



# Insights into an Award-Winning Summer Internship Program: The First Six Years

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Since its inception in 2008, the American Center for Reproductive Medicine's summer internship program in reproductive research and writing has trained 114 students from 23 states within the United States and 10 countries worldwide. Its fundamental goal is to inspire pre-medical and medical students to embrace a career as a physician-scientist. During this intensive course, established scientists and clinicians train interns in the essential principles and fundamental concepts of bench research and scientific writing. Over the first six years (2008 ~ 2013), interns have collectively published 98 research articles and performed 12 bench research projects on current and emerging topics in reproductive medicine. Interns have also developed and honed valuable soft skills including time management, communication and presentation skills, as well as life values, which all enhance personal and professional satisfaction. Program graduates are able to recognize the value of medical research and its potential to impact patient care and gain insight into their own career pathway. Between 2011 and 2014, the internship program was thrice awarded a Scholarship in Teaching Award by Case Western Reserve School of Medicine for its innovative teaching approach and positive impact on medical education and student careers. This report highlights the demographics, logistics, implementation, feedback, and results of the first six years of the American Center for Reproductive Medicine's summer internship program at Cleveland Clinic (Cleveland, OH, USA). This may be helpful to other research and academic institutions considering implementing a similar program. In addition, it creates awareness among potential physician-scientists of what the world of research has to offer in both scientific writing and bench research. Finally, it may stimulate further discussion regarding narrowing the gap between physicians and scientists and refinement of the current program.

**Key Words:** Internship and residency; Physicians; Students, medical; Translational medical research

## BACKGROUND

There has been tremendous growth and advancement in biomedical research in recent decades. Physician-sci-

entists play an increasingly vital role in translating advancements in basic science into clinical practice. Thus, emphasis is being given to translational research, in which bench research findings are applied in a clinical setting.

Received: Sep 21, 2015; Revised: Oct 18, 2015; Accepted: Jan 24, 2016

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The goal of translational medicine is to have basic and clinical studies meet halfway and allow integration of both perspectives, whereby scientists think like physicians and physicians act like scientists.

However, a disconnect remains between scientists working at the bench, and physicians working with patients. Each group encounters its own set of problems, which could potentially be solved via mutual discourse and collaboration. Furthermore, the number of physicians entering research careers is declining [1-4]. As clinical roles have expanded in academic medical centers, so has their degree of specialization. Thus, physicians who may have also considered taking an active role in research often lose out to more specialized roles, contributing to the decline in dedicated physician investigators. Research programs have emerged to address this issue, although only a few have emphasized a research experience for medical students [5-9]. Thus, great weight is placed on medical schools to promote and develop physician-scientists.

In 2008, the American Center for Reproductive Medicine (ACRM) at the Cleveland Clinic introduced its summer mentorship program in recent advances in reproductive research. The program is offered to students during their summer vacation and, since 2010, as an elective to fulfill course requirements. The broad goal of the program is to offer students a look into the dynamic world of research and medicine. It aims to expose aspiring physicians to scientific research by giving them the opportunity to work alongside renowned physicians and scientists while also engaging in hands-on bench research at a busy tertiary care facility. This involves in-person mentoring as well as a step-by-step approach to learning and acquiring the research skills necessary to participate in various research projects. At the same time, interns are provided with an opportunity to translate the knowledge they gained through lectures and research by publishing research articles, thereby discovering what quality research outcomes can achieve in terms of enhancing patient care.

The program also aims to build interest in becoming physician-scientists or researchers in any field. Soft skills such as time management, communication, and professionalism are emphasized, as they are applicable across many disciplines and, once acquired, can affect performance at school and the workplace.

This article provides insight into the first six years of the summer internship program, describing the demographics, logistics, planning, implementation, and outcomes of the program. We hope that this will assist research and academic institutions wanting to offer a similar program and also create awareness to potential physician-scientists of scientific writing and bench work opportunities in the research world.

