Implementation of a New Advanced Graduate Education Program in Oral Implantology

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Abstract: The academic program for the Harvard School of Dental Medicine's Advanced Graduate Program in Oral Implantology is based on scientific evidence applied to educational quality, translational research, patient care, and service. The objective of the program is to enable highly motivated individuals with proven scholarship and excellence in patient care to achieve academic leadership in the clinical and scientific fields of implant dentistry and tissue regeneration. A detailed curriculum describing the academic program, as well as a business plan (which included a management plan describing the organizational structure, financial implications, and market forces) and implementation and communication plans, were developed before moving forward. With careful academic and business planning, the result was a vibrant implant program, in which all placements and restorations of implants are coordinated with regard to practice management. The program is integrated into the existing clinical care model and has been financially self-sustaining from its inception. Six students have participated in the last two years. On average, each student performed seventy-nine procedures on twenty-nine patients, generating over $46,000 in production. The curriculum includes didactics, hands-on clinical learning, and research activities. Research is a critical component as well. The results demonstrate that the time taken to develop a detailed curriculum and business plan for a new academic program, which anticipated and resolved potential barriers to success, was instrumental in the successful implementation of an oral implantology residency program.

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Founded in 1867, the Harvard School of Dental Medicine (HSDM) was the first university-based dental school in the United States. HSDM trains both predoctoral dental students and postdoctoral dental residents. The school is a national leader in dental education, with graduates assuming leadership positions in the dental profession. The Harvard Dental Center (HDC) is a "school within a school." Patients can receive dental care at the Teaching Practice, where treatment is delivered by predoctoral dental students and dental residents, or at the Faculty Group Practice from Harvard faculty care providers. In 1996, the HSDM expanded and remodeled the facility used by student dentists. Today, the Teaching Practice at the HDC is a state-of-the-art facility with well-equipped operatories, modern technology, and sterilization equipment. Student dentists, supervised by Harvard faculty, provide comprehensive care to patients in the fields of general dentistry, periodontology, prosthodontics, endodontics, orthodontics, and dental hygiene.

Until recently, the periodontology faculty members and their residents placed most implants, while some of the prosthodontic faculty members and their residents performed the restoration of implants. Neither a formal clinical implant program nor a formal teaching implant program existed at the school. Placement of implants was performed in two clinical settings: the operating rooms and the operatories assigned to the periodontal residents. Restoration of implants was performed at the operatories assigned to the prosthodontic residents. The HDC appeared to be a natural clinical setting for a formal academic implantology residency program at HSDM. Private faculty members complete 25,000 patient visits per year, and advanced graduate education (AGE) residents see patients with their supervising faculty in this modern and recently renovated setting. After providing an overview of the development of implant dentistry and implant education programs, this article will describe the new advanced graduate education program in oral implantology at HSDM.

Implant Dentistry

Implants were introduced in dentistry in the late 1800s with limited success, and it was not until the late 1930s that modern implant technology and terminology were developed.[1] Extensive documentation by Brånemark in 1977[2] marked the beginning of a new era for dental implants, and the 1980s saw a true popularization of the technique. In 2005, dental implant and bone graft procedures were projected to approach $3.5 billion by 2010.[3] The current economic slowdown[4] has affected the dental market. However, it is expected that the U.S. dental implant market will recover after 2011 and exceed $1 billion by 2013.[5] The implant market continues to be driven by the aging of the population, technological advances, public acceptance of the techniques, and an increasing number of general dental practitioners and specialists incorporating implantation and bone substitution into their practices.[5,6] Consequently, the specialized training of dental specialists who have the skills, knowledge, and interest in oral implantology seems justified.

