

VIEWPOINT

QUALITY IMPROVEMENT PROJECT

Cardiology Research Internship for Undergraduate Students Provides Unique Opportunity for Next Generation of Health Care Professionals



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INTRODUCTION

For undergraduate students interested in health care, exposure to clinical health care is challenging due to limited opportunities (1-8). Becoming a physician is a major commitment that necessitates programs that provide insights into the true scope of such a career. There are increased efforts to diversify the physician work force such that it is more reflective of the demographics of the US population (9). Given underrepresentation of women and minorities in cardiology, there is interest in exposing such students to cardiology at an early career stage (10). The Minneapolis Heart Institute Foundation (MHIF) Research Internship Program was designed to provide pre-medical students with clinical and research exposure within cardiology. We reviewed the 18-year results of the MHIF research internship program to provide insights into the intern and physician experiences, research productivity, and ultimate career path of intern alumni.

METHODS

Each summer internship season, 8 to 15 college students are selected from a pool of approximately 200 applicants (7). The program is advertised using direct e-mail to colleges and universities, and also on a variety of Web sites, including Handshake, Association of American Medical Colleges, Chegg, and Internship.com. Applications are reviewed by a committee and evaluated based on essays, year in school, research, employment and volunteer experience, and their motivation. We strive to provide educational opportunities to a diverse and balanced cohort. The program is a 12-week, full-time position.

MENTORSHIP. Each student is paired with a physician mentor and clinical research coordinator who works in the student's area of research. Students value the physician mentorship in their professional development; the close relationship and shadowing opportunities allow the student to gain an understanding of the physician role as well as the lifestyle and challenges.

CLINICAL AND DIDACTIC EXPERIENCES. A lecture series is set throughout the summer with 25 total talks on a broad overview of clinical and research topics ([Supplemental Table 1](#)). Structured clinical experiences occur in the heart hospital on various units, including the catheterization and electrophysiology laboratories, cardiovascular imaging (echocardiography, nuclear, cardiac computed tomography, magnetic resonance, and exercise test) laboratory, cardiac telemetry and intensive care units, and operating rooms. Interns also participate in shadowing their

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mentors, and have offsite visits touring academic research settings and medical device companies (Supplemental Table 2). Approximately 100 h are spent on nonresearch activities.

RESEARCH EXPERIENCE. Research mentors submit project proposals that are reviewed by the research committee for scientific merit and feasibility with the goal of having Institutional Review Board approval before student arrival. The program orientation provides an overview of research objectives and process, Institutional Review Board, data collection, and analysis. Over the course of the internship, students acquire the clinical data and when feasible, analyze the data and prepare for presentation and publications. Intern presentations and posters are delivered during the final week of the program.

PROGRAM COSTS. Internship costs primarily consist of intern stipends as well as staff time, which is used for intern selection, research organization and support, facilitation of educational activities, and mentorship. Additional funding is provided for interns to present their work at national conferences. Costs are primarily funded through philanthropic donations and industry sponsors provide in-kind donations.

Data collected for this article are based on prospective collection of academic productivity from abstracts submitted to major scientific meetings, surveys from interns and mentors, annual retrospective queries of past interns regarding present positions and training, and supplemented by Internet searches.

RESULTS

Since its inception in 2002, a total of 201 interns (50% women, 50% men, 70% White, 18% Asian, 5% Black, 4.5% Hispanic, 1.5% American Indian/Alaska Native) have completed the program. Interns represent more than 50 undergraduate institutions, originate from 20 states, have gone on to learn or practice in more than 30 states, and have been matched with more than 50 physician mentors, including cardiologists, vascular medicine specialists, and surgeons.

For alumni, 55% ($n = 112$) have now graduated from medical school, 19% ($n = 39$) are in medical school, and 7% ($n = 15$) are in premedical studies (thus 81% in a physician track) and an additional 14% ($n = 28$) are in health care-related fields, such as pharmacy, advanced practice providers, and nursing. Only 3% ($n = 7$) are not in a health care-related field and include 4 in business and marketing, 2 in other research fields (physics and agronomy), and 1 emergency awareness instructor. Of the 69 physicians in fellowships or practicing and 5 advance practice providers, 16% ($n = 12$) are in a cardiovascular field, half of whom are women (Figure 1).

As of May 2020, interns have contributed to 138 posters and presentations at national scientific sessions and 161 published manuscripts, totaling approximately 300 original works. Interns frequently present at major national meetings and publish in high-impact journals. Projects cover a wide spectrum from case reports/series to projects from existing databases to original research studies. (Table 1 outlines research areas with student authors and Supplemental Table 3 shows representative citations in these research areas).

Interns frequently comment on the value of wide scope of experiences to provide context for their respective internship projects (Supplemental Table 4). In addition, interns have enthusiastically endorsed the usefulness of their clinical experiences in personal statements for medical school, and as a significant influence on future specialty choice.