## APPLICATION PROCESS

Interns apply to the program from all over the world (Table 1). A variety of electronic platforms, e-flyers, and printed announcements are used to make students aware of the program. Applicants submit a brief application containing their resume and answers to essay-based questions that explore areas such as their interest in reproductive medicine, prior research experience, and future career plans. The most notable attractant to the program for many applicants is the hands-on bench research and opportunity to learn how to write and participate in writing sci-

**Table 1.** Characteristics of summer interns (2008~2013)

Characteristic	Summer interns (2008~2013)
Gender (n=114)	
Female	64 (56.1)
Male	50 (43.9)
Educational background (n=114)	
Undergraduate/pre-medical students	81 (71.1)
Medical students	22 (19.3)
Postgraduate students	8 (7.0)
Medical doctors	3 (2.6)
Intern educational affiliation (n=114)	
Local schools (Ohio)	32 (28.1)
Ivy League schools	10 (8.8)
Schools from other states within the US	50 (43.9)
International schools	22 (19.3)
Continent (country) of origin of international interns (n=22)	
Asia (India, Lebanon, Pakistan, Qatar)	11 (50.0)
Africa (Egypt)	1 (4.5)
Australia	1 (4.5)
Europe (Armenia, United Kingdom)	3 (13.6)
North America (Canada)	2 (9.1)
South America (Brazil, Netherland Antilles)	4 (18.2)

Values are presented as number (%).

entific articles from start to completion. A team of program leaders reviews the applications and offers a phone or Skype interview to about 25% of total applicants. Each year the applicant pool has become more competitive. The program selects interns based primarily on their potential interest in exploring a career as a physician-scientist. Prior research experience is not a requirement. In fact, most (>95%, as defined by participation in scientific writing of articles for publication and/or hands-on bench research) accepted applicants did not have prior research experience. The acceptance rate is usually about 15% of the initial applicant pool, with an average of 19 candidates accepted annually over the six years.

## OVERVIEW OF INTERNSHIP ACTIVITIES

A structured, organized, and timely schedule has been developed for the 7-week program. The first two weeks comprise of lectures on the basic theoretical background to reproductive medicine; since 2010, the second week also includes three mandatory days of bench research training. As the program advances from weeks 3 to 5, lectures are only given on two days of the week, with the remainder devoted to bench research and scientific writing projects. Formal evaluations begin in the second week. Interns' oral presentations, with and without the use of PowerPoint slides, are evaluated individually and with their research team. Two practice sessions are given; one for bench research and another for scientific writing. From that point on, each presentation is evaluated by fellow interns and mentors and counted towards the final grade. Highlights of the course include final day presentations of research findings followed by a gala dinner. For an example of the complete internship schedule from the 2013 program, see Supplement Material.

### 1. Lectures

The ACRM faculty and invited scientists and clinicians from around the world deliver a series of lectures throughout the program. Lecture topics range from human reproduction, male and female infertility, urology and robotics, general medicine and wellness, bench research and scientific writing, and professionalism (see Supplement Material for examples). Examples of lecture titles in-

clude: 'Physiological and pathological role of reactive oxygen species in sperm function'; 'Sexually transmitted infections'; 'Writing an informative and concise, yet interesting abstract'; and 'Public speaking'. Sessions are often interactive, involving open forum discussions and question-and-answer sessions, exposing interns to prominent clinicians and investigators who may serve as role models.

### 2. Bench research

Interns work on an original bench research project in teams of five to six under the direct supervision of a reproductive biologist/researcher who serves as the lead mentor. This enables interns to translate their knowledge gained through their prior coursework and the series of lectures into solving current clinical problems. Each project is carefully researched, planned, tested, and approved by the Institutional Review Board (IRB) before the program begins. Interns are assigned to projects based primarily on their past laboratory experience.

A description of the planned projects is made available to the interns several weeks in advance of the program and again on the first day. Introductory lectures and small-group sessions with their team and mentor provide interns with a chance to learn the research techniques and protocol and to ask questions. The mentors teach the interns the skills required to perform the experimental techniques, from sample preparation to data recording. Following a week of vigorous lab protocol training and testing, upon receiving verification from their project mentor and the program director, interns may participate in the actual experiment.

The bench research projects and techniques performed between 2010 and 2013 are listed in Table 2. Examples of these projects include: (1) oxidative stress and alterations in major sperm proteins in infertile men – a proteomic approach; (2) evaluation of the effect of silicone vaginal lubricant on sperm function; (3) validation of five major proteins in immature and mature human sperm by Western blot; and (4) a controlled trial to assess the efficacy of freezing protocols in preserving sperm function and DNA integrity in normozoospermic and oligozoospermic samples.