Implant placement is routinely integrated into periodontal and oral and maxillofacial surgery residencies.[7-9] In 2005, the American College of Prosthodontists added placement of implants to its accreditation standards for advanced specialty education programs in prosthodontics.[10] Additionally, general practice residencies may offer this training.[11,12] Many dental schools include implant placement in their predoctoral dental curricula, often with the caveat that the cases are straightforward or done using simulation and that placement is done under substantial supervision by trained dentists and oral and maxillofacial surgeons.[13-16] The First European Workshop on Implant Dentistry University Education, as well as the British Society of Prosthetic Dentistry's Education Group, are suggesting the integration of implant training into predoctoral dental curricula.[17,18] In 2009, a survey of 1,505 American endodontists found the majority believed that implant placement is within the scope of their practice and that the time has come to consider whether formal implant training should be incorporated into endodontic curricula.[19]

The increased interest in integrating implant dentistry into existing graduate programs, as well as into predoctoral curricula, has raised the question of whether a separate implantology program is necessary and sustainable. Melo et al.[8] reported that more than a quarter of the U.S. oral surgery residents they surveyed felt inadequately prepared by their residency training, even though almost all believed that implant placement will be an important part of their future practice. Brandt et al.[20] noted that few general dentists who attended an intensive continuing education course in implant placement chose to actively participate in implant placement. Donos et al.[21] noted that there were qualitative and quantitative differences between industry-driven training courses and university-based curricula. A trained specialist will be able to address and manage the often complex biological, as well as esthetic, situations presented. The well-trained implant dentist will have a good understanding of the bone and soft tissue biology; the prosthetic understanding necessary to insert implants in a restorative-driven position; and the skills to perform a low-trauma surgical technique that will not overstress the healing potential of oral tissues.[22] Advanced academic training in implant dentistry will allow the clinician to become proficient in both the surgical and prosthodontic aspects of implant-supported restorations.

Design of the Academic Program

The objective of the HSDM Advanced Graduate Program in Oral Implantology is to enable highly motivated individuals with proven scholarship and excellence in patient care to achieve academic leadership in the clinical and scientific fields of implant dentistry and tissue regeneration. The two-year program leads to a certificate in implant dentistry, although the department may consider M.M.Sc. or D.M.Sc. opportunities individually upon request. However, combining such degrees requires an additional time commitment beyond the two years.

Given the emphasis on developing leaders and research activities, HSDM is in a unique position to attract three groups of implant students: 1) dentists interested in pursuing a career in research in implantology and tissue regeneration who prefer to combine major research time with a school-based faculty practice limited to implant care; 2) dental specialists interested in expanding their knowledge about implantology who desire a degree to ultimately obtain a leadership position in an academic setting; and 3) clinicians interested in moving away from the demands of a private office setting who want to become researchers and teachers in a new phase

of their careers. Resident selection was based on the principles that applicants must have a D.M.D., D.D.S., or equivalent diploma and at least two years of advanced graduate education in a dental specialty or a minimum of three years' professional experience.

Clinical activities take place in the Faculty Group Practice of the HDC and at affiliated institutions. Implant fellows are exposed to both the surgical and restorative aspects of implant dentistry, with special attention to patient care under comprehensive treatment planning. Formal coursework and seminars are a required component of all certificate programs at HSDM. Implant residents are required to attend the oral biology core course series and other basic science courses. In addition to the mandatory implant curriculum, these residents must attend courses in biostatistics, epidemiology, health care management, and related topics. The didactic components are delivered in core modules throughout the two-year program (Table 1). Each module is presented under the concept of evidence-based dentistry, and material is covered in lectures, workshops, laboratory activity, and literature reviews. Additional lectures from the HSDM AGE course catalogue are also offered. Didactic courses include training in digital dental photography and speaker development.

From the beginning, it was decided that existing HDC faculty would staff the program. Only HDC-credentialed dentists who are part of the full-time Faculty Group Practice and are privileged by HDC to provide implant care are allowed to oversee the implant program residents with regard to implant placement. Faculty members who are credentialed as prosthodontists are allowed to oversee the restorative process. Part-time faculty members overseeing the implant residents and fellows are HDC-credentialed, part-time faculty and are privileged by the HDC to provide oversight in implant care. At all times, appropriately credentialed and privileged part-time or full-time faculty members supervise when residents and fellows are providing implant care.

The responsibilities of the program director are defined in detail. The program director is responsible for the organization and execution of the educational and administrative components of the program and participates in the student selection process. The director develops and implements the curriculum to provide a diverse educational experience in biomedical and clinical sciences. The director maintains a record of the number and variety of clinical experiences accomplished by each student and ensures that the faculty members assigned to the program are educationally qualified implant dentists. In addition to preparing written faculty evaluations at least annually, the director conducts periodic staff meetings. Lastly, the program director maintains adequate records of clinical supervision and coordinates residents' research activities with basic science mentors.

