Creation of a Ph.D. Program Dedicated to Training a New Generation of Translational Scientists

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Introduction

In July 2007, the Department of Molecular Medicine of the Cleveland Clinic Lerner College of Medicine, with support from HHMI, inaugurated a new PhD program designed to prepare future scientists to translate laboratory discoveries into new medical treatments. To achieve this mission, we developed an entirely new curriculum to teach basic science in the context of human biology and disease and to integrate this knowledge with clinical medicine. We are now in the process of accepting our fourth class of students into this program. All are thrilled to be "Howard Hughes Med Into Grad Scholars".

Novel Curriculum

- Clinically integrated core curriculum (50 weeks, 10 hr/week), starting with organ-based physiology and complemented by related journal clubs
- Comprehensive biomedical statistics and clinical epidemiology in a new course entitled: Principles of Clinical and Translational Research
- A bench scientist (thesis advisor) and physician (clinical mentor) jointly mentor each student
- Tailored clinical experience for each student to complement thesis research
- Optional autopsy conference, twice a week
- Grant-based qualifying exam with at least one translational aim
- Weekly theme-based, interactive grant design in year 2 with medical students

Evaluation Methods

Program evaluation provides a systematic way to determine the extent to which our new PhD program achieves its goals, to identify areas for improvement, and to contribute to our understanding of teaching and mentoring. With IRB approval, we implemented comprehensive plans from our logic model to judge the merit and worth of the Molecular Medicine PhD program. Some of our evaluation activities include:

- Using web-based process to collect and report students' course evaluations and assessments
- Meeting with core faculty monthly to review curriculum/program
- Using student and faculty questionnaires to monitor program implementation and outcomes
- Conducting one-on-one interviews with students after qualifying exam
- Holding periodic meetings and focus groups with stakeholders
- Tracking students' research using an electronic curriculum vitae application

Student Perspectives

What is the coolest thing about the program?

"...the perspective. The research is fascinating, but being able to connect with the clinical side and see the patients' views provides inspiration to focus in the laboratory."
Susan Westerfield, third year student

"I really like the way the faculty challenge me to use basic science knowledge to solve clinical problems. For me that should be for the well being of the world."
Isaac Adjei, second year student

"...the research opportunities that are state of the art and translational with tremendously qualified faculty."
Devi Ramakrishnan, second year student

"This program is unique in the way it prepares us to be translational scientists. No matter which lab in which we choose to do our thesis research, we are given the opportunities to experience translational research by connecting our benchwork to the bedside through our clinical mentor and clinical experience."
Laura Dixon, second year student

Clinical Mentor Perspectives

"This mentoring program places your students in the context of patients whose lives their research may impact one day. I have seen this be a vision-changing experience."

Mira Milas, M.D.
Center for Endocrine Surgery
Director, Thyroid Center

"as a clinical research oriented clinician, it has been great to share in the mentorship of a PhD student. I am certain this will open up some doors for bedside to bench collaboration between my clinical group and this lab."

Heather Gornik, M.D.
Medical Director, Non-Invasive Vascular Laboratory
Department of Cardiovascular Medicine

First Annual Molecular Medicine Ph.D. Program Retreat

This event was entirely student organized and run. Awards were given for Best Poster, Best Oral Presentation and Most Translational Project. The invited speaker was Dr. Jonathan Stamler, Director of the Institute for Transformative Molecular Medicine at Case Western Reserve University.

Program Successes

Admissions and Recruitment (see Table 1)

- Continued improvement of the quality and diversity of program applicants
- Dramatic increase in domestic applications
- Recent success in recruiting under-represented minorities and disadvantaged students
- Attraction of students who choose our program because of the integration of human disease (88%) and clinical experience (76%)
- Increased domestic (training grant eligible) applicants

Curriculum

- Designed and implemented nine new courses for the core curriculum and a longitudinal clinical experience as originally proposed
- Students engaged in thesis projects that explore clinically relevant topics (see Table below)
- Students consistently describe their clinical experiences when applicants ask them about the program
- Relationships with other "Med into Grad" programs have improved the quality of our program
- Ph.D./Medical Student course for brainstorming theme-based grant design