Some of the research techniques involved sophisticated instrumentation or required a level of technical expertise that could not be mastered within the short time frame of

**Table 2.** Information on bench research projects performed during the summer internship (2010~2013)

Year	Bench research projects by year	Main techniques involved
2010		
1	Nitric Oxide Production and Susceptibility of Different Sperm Population from the Same Semen Sample	SCM, E-N, CRYO, AR, DDG, TUNEL, NO
2	Does the Use of Super-Cool Ice-Blockers During Vitrification Improve 8-Cell Mouse Embryo Survival?	ASEP, ET, VIT, EMT, EC, ES, ED, CO-INCUB, BDR
3	Improving the Predictive Value of the TUNEL Assay in Clinical Setting	SCM, E-N, DDG, ROS, TUNEL
4	Development of a Novel Alternative to Onsite Collection of Semen Samples in Men Seeking Infertility Treatment from Geographically Remote Sites	SCM, E-N, HOS, MORPH, CRYO, AR, TUNEL
5	Analyses of Catalase (CAT) Gene for Mutations/Polymorphisms in Male Infertility	SCM, ROS, DNai, PCR, PRIMERS
2011		
1	Copy Number Analysis of Y-heterochromatin (Yq12) Repeats and SOD Activity in Infertile Men	M-IM, E-N, MORPH, DNai, RT-qPCR
2	Oxidative Stress and Alterations in Major Sperm Proteins in Infertile Men – A Proteomic Approach	SCM, E-N, MORPH, PCA, IN-GEL, 1D & 2DGE, LC-MS, BIOINFO
3	Potential Role of Curcumin and Pentoxifylline in Improving Sperm Motility in Post-Thaw Human Spermatozoa Following Exogenous Exposure to Oxidative Stress	SCM, E-N, SU, CRYO, NO, PTFO, FCM
4	Protein Carbonyl and Lipid Peroxidation as Markers of Oxidative Stress in Human Spermatozoa	SCM, E-N, MORPH, MDA, CARB
2012		
1	Assessing the Inter-, Intra-Observer and Longitudinal Variability in Routine and Advanced Semen Parameters	SCM, E-N, MORPH, ROS
2	Evaluation of Semen Quality Following Preparation of Human Semen Specimens for ART: A Controlled Trial	SCM, E-N, HOS, DDG, TUNEL
3	Proteomic Analysis of Differential Protein Expression in Mature and Immature Spermatozoa	SCM, E-N, MORPH, MIM, PCA, IN-GEL, 1D & 2DGE, LC-MS, BIOINFO
4	Comparative Dynamics of Cryopreservation Induced Sperm DNA Damage Between Semen Samples Collected Onsite Versus Samples Remotely Collected and Shipped	SCM, E-N, HOS, CRYO, TUNEL
2013		
1	Cryoprotective Effect of Lycopene on Human Spermatozoa Following Exogenously Induced Oxidative Stress and DNA Damage – An <i>In Vitro</i> Study	SCM, E-N, HOS, TUNEL, CRYO
2	Antioxidant and Cryoprotective Effects of Lycopene on Human Sperm Following Cryopreservation and Induction of Oxidative Stress	SCM, E-N, MORPH, SU, CRYO, MDA, MMI
3	Validation of Five Major Proteins in Immature and Mature Human Sperm by Western Blot	E-N, MORPH, TDG, WB
4	A Controlled Trial to Assess the Efficacy of Freezing Protocols in Preserving Sperm Function and DNA Integrity in Normozoospermic and Oligoasthenozoospermic Samples	E-N, MORPH, TUNEL, CRYO (Slow Freezing, Rapid Cooling)

TUNEL: DNA damage by TUNEL test, SOD: superoxide dismutase, ART: assisted reproductive technique, SCM: sperm count and motility, E-N: vitality test (eosin-nigrosin test), CRYO: sperm cryopreservation, AR: acrosome reaction, DDG: double density gradient separation, NO: nitric oxide measurement, ASEP: aseptic preparation of dishes, ET: transfer of embryos, VIT: loading and unloading of vitrification straws, EMT: embryo manipulation and transfer, EC, ES, ED: embryo culture, survival and embryo development (cleavage and blastocyst), CO-INCUB: co-incubation in super cool ice blockers, BDR: blastocyst development rate, ROS: reactive oxygen species measurement, HOS: hypo-osmotic swelling test, MORPH: sperm morphology, PCR: polymerase chain reaction, PRIMERS: selection of primers, M-IM: sperm preparation for separation of immature and mature sperm, DNai: DNA isolation, RT-qPCR: real-time quantitative PCR, PCA: protein concentration assay, IN-GEL: In-gel separation of proteins, 1D & 2DGE: proteomic analysis utilizing one and two-dimensional gel electrophoresis, LC-MS: liquid chromatography-mass spectrometry analysis of proteins, BIOINFO: bioinformatics analysis, SU: swim-up, PTFO: pentoxifylline optimization, FCM: flow cytometry, MDA: malondialdehyde test, CARB: protein carbonyl measurement, MMI: mitochondrial membrane integrity test, TDG: triple density gradient separation, WB: Western blot.