Business Plan

The next step in designing the program was the development of a business plan. As Campbell noted, a good planning process is mindful of both analytic techniques and organizational processes that fit the individual business and the skills of the manager.[23] We worked together closely to develop the business

Table 1. The didactic components for the implant course

Didactic Block	Module 1	Module 2	Module 3
Diagnostic and Treatment Plan	• Introduction to Implant Dentistry • Medical History Review • Radiographic Evaluation	• The Implant Team • Comprehensive Restorative Exam	• SAC Classification • Esthetic Evaluation • Site Assessment
Implant Placement	• Biological Principles • Implant Design	• Tissue Integration • Implant Surfaces Osseointegration	• Implant Placement Protocols • Grafting Techniques
Implant Prosthodontics	• Implant Abutment Interfaces • Single Implants • Digital Impressions	• Loading Protocols • Implants in Partially Edentulous Patients • CAD/CAM	• Esthetic Implant Rehabilitations • Implants in Fully Edentulous Patients
Management of Complications	• Risk Factor Analysis	• Biological and Technical Complications	• Resolution of Implant Prosthetic-Related Complications

plan and plan its implementation. The assistant dean of clinical affairs functioned as the strategy officer: she had the responsibility of clarifying the strategy to the school's leadership, the faculty, and all employees and ensuring that everyone understood the plan's details and how it connected to the school's overall goals. Second, she drove the immediate change, moving from creating shared alignment around a vision to ensuring successful implementation.[24] Following Mitlyng et al.'s suggestions,[25] we "hedged our bet" during the roll-out of the plan in order to set the stage for possible future adjustments to the program by stating that revisions will be likely as the program develops; including an annual review of the program's clinical and financial performance; and informing all affected by this new program that they will be asked for continuous feedback.

As Sahlman has noted, a good business plan should not focus merely on financial projections, but should include an analysis of the people involved, the market opportunity, the context in which the plan fits, and a risk-reward analysis.[26] Our business plan was developed in several major sections: the academic program and clinical management program; an implementation plan; a communication plan; and evaluation and outcomes measures. The academic program described the objectives of the program, the selection process for its residents, the didactic component, the curriculum, the responsibilities of the program director, and the faculty involved. The clinical management program described the vision and organizational structure of the program, the impact on clinical operations, the financial plan for the program, and a market analysis. The research agenda and fund development approach were developed in parallel, but were not part of the business plan.

Clinical Management Program

Vision and goals. We envisioned the development of a vibrant implant program at the HDC, in which all placements and restorations of implants are coordinated with materials management, chair utilization, patient management, finances, and personnel. Specific goals included facilitating the development of specialized clinicians who would be on track to become future academic leaders in the implant field; creating a setting within the HDC for clinical trials originating from basic as well as translational research; and capturing questions that arise from patient care with the potential to be addressed through scientific research.

Strategic position. HSDM's core mission is to develop and foster a community of global leaders in order to advance oral and systemic health. This mission encompasses a vision to set the standard of excellence and define the future of dental education, practice, and research. As such, a one-year residency program to develop the clinical skills of practitioners is not part of its core mission. Rather, HSDM aspires to develop leaders in implantology and further scientific pursuit in this area. Consequently, the HDC is not only the setting for clinical implant care but for translational research as well, where chair-side research is intrinsic to the implant program. Chair utilization reflects clinical care provided by residents and faculty, as well as extended time necessary for research activities.

The HDC has been well situated to house this exciting clinical program. The 2008 refurbishment of the faculty practice, where the implant residents practice, allows for a pleasant and professional setting. Although the HDC is located in an urban setting with traffic and parking as barriers to attracting patients, its immediate location includes other health care institutions as well as transportation options that improve access for its targeted population. Pricing for services provided by the implant fellows is set between pricing for services provided by postgraduate residents and faculty members.