In addition, physician mentors benefit from the opportunity to impact the next generation of medical professionals and the interns' contributions to the research projects have been invaluable for data

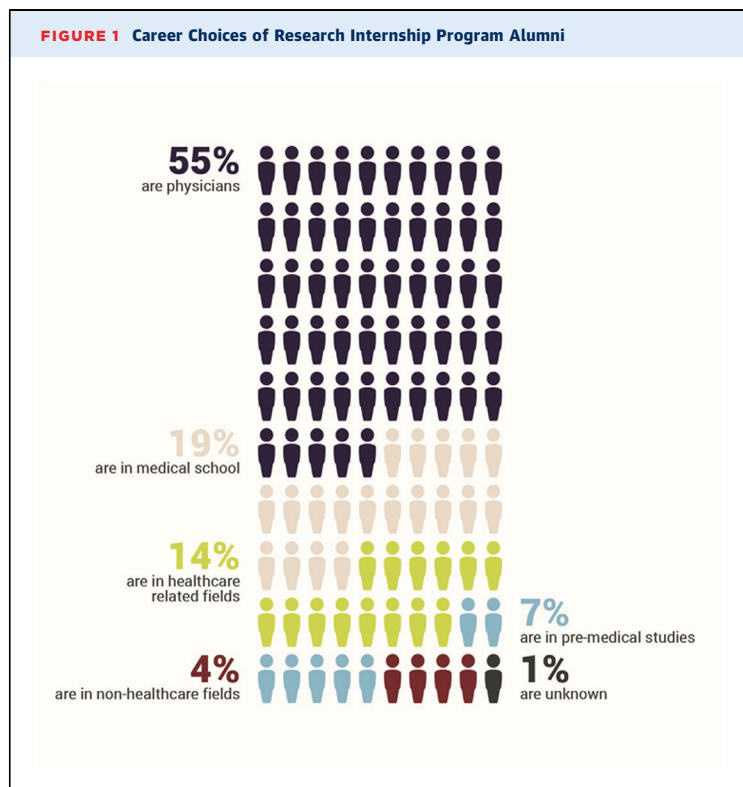


TABLE 1 Areas of Research

Complex coronary artery disease
Sudden death in athletes
Cardiac emergency programs
Myocardial infarction
Aortic dissection
Out-of-hospital cardiac arrest
Stem cells
Vascular medicine and surgery
Cardiovascular imaging
Electrophysiology
Preventive cardiology
Advanced heart failure and mechanical support
Structural heart disease

collection, stimulating new ideas and ultimately publications. Most physicians reported a modest additional time beyond clinical duties over the 12-week program, but unanimously felt it was manageable and rewarding. All mentors said they would likely or definitely recommend becoming a mentor for this program.

DISCUSSION

Over an 18-year period, the internship program has been shown to be extremely beneficial to students, their cardiology mentors, and the academic community. Of the graduates of this program, 81% are physicians or in training, and only 3% are not in the health care field. At least 300 peer-reviewed scientific publications have resulted from the work done by the interns.

Although immersive experiences for undergraduates are limited (1), the available data on undergraduate experiential learning programs is overwhelmingly positive. There are a few programs similar to this program (1-5), including 1 initiated in a rural area by cardiologists that were early graduates of our program (6,7). The immersive experience is highly valuable to summer students with patient contact, mentoring relationships, and unique insights into a potential career in medicine. Most summer interns have gone on to medical practice and 16% have chosen a cardiovascular field. Although 81% of students have chosen to go to medical school and an additional 14% have chosen another health care profession, a few have realized medicine is not the best choice for them (8).

According to Centers for Disease Control and Prevention and American College of Cardiology projections, cardiovascular disease continues to be the leading cause of death in the United States and

there will be an ongoing need to have an adequate supply of cardiologists. It is an advantage to introduce students at an early stage to the countless opportunities within cardiology to address ongoing needs (11).

In addition, we have trained a large number of women and underrepresented minority students, and of the students who are now physicians in fellowship or beyond or are advance practice providers, 16% are cardiovascular, including half who are women. In contrast, only 12% of practicing cardiologists are women, and in addition only 8% identify as underrepresented minorities (12). Increasing exposure and field experience to underrepresented students may help close these gaps and diversify cardiology and the medical field in general (9,10,12,13).

From the cardiologist perspective, the program allows busy clinicians an opportunity to explore clinical questions. Although not every research question can be answered through the relatively short time frame, many students have contributed to data bases that are continued by interns in subsequent years and ultimately published. For the physician, there is also the reward that comes from mentoring young intelligent and ambitious students and seeing the success that results from their work. In an era in which much of the cardiology workforce is experiencing burnout (11), this allows the cardiologist the chance to complete projects that are important to them.

Obtaining accurate data on research productivity is challenging because many projects are completed after the summer internship. In addition, many publications have included more than 1 summer intern as authors. This may affect and likely underestimate the quantity of presented abstracts or manuscripts attributable to the program.

CONCLUSIONS

For students considering a medical career, opportunities for clinical exposure and research are limited. Over an 18-year period, the MHIF cardiovascular research internship has been shown to be both sustainable and beneficial for the students, their mentors, and the academic community overall. Similar programs should be emulated elsewhere to offer other students and especially under-represented communities these same opportunities.

ACKNOWLEDGMENTS The authors thank the Minneapolis Heart Institute Foundation, Minneapolis, Minnesota, Abbott Northwestern Hospital Foundation, Minneapolis, Minnesota, and other generous

individuals who have graciously supported the intern program throughout the years.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS education, female, premedical, research, undergraduate

APPENDIX For supplemental tables, please see the online version of this paper.