the program. In these cases, interns were instead given a demonstration on how to perform the particular technique, briefed on its theoretical background, and in some cases given the opportunity to carry out the test as a trial run (the results of which were not included in the actual study). While performing the bench research, interns are taught the theoretical basis for the test, common technical errors and how to avoid them, how to troubleshoot, and what precautionary measures should be taken to yield technically sound results.

Of the 79 interns who participated (2010~2013) in bench research projects, more than half ( $n=41$ , 51.9%) lacked any prior bench research experience (Table 3). However, nearly 94.9% ( $n=75$ ) went on to successfully complete their bench research training during their internship. This could be attributed to the effort perceived by interns to provide a clear explanation of the bench project along with written material ( $n=113$ , 99.1%) and ensure that the rationale and significance of each project was sufficiently explained ( $n=76$ , 96.2%). Furthermore, interns received adequate training before the commencement of the actual bench project (96%) and felt that their mentors were knowledgeable in the bench work (96%) with whom they had daily discussions about their research experience (86%).

At the end of the program, interns were queried via questionnaire and the data were compiled to assess various aspects of the program. Of the interns that completed the questionnaire, 71% felt sufficient time had been spent

on the bench project and most rated their bench projects as good, very good, or excellent based on the expertise, content, and ease of understanding (86%). This hands-on experience provides interns with a competitive edge when applying to medical schools, pursuing a career in research or health-related fields, and participating in college science lab courses.

### 3. Scientific writing

One of the most critical aspects of the scientific process is the ability to communicate scientific information in an effective and comprehensive manner [10]. A major part of the internship requires the completion of a rough draft for an assigned writing topic. Each topic is prepared with an overview, rationale and significance, keywords, brief outline, and references to assist with the initial search. These files are shared before the program begins so that the interns can preview them.

During the first week of the program, interns receive a survey in which they rank the writing project topics according to their interest. A random selection process then allocates the first drawn name his/her first choice, continuing until all interns are assigned a project. This selection process has worked reasonably well over the years, giving the majority of interns one of their top choices. This year (2015), 84% ( $n=26$ ) of interns received one of their top five choices. Moreover, the bulk of the interns ( $n > 25$ ,  $> 80\%$ ) agree that this random selection process is fair. Each topic is paired with a mentor who assists and guides the intern

**Table 3.** Results of survey on bench research projects by summer interns (2010~2013)

Response	Interns		
	Yes	No	Total
Prior bench research experience	38 (48.1)	41 (51.9)	79 (100)
Hands-on participation in bench research during the summer internship program	75 (94.9)	4 (5.1)	79 (100)
Given clear explanation and written material about nature of bench project	78 (98.7)	1 (1.3)	79 (100)
Rationale and significance of bench project adequately explained	76 (96.2)	3 (3.8)	79 (100)
Received adequate training prior to starting bench project	76 (96.2)	3 (3.8)	79 (100)
Mentors knowledgeable about bench project	76 (96.2)	3 (3.8)	79 (100)
Discussed daily research experience with mentor	68 (86.1)	9 (11.4)	77 (97.5)
Adequate time was spent on bench project	56 (70.9)	20 (25.3)	76 (96.2)
Rating of bench project based on expertise, content, ease in understanding as good, very good, or excellent	68 (86.1)	2 (2.5)	70 (88.6)

Values are presented as number (%).

throughout the writing process.

Expertise is a pre-requisite in gaining communicator credibility and trust with an audience [10]. Thus, it is critical that the interns become experts in their assigned writing topic. Lectures provide a foundation to build from, although it is up to each intern, with help from his/her mentor and peers, to research the topic during the allotted study periods, between experiments, or in their own free time. Hence, time management becomes essential throughout the program in staying on track with assignments while continuing to participate in the daily-required activities. Importantly, the high expectations and supportive environment of the program provide an opportunity for interns to become adult learners, discovering new ways to cope and excel in such demanding times without relying on didactic learning styles.