Organizational structure. The organizational structure (Figure 1) has the implant program director reporting directly to the chair of the Department of Restorative Dentistry and Biomaterial Sciences and working closely with the chair of the Department of Oral Medicine, Infection, and Immunity, the program director of the Oral and Maxillofacial Surgery Program, and the dean for education. Additionally, the implant program director will work closely with the director of clinical operations for daily clinical activities and will inform the HDC Operations Committee of the program's progress as is required by all program directors. The Materials Management Committee is the HDC mechanism to discuss, suggest to the Operations Committee, and sign off on the choice of all materials, including implant systems and other necessary materials.

The program also has an implant coordinator who reports to the HDC clinic manager and has dotted line responsibility to the implant director. The program has an assigned dental assistant, and during the two evening clinics, interested dental students may also be recruited to assist. Additionally, as part of the other AGE residents' curriculum, it is pos-

sible for first-year periodontology or prosthodontic residents to observe and/or assist the senior implant resident. The implant fellows are an integral part of the implant program, the only difference being their funding source. The assistant dean for clinical affairs oversees the HDC, and all clinical issues ultimately report to this position.

Clinical operations. The clinical application of current trends and cutting-edge technology is ensured by the extent, the comprehensive approach, and the clinical research conducted in the implant program. All implant care is provided in two designated implant operatories and the operating rooms. Other staff members are one full-time dental assistant trained to assist with implant care and one full-time implant coordinator who oversees inventory management, efficient chair utilization, and consistent and courteous collaboration among all parties involved.

As a first step in the clinic's financial plan, assumptions were drafted, tested, and agreed upon by the program director and assistant dean for clinical affairs, and later by the dean of finance and administration and the Clinical Operations Committee as part of the sign-off process. Assumptions included the following: no revenue growth for the first few years; actual implant and other lab expenses covered by the HDC; one full-time implant coordinator already in place, who would spend some of her time in the implant program; one full-time dental assistant to be added to the new implant program; and salaries, fringe benefits, and overhead as per Harvard University current standards.

A break-even analysis using data from July 1, 2006, through June 30, 2007, was performed assuming implant/prosthetic treatments, but excluding conventional prosthodontic care. Costs included the device but not any restorative materials. Fixed costs included the HDC staff directly related to clinical care for implant patients, overhead charged by the university, and general fixed costs. Additional overhead (sterilization and dispensary costs, management cost, building costs, etc.) was not part of the break-even analysis. The analysis showed that if fifty-two implants are placed each month, the HDC would break even for the program (Table 2).

Once the break-even analysis was completed and the monthly break-even target was considered reasonable, a profit and loss statement was developed for the program using revenue data from 2007, projecting forward for 2009. Sources of revenue for the clinical part of the program were determined to include dental insurance and self-pay (Table 3). Capital needs, absorbed by the HDC, included the fitting of two operatories, additional forms and treatment fees for the electronic dental record, and augmenting current instrumentation.

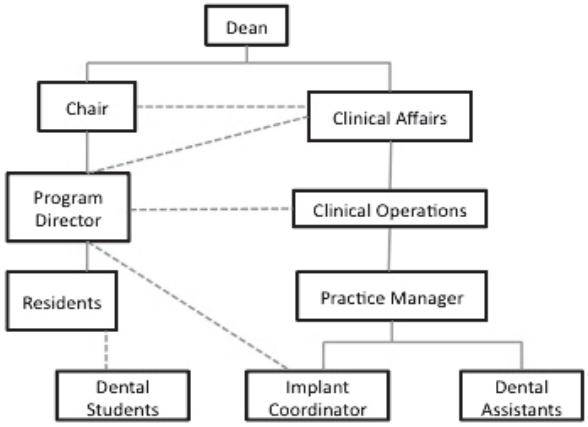

Figure 1. Organizational chart

Table 2. Break-even analysis for FY 2009

Monthly units break-even	52
Monthly revenue break-even	$53,055
Assumptions:	
Average per-unit revenue	$977.00
Average per-unit variable cost	$526.00
Estimated monthly direct fixed cost	$23,335

Market analysis. The primary market for dental implantology is the increasing elderly population, who account for the majority of patients suffering from total or partial edentulism. There are between fifty-five and sixty-five million people with total or partial edentulism. Due to the larger number of people missing teeth and the rapidly growing population of older individuals, the patient caseload that could benefit from implant-based dental restoration is substantial. Population growth, particularly significant in the older population, and changes in dental, health, and lifestyle trends are all factors that will affect the dental implants market.[6]

