 represents an overall curriculum schematic illustrating the research/scholarly track and other curricular elements.

When fully implemented, the new MUSoD curriculum will be comprised of nine educational
The research/scholarly track (number 7) provides twenty contact hours of information for all students during each semester over the entire four-year curriculum (160 total contact hours). For all eligible students, time for one three-month mentored research/scholarly experiences is taken from the other tracks through customized scheduling based on student academic performance and clinical abilities.

At present, the concept of a dedicated research/scholarly track is unique to MUSoD. Other research non-intensive dental schools have utilized parts of this approach as elective or alternative student experiences and reported positive impacts on student attitudes toward careers in academic dentistry. It is anticipated that the MUSoD approach will have a significant effect because it provides research/scholarly content through dedicated curricular time that is compatible with clinical experiences and facilitates clinical applications and positive student experiences. Additionally, the approach differs from other curricular reform efforts where institutions attempt to retrofit traditional research components with no regard for providing the necessary curricular time and mentorship required for them to succeed.

The placement of extended mentored research experiences into the regular dental curriculum is particularly significant for research non-intensive institutions. Most other dental schools currently provide these experiences outside normal curricular hours. There is one example in the medical literature of extended research experiences placed into the regular curriculum and two examples in the dental literature of comprehensive scholarly curricula at research-intensive dental schools that utilize problem-based learning to provide a connection between research and clinical practice. Evaluation of these curricula indicates that a large majority of students demonstrate an increased ability to formulate hypotheses, conduct literature searches, critically evaluate the literature, and write research papers. Additionally, students from these institutions are as well prepared for clinical practice as those from in-

Figure 1. The new MUSoD curriculum, with its nine educational tracks.
stitutions with traditional curricula. A recent study demonstrated that a research experience is an important factor in the choice of a career in academic dentistry. Thus, there may be significant benefit to changing the curriculum in research non-intensive institutions to enable greater numbers of students to take advantage of mentored research/scholarly experiences.

Current Progress: Evidence of Cultural Change

The new curriculum was initiated during the 2001-02 academic year for the class of 2005 (other classes remained on the old system). As that class progresses through the new format, subsequent first-year classes will be included in a stepwise fashion until all dental classes are participating in the new curriculum (classes of 2005 through 2008). Content sequences for each year are implemented for the class of 2005 as it progresses through the four-year educational program. The reorganization of the curriculum into tracks, creation of a dedicated research/scholarly track with an independent budget, and establishment of a formal faculty development program to support the new curriculum constitute large internal changes for MUSoD. Additionally, the new curriculum requires significant resources with regard to faculty time/training, development of curricular materials, and program evaluation. This initiative would not have been possible without significant funding in the form of two grants (U.S. Department of Education Fund for Improvement of Postsecondary Education and the NIDCR Oral Health Research Curriculum). These grants provide approximately $1 million for faculty salaries, faculty development, technology, and curriculum materials over a six-year period.

Mentored research/scholarly experiences of one to three months’ duration have been successfully piloted for six dental students over the past two years including an NIDCR Intramural Summer Fellowship that resulted in a first place award at the 2002 Hinman Student Research Competition. Prior to 2001, no MUSoD student had ever participated in such a formal mentored research experience. Preliminary results for the current freshman class (eighty students) indicate a significant increase in the number of students interested in mentored research/scholarly experiences (fifteen students in the current class compared to five students in the previous class). Applications and acceptances for the 2003 NIDCR summer program also increased significantly (five applicants/two acceptances in the current class compared to one applicant/one acceptance in the previous class).

The first formal evaluation of the effectiveness of the new curriculum is currently being completed. The class of 2005 was surveyed during and following the first academic year. Initial data was collected utilizing questionnaires, and the results were used to develop a series of questions for focus groups. At the beginning of the next academic year, students in the 2005 curriculum cohort were surveyed again regarding whether curriculum milestones had been met. Additionally, students were given a comprehensive content examination that covered the didactic components of the first year. These same students will undergo a comprehensive assessment of clinical components this year utilizing a series of skill assessments and an objective structured clinical examination (OSCE).

Results of these various assessments indicate a high degree of satisfaction and confidence on the part of this initial cohort of students. They indicated that: 1) the new curriculum was rigorous but fair; 2) the new integrated courses provided an excellent view of dentistry but needed better organization; and 3) the early clinical exposure they received made the didactic material more relevant. When specifically asked about the curriculum milestone for research, 74 percent of the students were confident of their skills in this area, and 89 percent felt the milestone had been met and reinforced/applied in the integrated courses and dental rounds. The content exam that was administered indicated that 73 percent of the students had competency in the research aspects of the exam, thus validating student perceptions. This is in direct contrast to current senior students in the old curriculum cohort, who when given the same content exam only demonstrated 30 percent at the competency level.

The development of a new dental curriculum provided MUSoD with a unique opportunity to design and implement a comprehensive research/scholarly track for dental students. This track provides dedicated time for content and mentored research/scholarly experiences at local and national sites during all four years of dental education. Thus, the traditional culture of an institution that regarded re-
search and scholarly activity as an add-on or afterthought is shifting to a new culture where research and discovery are an integral part of the educational experience and a necessary component of clinical practice. The research/scholarly track will serve to transform dental education at MUSoD, and the newly created curriculum element could be implemented at other dental schools nationwide.

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