While nearly 89.5% (n = 102) of interns (2008 ~ 2013) had received some electronic literature search training before entering the program, less than half had any prior scientific research writing experience (Table 4). Thus, a series of lectures is scheduled during the first two weeks of the program to review all processes needed to successfully complete a scientific manuscript. Several deadlines are set throughout the program and interns maintain frequent communication with their mentors to facilitate real-time assessment of the progress of the project. This self-directed learning approach gives interns a chance to critically analyze the task and devise ways to accomplish it, and receive feedback and direction to useful resources from their mentor.

#### 4. Evaluation

Throughout the course, the interns' performance in scientific writing, presentation skills, and bench research is evaluated, which constitutes a large portion of their final grade. For instance, after an intern's presentation on a project update, mentors complete a scoring card and provide feedback on areas performed adequately as well as ways to improve performance for the next evaluation. At the end of the program, each intern must submit a completed rough draft and deliver a 10 minutes oral presentation summarizing their findings of their writing assignment.

Interns also work with their bench research team to prepare and deliver a presentation on their research results. These presentations are presented to and scored by invited guest judges who are physicians and/or scientists as well as faculty and mentors. Interns are presented with awards based on their performance throughout the program in various categories such as final presentation, bench research performance, and scientific writing ability. The criteria that are used for evaluating each of these main aspects throughout the internship are presented in Table 5.

Internship evaluations are distributed upon completion of the summer internship to assess and find ways to improve the program. The evaluation encompasses a range of questions on the following aspects of the program: lectures, bench research, scientific writing, speakers, faculty and staff, ACRM facilities, future career plans, and overall impression. Questions may be closed (yes/no), scaled, or open-ended. Response rates to the evaluation forms were between 96% to 100%. The responses provided the quan-

**Table 4.** Results of survey on scientific writing projects by summer interns (2008 ~ 2013)

Response	Interns (n = 114)	
	Yes/Helpful	No/Not helpful
Prior scientific writing experience (yes/no)	55 (48.2)	59 (51.8)
Electronic literature search training (helpful/not helpful)	102 (89.5)	12 (10.5)
Access to online scientific journals (yes/no)	108 (94.7)	6 (5.3)
Scientific writing course in reviewing scientific articles (helpful/not helpful)	69 (60.5)	45 (39.5)
Scientific writing course in writing original articles (helpful/not helpful)	73 (64.0)	41 (36.0)
Scientific writing course in writing review articles/book chapters (helpful/not helpful)	73 (64.0)	41 (36.0)

Values are presented as number (%).

**Table 5.** Main criteria assessed within three key aspects of the internship

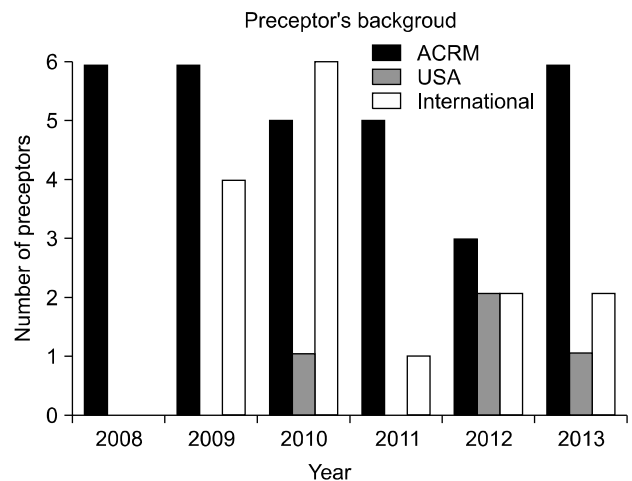
Scientific writing	Bench research	Presentation skills
1. Keyword search	1. Skills and accuracy	1. Delivery style
2. Literature search	2. Project knowledge	2. Organization
3. Review of key articles	3. Teamwork	3. Clarity and knowledge
4. Refinement of initial outline	4. Data entry	4. Responses to questions
5. Writing progress	5. Interpretation of data	5. Slide quality
6. Regular written updates to mentor		6. Time management
7. Creation of figures/tables/flow diagrams		
8. Quality of article		
9. Completion of first draft		
10. Complete references and Endnote library		
11. Plagiarism report		
12. Innovative writing skills		

titative data described in this article. These evaluations have proven to be invaluable in bettering interns' experience as well as optimizing their time during their short stay. Moreover, they provide a clear picture of the beneficial effects the program had on their research and career path.