HSDM mainly serves the Boston area, which had a total population of 589,141 in the 2000 census.[27] Over the next ten years, the fifty-five to seventy-four age group was expected to grow by 30 percent, while the thirty-five to fifty-four age group was expected to expand by only 10 percent.[6] For 2008, an estimated

Table 3. Projected profit and loss statement for new implant program

	FY 2007	FY 2009	FY 2010
Income			
Tuition and fees	$91,800	$183,600	$183,600
Clinic revenue collected	82,407	164,814	164,814
Research net 35%	7,000	7,000	7,000
Fundraising	50,000	50,000	50,000
Net income	231,207	405,414	405,414
Expenses			
Salaries and fringe benefits	138,723	138,925	139,129
Education supplies	15,000	15,600	16,224
Lab fees	34,694	69,388	69,388
25% overhead	20,602	41,204	41,204
Total expenses	209,019	265,117	265,945
HSDM profit/(loss)	$22,188	$140,297	$139,469

29.5 percent of Bostonians (173,207 individuals) were projected to be between the ages of thirty-five and fifty-four, with 42.5 percent (250,385) of those in the Boston area between fifty-five and seventy-four years of age. Eighteen percent of Bostonians have received a college degree, and 10 percent attended graduate school.[28] HSDM continues to enjoy a positive perception within the community and especially within the Longwood area, its immediate market area.

The target market for the implant program focuses on the Boston area population and especially on that segment of the market with the financial means, including dental insurance, and interest for implant care. The most immediate focus was on the Longwood area, as it houses a number of larger institutions (Harvard Medical School, Harvard School of Public Health, Beth Israel Deaconess Medical Center's two hospitals, Dana Farber Clinic, Children's Hospital, Joslin Diabetes Clinic, and Massachusetts College of Pharmacy and Health Sciences). All other Harvard schools are connected to the Longwood area through the Longwood Medical Shuttle service. Therefore, it is the HDC strategic position to attract patients for the implant program mainly by marketing it to the Longwood area and the larger Harvard community.

The Boston area has three major dental schools: at Tufts University, Boston University, and Harvard. Tufts offers one- and two-year fellowships in implant dentistry. The one-year fellowship is an advanced program in restorative implant dentistry covering techniques to master the restoration of simple and complex implant-supported restorations. This program is supported with relevant coursework at the graduate level. The two-year fellowship program is available to those implant fellows who show outstanding performance during their first year of training and wish to expand their experience in the surgical techniques required for placement of dental implants. Additional relevant coursework and hands-on training is required of second-year fellows.[29] Boston University has a Center for Implantology and offers one- and two-year fellowships. Its twelve-month program is offered to candidates who have received previous training in oral and maxillofacial surgery, periodontology, or prosthodontics and wish to be cross-trained for either the restoration or placement of dental implants. This program includes both the core didactic curriculum and clinical components. The two-year program at Boston University trains candidates in the surgical placement and restoration

Table 4. Anticipated target population growth, based on 2000 census

	2008	2009	2010	2011	2012
Population age 55–74	250,385	257,972	265,789	273,842	282,139
Population age 35–54	173,207	173,415	173,623	173,831	174,040
Total for ages 35–74	423,592	431,387	439,412	447,673	456,179

of dental implants. This program includes both the core didactic and clinical components, and graduates receive a C.A.G.S. in implantology.[30]

Implementation Plan

Since the HSDM is situated in the middle of the Longwood area, it is able to capture a large, sophisticated population of patients who have dental insurance. The proximity to a number of large institutions eliminates the need for parking and allows patients to come in for more frequent, shorter appointments as is sometimes necessary because of pre- and post-operative care requirements. As HSDM strives to be the premier provider of dental care for the Longwood area, it implemented a number of creative marketing approaches, including open houses, e-mail notifications through the university e-mail system, and flyers at the time of benefits open enrollment period. The marketing strategy communicates the unique value the program offers and redirects focus from cost to the benefits that patients can expect.

