Innovation and Entrepreneurship

The Dental Enterprise: Its Transition from Xenodontic to Biodontic Dentistry

When patients visit a dental office they expect a diagnosis and resolution of the problem. They expect to leave the office with their problem solved completely, with minimum physical and psychological discomfort, and at a reasonable cost. The success of a dentist in providing oral health care quickly, completely, painlessly, and at a reasonable cost requires the collaborative effort of what can be referred to as the dental enterprise. In the United States, the dental enterprise includes the dental industry, dental schools, dental provider associations and organizations, and a number of dental government agencies. It is through the cooperation of this enterprise that dentistry is able to provide oral health care to the American people. The necessity for cooperation among the components of this enterprise cannot be overemphasized, since good oral health is vital to the quality of life of each citizen. Reciprocally, the good oral health of citizens is vital to our nation's economy. In addition, maintaining the oral health of our armed forces is an absolute for national defense.

During the 20th century, the dental enterprise cooperated on developing methods, techniques, and materials for the repair and restoration of lost tooth structure and for the replacement of lost teeth. For most of that century, repair, restoration, and replacement (the 3Rs of dental practice) were accomplished using metals of various types (gold and amalgam), plastics (acrylics), ceramics, and rubber for dentures. These materials are nonbiological, or foreign to the body, and because the Greek word for foreign is *xeno*, I will refer to the practice of dentistry during this period as the practice of *xenodontic dentistry*.

Edward F Rossomando, DDS, PhD, MS
Professor and Director
Center for Research and Education in Technology Evaluation
University of Connecticut
School of Dental Medicine
Farmington, Connecticut
erossoma@nso2.uchc.edu

Xenodontic Dentistry

The components of the dental enterprise cooperated in the development of xenodontic dentistry during the 20th century. Dental schools taught it, the dental industry manufactured and distributed the products for it to function, and dentists used these products to provide care to patients. The National Institute of Dental and Craniofacial Research (NIDCR), the research component of the dental enterprise, provided financial support for research, which emerged new or improved products, equipment, and procedures to enhance xenodontic dentistry. In addition, the NIDCR funded clinical trials and programs to train the next generation of scientists and teachers for dental schools.

During the second half of the 20th century, a series of discoveries from basic science laboratories suggested that the era of xenodontic dentistry might end. One of the first papers to support this was in 1953 when the structure of DNA, the hereditary material of life, was elucidated.[1] Additional support came about 50 years later when the sequence of the human genome was published in 2000.[2,3]

As this milestone was reached, many in the dental enterprise began to envision a new era in dentistry: one in which xeno-materials were replaced by bio-based materials to repair and restore tooth structure and replace teeth lost to disease. I will refer to the practice of dentistry during this new era as the practice of *biodontic dentistry*. The introduction of bio-based materials into dentistry was more difficult than anticipated. Some segments of the dental enterprise were invested in xenodontic dentistry, and the introduction of biodontic dentistry would be disruptive because it would require displacing elements supportive of xenodontic dentistry.

The Dental Enterprise and Technologies

Mapping the sequence of the human genome, though a milestone for the scientific establishment, appeared to have little or no effect on the dental industry, dental education, or dental practices. To understand why it did not result in the mobilization or unification of these components of the dental enterprise, it is helpful to appreciate the difference between revolutionary and evolutionary innovations.

The necessity for cooperation among the components of this enterprise cannot be overemphasized, since good oral health is vital to the quality of life of each citizen.

A clear example of a revolutionary innovation is the flight of the Wright brothers' 1903 Flyer, an event that ushered in a new industry. This innovation was accepted so rapidly that in less than 100 years, that original flight of about 40 yards at Kitty Hawk evolved into a spacecraft, a flight that brought us hundreds of thousands of miles into space. A reason this innovation was accepted so readily and evolved so rapidly was that it was revolutionary. There was no preexisting aviation enterprise; therefore, acceptance of the Wright Flyer did not require the displacement of a preexisting form of flight. The acceptance of an innovation becomes more difficult if it must displace an existing enterprise.

Did mapping the sequence of the human genome represent a revolutionary event? And did its acceptance by the dental enterprise require the displacement of preexisting manufacturing, educational, and oral health delivery activities? Not necessarily. Although it is true that this event represented what is, without argument, the first step in what will eventually become biodontic dental practices and the displacement of xenodontic dental practices, the acceptance of this innovation should be described as an evolutionary step, one of many the dental enterprise has taken as the 20th century was traversed.

Like any evolutionary step, adaptation will be required of the dental enterprise. Manufacturers must recognize the need to adjust their products, and educators must redo their curricula. As a result of the transition from xenodontic to biodontic dentistry, dental offices will not have to change the services they provide in any drastic way. Their responsibility will remain to repair, restore, and replace teeth and tooth structure lost to disease. What will change is how they do this. Instead of using xenodontic materials like metals, plastics, and ceramics, they will use biodontic materials like those derived from stem cells or other biologically obtained materials. It will be the ease of use, the opportunities for greater success, and the enhanced patient satisfaction that will drive the transition from xenodontic to biodontic dental practice.

Transition from a Xenodontic to Biodontic Dental Practice

Most evolutionary changes take time. The amount of time depends on what is evolving. In the case of mammals, evolution can take many generations. In the case of bacteria or viruses, changes can occur in 1 generation. Based on the historical trends of acceptance time for innovations in dentistry, the transition from xenodontic to biodontic dental practices might be expected to take several generations. This would be true if not for 1 critical factor: the intellectual level of the students entering dental schools today. These students are not only more "cyber savvy" than previous generations, but they enter dental school with a better biological background than before, and they are taught more biological science in dental school than before. As a result, the use of biodontic products for repair, restoration, and replacement is more acceptable to them than the use of xenodontic products.

Fortunately, there are those in the dental enterprise who have recognized this change. Several schools have already altered their curricula to increase the number of basic science hours. Some dental manufacturers have acquired biotech start-ups, recognizing that the need for biodontic materials will increase as soon as these students graduate. Some manufacturers, recognizing the rapid rate of change, have joined with dental schools in ventures that promote the use of new biodontic products and equipment by the students.

For example, at the University of Connecticut School of Dental Medicine, the dental students in the Connecticut chapter of the Biodontic Society have set up an interest group for exploring the use of new equipment and products. With the support of the dental school's administration and other dental companies, these students have acquired space and solicited products and equipment to be tested. In addition, student chapters of the Biodontic Society are being formed at other dental schools with the expectation that Product Evaluation and Research Laboratories (PERLs) will be formed.

Given the role of dental students as agents of change and the support of all components of the dental enterprise, it should come as no surprise that the transition from xenodontic to biodontic dental practice may take less than 1 generation.

References

1. Watson, JD, Crick, FHC. A structure for deoxyribose nucleic acid. *Nature*. 1953;171:737-738.
2. National Institutes of Health. "Working Draft" of human genome announced at White House. The NIH Record [serial on-line]. Available at: http://www.nih.gov/news/NIH-record/08_08_2000/story03.htm. Accessed May 8, 2000.
3. Venter, JC, Adams MD, Myers EW, et al. The sequence of the human genome. *Science*. 2001;291:1304-1351.

Dental students interested in starting a chapter of the Biodontic Society at their school are asked to contact Dr Rossomando at erossoma@nso2.uchc.edu.