## TANGIBLE AND INTANGIBLE BENEFITS

Over the first six years (2008~2013), 114 students from all over the world participated in the internship program (Table 1). These interns were generally academically motivated and intellectually curious, primarily with an educational background in medical or health sciences and/or considering pursuing a career in medicine and/or research. There were more female ( $n=64$ , 56.1%) than male ( $n=50$ , 43.9%) interns. They were predominantly undergraduate/pre-medical students ( $n=81$ , 71.1%), with a smaller number consisting of medical students ( $n=22$ , 19.3%), post-graduate students ( $n=8$ , 7.0%), and qualified medical doctors ( $n=3$ , 2.6%).

Interns originated from prominent schools in 23 states within the United States and 10 countries worldwide. Over one-fourth ( $n=32$ , 28.1%) of them came from schools within Ohio and from other states across the United States ( $n=50$ , 43.9%). There have been interns from six of the eight Ivy League schools in the United States, namely Brown University, Columbia University, Cornell University, Dartmouth University, Princeton University, and the University of Pennsylvania. In addition,



**Fig. 1.** Distribution of preceptors that participated in the summer program from 2008~2013 by location. ACRM: American Center for Reproductive Medicine.

most of the international interns that apply to the program are from the top medical schools/universities in their country; some of these include: University of Toronto and McGill University, Canada; All India Institute of Medical Sciences, India; Alexandria University, Egypt; Yerevan State University, Armenia; Saint James SOM, Netherlands Antilles; American University Beirut, Lebanon; Weill Cornell Medical College, Qatar; and University of Sao Paulo, Brazil; and Pontifical Catholic University, Brazil. The number and diversity of preceptors has also grown over the years (Fig. 1). Not only do all of these aspects provide a diverse experience, but also a unique opportunity for students to gain a worldly perspective and learn how to work with fellow interns and preceptors from different cul-

tural backgrounds.

Interns from the first six years (2008~2013) have collectively published 98 scientific research articles and performed 12 bench research projects on current and emerging topics in reproductive medicine. Moreover, as the program continues to improve, the number of successfully published interns continues to rise each year. Previous interns have touted their success in receiving acceptance into medical schools, residency, and other career-related positions, crediting their accomplishment in publishing a scientific manuscript that set them apart. K.D.L., a 2009 award-winning intern, writes, "The research experience and knowledge that I acquired at the summer internship was invaluable. Not only did it absolutely aid me in getting into medical school, but set me up for successful research in my area of interest. Even during residency interviews, I was asked questions about my research topic from the program. Everyone I have interviewed with has been impressed by my number of publications and appreciates how much knowledge I gained about writing academic articles, surveying the present literature, and analyzing results."

The soft skills interns develop throughout the program are also of critical importance. The program carries an intense workload, numerous deadlines, and high expectations. Many interns consider its intensity equal to, if not greater, than their medical school coursework. Hence, the program calls for dedication, sacrifice, and focus, and time management becomes vital to keeping up. Interns have conveyed a new appreciation for time and their learned ability to use it efficiently. For example, M.F. (2010) stated, "My experience as an intern has allowed me to better my time management skills as well as my communication and team work capabilities... It has allowed me to appreciate the time and effort needed in publishing scientific articles and has given me a new-found respect for the field of research."

Communication at different levels among the program attendees is highly valued. Constant updates with mentors and interaction with fellow interns improve the productivity of the interns and help to relieve any stress that may come with the workload. Interns have noted this continual communication as a critical part in successful completion of the program. They also valued the presentation

skills they learned from the various opportunities they are given to present in front of their colleagues, guests, and faculty. All interns are expected to become well-versed in their topics. The series of lectures given during the first few weeks and the opportunity to present their work in front of fellow interns and preceptors has been noted to provide additional confidence and ease with public speaking.

Lastly, the life values and interpersonal skills gained from the program have been reported to enhance interns' personal and professional lives. Program graduates have not only recognized the value of medical research, its necessity, and potential impact on patient care, but also have added insight into their own future careers. One intern, J. B. (2009) writes, "It has given me the exposure to medical research that I needed before pursuing a career in medicine." G.H. (2010) adds, "It was probably the single best experience I have had in my career. I firmly believe in this program and the value of the experiences it provides. The program simultaneously stimulates both personal and professional growth and development." These testimonials further support and reinforce the achievement of the goals and aims of the internship.