The program has needed to be vigilant in analyzing how it can maintain quality and integrity within the finite financial resources of the school. Costs are always likely to increase, as are the demands and expectations of patients. A growth strategy was implemented based on continued attention to the quality of the experience in conjunction with identifying opportunities to expand the number of patients. This strategy included changes in key areas, such as facilities upgrades, staff reorganization, and customer service training for all HDC staff. It was decided that all critical incidents must be reported to the Quality Improvement Committee, where they are analyzed using a root cause analysis approach. To balance the operating budget for the implant program, as well as HDC as a whole, several critical areas were identified. These include consistent revenue collection, development of profitable contracts, and attracting reliable self-pay patients. Revenues must be tracked, and internal expenses closely monitored. The implementation of the electronic dental record was expected to facilitate standard of care as well as improve the collection rate.

Communication Plan

A solid communication plan has been key to obtaining buy-in from all faculty members, students, and staff, as well as for positioning and building the prestige of the program outside of Harvard. Internal communication consisted of the following constituents and components. For the dean and department heads, the business plan was presented for discussion and approval at a regularly scheduled dean's meeting in early spring 2008. For faculty members, a summary of the implant program was provided at the regular scheduled faculty meeting in spring 2008, and a copy of the finalized business plan was made available. For staff, a summary of the business plan was presented at a variety of staff meetings, including Open Forum, bi-monthly hygienist meetings, and monthly dental assistant meetings. For students, a summary of the business plan was presented at student meetings, and a copy of the business plan was made available through "my courses" on Harvard's internal website. For other parties, a copy of the business plan was made available online as well as in hard copy at various meetings. Open Q&A lunch sessions were held for anyone who might be interested, and updates about the program were sent out through a biyearly electronic newsletter. An informal lecture series to present literature reviews or interesting projects in the program was also offered to staff and students.

The external communication plan included the web and the media. An HSDM implant program website was developed to showcase the virtual business card and portfolio for the program, as well as to establish its online home. The website features information for prospective students, current students and staff, researchers, clinicians, and prospective patients. As such, it has relevant links to professional articles and scientific publications. The website is used for marketing activities, which include promoting seminars with a content page showcasing each offering and a calendar with dates and locations. Pages for the fellowship program feature the curriculum, general requirements, and program activities. A password-protected, contact/classified page is being developed for internal communication among graduates. Specialized media outreach included press releases about the program launch and other key events and developments. As part of developing the program's brand, special messages were identified for different audiences (prospective students, global implant community, and investors) to position the program and promote it to a wide audience.

Evaluation and Outcomes Measures

We believe strongly that success does not happen unless we measure it, so it was decided that we would measure outcomes at two levels: academic and

clinical. Academically, success would be measured using the following parameters: 1) the program would gain in popularity based on its reputation, and the number of applicants for the next academic year would at a minimum exceed the number of positions available by a factor of three; 2) 90 percent of applicants would meet or surpass the minimum requirements for acceptance into the implant fellowship program; 3) 90 percent of fellows over a period of five years would graduate from the program; 4) the first ten graduates from the program would move into academic/clinical leadership positions within two years after graduation and/or continue their careers in full-time or part-time research and teaching positions; 5) starting in 2010, four papers per year would be submitted and two published each year by the fellows or growing out of work (clinically or research-related) performed by the fellows; and 6) the accomplishments of program graduates would be placed on the website, with at least one significant update per year starting in 2012.

Clinical business success would be measured as follows: 1) the implant program would show a positive bottom line starting FY 2009; 2) the number of patients receiving implant care at the HDC would increase 10 percent for FY 2009 and 10 percent for FY 2010; thereafter, growth would be at least 5 percent per year for the next five years (note that the implant program's revenue was held static for FY 2010 as part of a conservative budgeting strategy); 3) the materials used for implant care at the HDC would be standardized by July 2008; and 4) an appropriate peer review process would be in place for all implant providers by 2010.