Programmatic/Institutional

- In 2008, over 80% of our surveyed faculty (64% response, n = 67/107) agreed they have sense of pride in the establishment of the new Molecular Medicine PhD program and plan to maintain (84%) or increase (10%) their level of involvement in the program
- Clinical mentors are enthusiastic about being part of this program and have a new appreciation for the rigor of research
- Program is attracting local, as well as national, attention due to its translational nature

Table 1

Entrance Year	Total Applicants	URM Applicants % (#)	Training Grant Eligible % (#)	Enrolled Total / URM	Enrolled Training Grant Eligible
2007	45	4% (2)	40% (18)	9/0	67% (6)
2008	48	8% (4)	38% (18)	7/2	86% (6)
2009	53	11% (6)	53% (28)	10/3	100% (10)
2010	76	5% (4)	50% (38)	7/1	71% (5)
Overall	222	7.2% (16)	46% (102)	33/6 (18%)	81% (27)

Evaluation Impact

We list examples of "action items" to demonstrate the impact of evaluation on program delivery/improvement:

- Encouraged graduate students to attend autopsies to improve their knowledge of anatomical structures/pathology [student feedback during "Human Physiology and Disease" course].
- Increased formal (Annual Research Retreat for program, etc.) and informal (monthly social hour, etc.) opportunities for students to interact with graduate students and medical students [student feedback during class meetings/focus groups].
- Designed and implemented a new, Year 1 course titled "Tools for Research" to introduce students to laboratory techniques [student/faculty feedback during journal club and student interviews].
- Restructured course sequence/length to improve curricular integration/delivery [feedback from student interviews and faculty at curricular retreat].
- Collaborated with Baylor University to identify best teaching/curricular practices, obtain external review of our programs, and participate in multi-institutional survey research [peer cluster visits, "Med into Grad" meetings]
- Increased visibility of Molecular Medicine PhD program by describing curriculum at institution's Annual Research Retreat [feedback from faculty questionnaire].

Table 2 HHMI Med Into Grad-Inaugural Class Molecular Medicine Ph.D. Thesis Projects

	Student	Thesis Advisor	Thesis Topic	Clinical Mentor
	Sumantha Bhatt	Anna Valujskikh, Ph.D. Immunology	Memory CD4 T Cells Are Believed to Play a Key Role in Accelerating Allograft Rejection	Venkatesh Krishnamurthy, M.D. Glickman Urological & Kidney Institute
	William Flavahan	Jeremy Rich, M.D. Stem Cell Biology and Regenerative Medicine	Investigating the Role of PTEN in Mediating Genomic Instability and DNA Damage Repair	Holly Pederson, M.D. General Surgery/Breast Ctr
	Fadia Mayyas	David VanWagoner, Ph.D. Molecular Cardiology	Impact of endothelin-1 Signalling on Ca+ Cycling in Normal and Fibrillating Atria	Mark Niebauer, M.D. Cardiovascular Medicine
	Ying Ni	Charis Eng, M.D., Ph.D. Genomic Medicine Institute	SDHx as Susceptibility Genes for CS/CSL Syndrome	Mira Milas, M.D., FACS Endocrine Surgery/Thyroid Center
	Kourtney Nickerson	Christine McDonald, Ph.D. Pathobiology	Dynamics of MDP Trafficking and Effect on Nod2 Activation in IBD	Jean-Paul Achkar, M.D. Digestive Disease/IBD
	Sowmya Srikanthan	Roy Silverstein, M.D. Cell Biology	Role of Erythrocyte Derived Microparticles in Thrombosis	Heather Gornik, M.D. Cardiovascular Medicine
	Shadi Swaidani	Xiaoxia Li, Ph.D. Immunology	The role of Act1 in IL-17- and IL-25-dependent Pulmonary Inflammation in Asthma	Mark Aronica, M.D. Pathobiology
	Susan Westerfield	Vinod Labhasetwar, Ph.D. Biomedical Engineering	Magnetic Nanoparticles for Drug Delivery and Imaging	G. Thomas Budd, M.D. Translational Hematology and Oncology Research
	Ao Zhang	Robert Silverman, Ph.D. Cancer Biology	Innate Immunity Signaling in Prostate Cancer	Eric Klein, M.D. Glickman Urological & Kidney Institute

Future Challenges

Supporting the program in the post-HHMI era
Sustaining evaluation activities long-term
Achieving greater visibility of the program
Development of faculty to maximize small group learning opportunities
Creating additional higher level courses
Improving the applicant pool size and quality