## CONTINUOUS IMPROVEMENTS

Analysis of 2008~2013 data revealed common areas to improve the program: (1) the option to participate in bench research (2008~2009 data, as bench research was not offered until 2010); (2) removal of the less practical lectures (2008~2013 data); and (3) increased free-study time to work on writing (2008~2013 data) and bench research projects (2010~2013 data). In order to address and resolve these issues, past interns were asked to provide suggestions in improving the program.

During the first two years of the program, interns participated only in scientific writing assignments and lectures. However, it was soon apparent that interns were anxious to apply the practical knowledge learned in a research setting, and subsequent interns were provided with the option to participate in bench research. This required a complete makeover of the program. In order to accommodate the large time-demand required for bench research, dozens of lectures were removed from the schedule, new equipment was ordered, additional faculty members were



hired, and new projects had to be researched, designed, tested, and approved by the IRB before the start of the program.

In 2010, bench research was started in the ACRM's research laboratory. The interns were trained in reproductive lab techniques from experts in the field and participated in a scientific bench project using human specimens. In the first year, bench research was optional. This was due to the uncertainty of incoming student interest as well as how the process would be conducted for such a large group. However, it immediately became one of the most sought-out aspects of the program. Since 2011, participating in a bench research project has become compulsory and remains a highly-valued feature of the program.

As the bench research component proved to be a success, new areas were proposed for further improvement. One of the most common issues became the workload. While some lectures had been removed, interns were still required to attend other lectures and meetings, give oral presentations, and assist with a scientific project, and work often carried late into the evening and onto weekends. Interns' requests for more free time to be allotted for researching and writing by removing lectures they deemed superfluous were taken into account and the program was revised accordingly.

The mentoring and support provided throughout the program remains one of the most valued aspects from past interns. Interns are assigned a preceptor to assist them throughout the scientific writing process, from researching to composing to presenting their assigned topic, as well as in their bench research projects. This one-on-one, direct communication with mentors has been suggested to be one of the most helpful aspects in terms of productivity and professional growth.

## IMPACT ON INTERNS

Early exposure to research allowed interns to: (1) gain an understanding and appreciation for the world of research; (2) determine if research was something they would like to pursue further; (3) discover talents while managing a sometimes uncomfortable workload and a tremendous number of opportunities; (4) appreciate the effort that goes into scientific advancements and how it

translates into clinical practice; (5) increase their attractiveness and acceptability for future career opportunities; (6) understand the process of researching and composing a scientific article; (7) gain a worldly perspective through working with individuals from different cultures; (8) become more likely to pursue a career in research and/or academic medicine; (9) manage their time and realize the importance effective communication; and (10) gain a lasting positive influence on their personal and professional lives.

The program's infrastructure provided a means to appreciate and understand the role of physician-scientists and translational medicine. The lectures, visiting clinicians and scientists, and scientific writing projects supplemented the interns' bench research experience. In addition, they had the opportunity to work together and learn about fellow interns' research projects – both of which assisted in cultivating a sense of community and camaraderie. Additionally, the weekly meetings with research teams and mentors helped the interns remain on schedule with the workload, receive feedback on their progress, and obtain any necessary assistance. This collaborative environment was beneficial to the efficiency, learning, and professional growth of the interns throughout the program. Interns noted these one-on-one mentoring meetings with continuous and timely feedback as one of the most valuable factors in handling the workload and staying on track with their work.

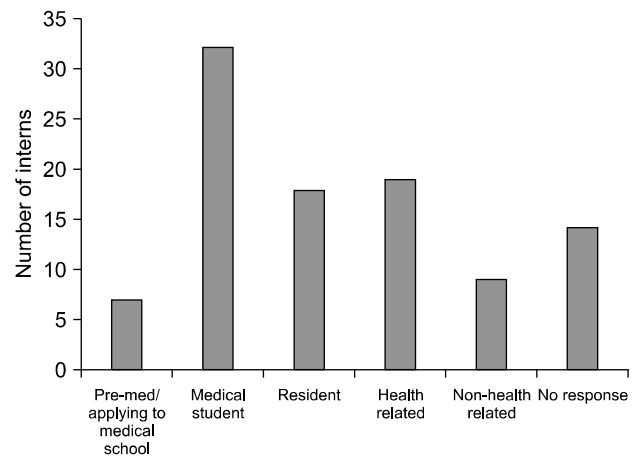
The reproductive medicine focus of the internship offered a unique and specialized setting for research and was instrumental in attracting many interns to the program. This was appealing as many past interns felt that research should be relevant to clinical care as well as contribute valuable scientific discovery. Thus, the clinically relevant projects enhanced interns' research experience and also helped them grasp the importance of translational research. A more senior intern, B.R. (2009), summarizes his experiences: "The program provided great insight into the medical profession, especially into the research arena. It also gave me a large amount of knowledge that helped me progress through medical school and even in my current residency program. Finally, it gave me the confidence to interact with other medical professionals and fully critique medical literature to provide the best possi-

ble care to patients.”