Implant dentistry combines knowledge from many dental specialties: periodontics, prosthodontics, orthodontics, endodontics, oral and maxillofacial radiology, and oral and maxillofacial surgery. In this context, our residents interact in multiple ways with other specialists. Treatment planning and monitoring treatment progress sessions take place once a month, with the scope of these seminars focusing on complex treatment planning cases using a multidisciplinary approach. AGE residents submit a case to be reviewed by the session leaders, and it is scheduled accordingly. The cases require optimal quality images, proper diagnosis, diagnostic casts, complete periodontal charting, and full radiographic documentation. After the session is adjourned, the students are asked to return and present the case progress according to the treatment planning phases discussed in this seminar. The implant group has also established a weekly clinical and translational research meeting; its objective is to develop, review, and monitor progress on research projects.

Results

The program has proven to be successful, although we acknowledge that the academic outcome measures cannot be fully assessed due to the short time since the program's inception. The program's increased popularity is demonstrated by the fact that the number of eligible applicants each year exceeds the number of positions available (two) by a factor of more than three, which was the benchmark. Additionally, more than 90 percent of applicants have met the minimum requirements for acceptance into the program. In 2009, all twelve applicants met the application requirements; in 2011, eighteen of the twenty met the requirements; in 2012, fifteen of the sixteen met the requirements.

Financially, all revenue goals were surpassed by 40 percent in the first year and 20 percent in the second year. The number of patients receiving implant care at HDC increased 21 percent in 2009 and 22 percent in 2010, surpassing the benchmark of 10 percent. Recent marketing efforts as well as the continuing education efforts targeted at local dentists have proven to be very effective. Expenses have been kept below budget, partially as an overall focused effort to reduce expenses within the HDC and also because of ongoing efforts in material management. Vigilant ongoing review of used treatment codes facilitates continuous feedback to ensure appropriate coding, as the residents at times forget to set procedures as "closed" in the electronic health record and thus prevent billing to the patient.

Six students have participated in the program since its inception, two of whom graduated after successfully completing the two years. Both graduates accepted full-time academic positions upon graduation. As the HSDM subscribes to a philosophy of comprehensive care, the implant residents completed a number of general dental procedures not considered in the overall measurements of the program as they pertain to general dentistry (e.g., amalgam and composite fillings and fixed prosthetics not related to implants). Over the two years, a total of 712 implant program specific procedures have been completed, including implant placement (D6010), bone augmentation (D4263, D4265, D4266), and implant crown and abutment placement (D6056, D6057, D6059,

D6066). These procedures were performed on 187 unique patients, who on average received four treatments, with a range of one to seventeen. On average, each resident generated $56,000 in yearly production revenue, which translated into an average of $2,998 of net income per implant patient. Students have, on average, a caseload of thirty-one patients and have performed, on average, fifty-nine procedures per year based on data for the period from July 2009 through July 2011 (Table 5).

The academic outcomes for 2008–11 include twenty scientific publications in peer-reviewed journals, fifteen of which were authored by the residents (two residents are co-authors in two publications) and five by the program director, and ten abstract presentations at national and international meetings. Table 6 shows the research outcomes for each of the six residents. Of the twenty publications, six were clinical, one was in vitro, two were animal, five were case reports, and six were literature reviews. Currently, this group is conducting four randomized clinical trials (HMS IRB-approved), one systematic review, and one animal study. These research activities are supported by $591,799.00 of research funding from independent and corporate sponsors.

Discussion

The development of a new academic program is exciting and challenging at the same time. There currently are numerous implant residency programs across the United States and Europe. Most programs range from one to three years, and most require that the applicants have previous clinical experience to be eligible.

Because the HSDM periodontal program teaches implant placements and its prosthodontics program teaches implant restoration, there was understandable concern about whether the establishment of an implant program would be viable and value added. Those concerns were not substantiated. The implant program surpassed its budgeted projections with regards to financial targets and the quality and number of the applicants. Additionally, the graduate periodontology program did not experience a decrease in patients, and the graduate prosthodontic program remained equally busy. This result is mainly due to a well-designed screening program. As in the past, patients who have periodontal problems *and* implant needs are referred to graduate periodontology and

Table 5. Procedures performed by implant residents July 2009–June 2011

ADA Procedure Code	Procedure Description	Number of Procedures	Number of Patients
D4263, D4265, D4266	Guided bone regeneration (GBR)	66	59
D5820	Interim partial denture	10	10
D6010	Surgical placement of endosteal implant	253	160
D6053	Implant-supported removable complete denture	1	1
D6056, D6057	Implant abutments	160	95
D6059, D6066	Implant supported crowns	165	85
D6069	Abutment—retainer	9	2
D6740, D6750	FPD crown	48	16
Total		712	187

Note: Total number of patients does not equal the total number of procedures as many patients had multiple procedures.

Table 6. Research outcomes for each implant resident

Resident	Publications	Abstracts	Oral Presentations	Awards	Ongoing Research Projects
1	4	1	4	3	1
2	2	4	2	1	1
3	2	3	—	2	1
4	2	1	2	—	1
5	2	—	4	1	2
6	5	3	1	—	1
Total	15	12	13	7	7

Note: Two residents are co-authors in two publications.

are not suddenly "shared" by the implant program. Those patients are treatment-planned in collaboration with AGE pros who will later ensure the completion of the implant/prosthetic work. However, patients with complex fixed prosthodontics needs, requiring numerous implants, are referred to the new implant program. Before the implementation of the implant program, those patients would have been referred to the private faculty practice. The HSDM prosthetic program is focused on providing care for patients who have extensive prosthetic needs, which may involve the need to restore implants or place overdentures. However, patients with implant-driven treatment plans are not the main focus of the HSDM prosthodontic residents. Indeed, we believe it is this group of patients who are being attracted to this program and as such are not being wooed away from any other parts of our teaching or faculty practices. Examples of complex cases are FPD in the anterior maxilla with a high esthetic demand, full arch cases, cases in association with bone grafting procedures, etc.

The development of a solid business plan that included a market analysis, financial analysis, and communication plan, as well as obtaining support up front, were major tools in obtaining buy-in from senior management. These actions helped frame the questions for discussion and have allowed for extensive exploration of risk and benefits—financial as well as academic. The program director's full-time equivalent (FTE) for this program is three days or 60 percent. All other faculty members involved with the implant residents do not separately dedicate time to this program; rather, the implant residents integrate into their existing classes. At times, a faculty member may be asked to present a special lecture for the implant residents, but that is not a special or different practice as all faculty members are asked at times to do so for groups of residents or dental students. Although the business plan did not include the salary and fringe benefits of the program director, which were already covered as she was an existing faculty member of the prosthodontics department, it is apparent that, as the implant program is maturing, the program will also be able to cover the salary and fringe benefits of the program director.

Academically, the program is inclusive and expansive, as it combines didactic information from the periodontal, general medical, prosthodontics, and oral surgery domains. By integrating the didactic components with classes that are also attended by other residents, the program and its residents were easily integrated into the HSDM postgraduate environment. The model of starting with only two experienced individuals allowed the first pilot year to be immediately successful as it was easy to supervise the residents, obtain their feedback, and make adjustments as necessary. By adding two residents the following year, the program was brought up to its intended number of four. As such, it continues to allow for close interaction between faculty and students (ratio 2:1), ensuring intimate didactic efforts, while at the same time the residents can provide each other with support and mentorship. Because of the small size of HSDM, a four-resident program fits in nicely.

This is a rigorous program that requires substantial research activities by the resident. However, in this program, the research is an integral part of the clinical and didactic program, which makes it not only manageable for the residents but it very much enhances their understanding and learning of complex cases. On a weekly basis, the following time distribution was followed: 50 percent in the clinic for supervised patient care and investigational appointments; 20 percent research; 10 percent didactic module; 10 percent teaching; and 10 percent self-employed time.

American, as well as international, individuals can and do apply for this program. Currently, there is no scholarship available specifically for this program; however, once accepted, residents can compete for certain scholarships available at HSDM. It is not the practice at HSDM to reduce tuition based on residents' or students' clinical production. We envision that graduates from the program will become involved as part-time adjunct faculty, enriching the program with scholarly and research efforts. Financially, we believe this program will remain successful and be self-sustaining. Further development of the didactic modules should ideally include integrating the residents into courses such as leadership and translational research.

Conclusion

The development of well-thought-out and vetted academic and business plans allowed the program planners to anticipate and resolve potential barriers to success. It also offered a powerful vehicle for obtaining buy-in and generating excitement within the academic institution. This approach has proven to be instrumental in the successful implementation of the oral implantology residency program at HSDM.

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