Interns were asked to share how their experience as an intern affected their life. One intern, K.C. (2010) noted, “The passion and integrity of the physicians and mentors inspired me to pursue medicine in the same manner.” Furthermore, many past interns have relayed how the program has served well in their personal and professional growth. One intern (S.K., 2009) conveyed, “It (the program) helped me gain invaluable leadership skills that I still apply today in my job as a 7th and 8th grade science teacher.” Another stated, “After the completion of the internship, I was able to handle my classes with ease. My training in the laboratory helped immensely in my biology and chemistry lab courses and prepared me for literary discussions among me peers and professors. Importantly, the program allowed me to present my research in an effective way (L.T., 2013).”

Collectively, the summer internship program in reproductive medicine provides an extensive and unique learning environment that is recollected as one of the most enriching educational, cultural, professional, and research experiences during the preparation for a career as a physician-scientist. A former award-winning 2010 intern (A.K.) reminisces on his experience: “The ACRM summer internship program is unrivaled in terms of quality and intensity of research, amiable environment, and professionalism. The program provided an opportunity to write scientific research articles, learn from experts, shadow physicians, and participate in bench research. The support and encouragement from the entire staff and visiting mentors exceeded my expectations and contributed significantly to my motivation to become actively involved. The skills and knowledge gained at Cleveland Clinic has provided me with the experience needed for future research in clinical medicine as an academician, physician, and writer.”

In early 2014, a follow-up survey was distributed to past interns regarding their future choice of residency. Of the interns from the 2008~2013 cohorts that responded, 14 out of the 22 medical students responded. Fifty percent of these interns (7) planned to pursue a residency in either obstetrics and gynecology or urology, while the remaining interns were planning to pursue other specialties (4; *i.e.*, internal medicine, pediatrics, oncology, or anesthesiology) or undecided (3). Among the 81 undergraduate or



**Fig. 2.** Status of 2008~2013 interns (114) as of July 2015.

pre-medical students in the 2008~2013 cohorts, 42 students (51.9%) responded regarding their plans to pursue medicine as a career. Of these 42 past interns, 28 interns (66.7%) were not yet in medical school at the time of survey, and 19 interns (67.9%) of them expressed plans to apply to and/or attend medical school. The status as of July 2015 of the 2008~2013 interns is reflected in Fig. 2. Of the 100 responders (87.7%), the majority of interns ( $n=91$ ) were either in pre-med or applying to medical school, current medical students or residents, or in health-related areas such as dentistry, pharmacy, or post-doctoral research.

The internship has also received recognition in teaching from Case Western Reserve University School of Medicine for the program’s contribution to medical education and careers of students. Between 2011 and 2014, the internship program was thrice awarded a Scholarship in Teaching Award by Case Western Reserve School of Medicine for its innovative teaching approach and positive impact on medical education and student careers.

## CONCLUSIONS

The 2015 summer internship program is a reflection of the recommendations made by past interns. The bench research and scientific writing projects remain the most popular features of the program. With the opening of a new clinical research center, it is possible to welcome and offer more students the same opportunity. The number of interns has grown from 14 persons in the inaugural batch

(2008) to 31 persons in 2015. Research is now performed in both the ACRM's research laboratory and in the new clinical research center. New and relevant bench research and scientific writing topics continue to be proposed each year. While the lectures from experts in their respective field remain mandatory, a great number of lectures have been removed to accommodate additional study periods. Currently, the 7-week program provides approximately 120 hours of bench research and 50 hours of lectures. The remaining time is allocated to presentations, research meetings, and study periods for researching and writing.

The Course Director and Organizing Committee accept that there will always be room for improvement and are open to suggestions to keep the internship program current and develop and expand its scope. In addition, technology has been integrated with the program so that, for instance, attendance is taken and a daily schedule with reminders is provided using a smartphone. This fresh, innovative attitude has shaped the program to become what it is today.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

## ELECTRONIC SUPPLEMENTARY MATERIAL

The online version of this article (<http://dx.doi.org/10.5534/wjmh.2016.34.1.9>) contains supplementary material.

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