

## **Third External Review, October 7, 2018**

### **Graduate Program: The Molecular Basis of Human Diseases**

#### **University of Crete Medical School**

##### **Introduction**

The Graduate Program on “The Molecular Basis of Human Disease” at the University of Crete is in its 15th year of operation, having started as the program in “Cellular and Genetic Etiology, Diagnosis and Therapy of Human Diseases” in the 2003-2004 academic year. It has proved to be a remarkable success story over this period, ably achieving its founding overarching major aims: To train B.Sc. biologists and other basic scientists as well as M.D. physicians in the basic skills of critical thinking and methods of medical research to become future leaders in biomedical investigation and academic medicine. It is an outstanding program that emphasizes rigorous engagement in multiple disciplines of human diseases, interactions with international leaders in their fields, development of hands-on laboratory skills in contemporary scientific techniques and successful researching a biomedical project that can advance a field. The Program is founded on the concept that achievement by students must be demonstrated at the very highest level, equivalent to what is achieved by those at the best universities of the world. The Program is dedicated to the ideal that it will spawn future scientific leaders in Greece by adhering to the most rigorous regimen of academic preparation combined with research experience at the cutting edge of biomedical knowledge.

##### **Leadership and Faculty of the Program**

The outstanding accomplishments of the Graduate Program on The Molecular Basis of Human Diseases can be credited to its leaders and faculty who have championed its establishment and

continued to strongly support its evolution and development. Among these prominent visionaries are the founding Program Director Professor Dimitris Boumpas, former Professor of Internal Medicine at the University of Crete (now at the University of Athens, but a continuing strong supporter of the Program), Professor of Biochemistry Dimitris Kardassis who is current Director of the Program, and Professor Vassilis Zannis, a former University of Crete faculty member, now at Boston University, who has been a major driving force in establishing the Program and sustaining its vitality. Other key leaders who also provide energy and commitment to the Program include Professor of Rheumatology Prodromos Sidiropoulos, who is also Associate Director of the Program; Professor and Head of Hematology Helen Papadaki; Professor of Clinical Chemistry Cristos Tsatsanis; and Associate Professor and Head of Clinical Microbiology and Microbial Pathogenesis Georgios Chamilos.

The above faculty leaders are the vanguard of a robust group of 30 faculty from the University of Crete and 20 faculty who visit from other Greek or foreign universities, including NYU, Imperial College London, University of Massachusetts, Boston University, Northeastern University, Temple University and the University of Athens. There is also representation from the pharmaceutical industry. It should be emphasized that the Program is also ably supported by the superb administrative efforts of Mary Adamaki. Thus, the Program has enjoyed the strong support from a large assembly of frontline scientists in a variety of biomedical fields that strongly enrich the curriculum and provide a diverse experience at the top level for the students. It is truly inspiring that the Program has been able to assemble and sustain the loyal commitments of all these scientists over a long period, and demonstrates the high regard the scientific members have for the leaders of the Program. Equally impressive is the fact that the Program continues to attract outstanding students, who are bright, energetic and enthusiastic participants in classroom discussions and in their laboratory work.

## **The Curriculum and Student Experience**

The skill sets that students are expected to achieve during a 24 month Masters degree curriculum include a broad spectrum of capabilities beyond basic concepts in molecular medicine. Time is spent honing skills in critical thinking through discussions of scientific publications, in making presentations, in laboratory safety and methods, in scientific writing and in conducting original research of high impact. The formal curriculum is based on a set of rigorous courses during the first 2 semesters that address major areas of the biomedical sciences and human disease. Included in the course topics of Semester 1 are Metabolic and Cardiovascular Disease, Autoimmunity and Infectious Disease, Cancer, Epidemiology and Biostatistics and Neuroscience. In Semester 2 the topics are Regenerative Medicine and Stem cells, Genetic Basis of Inherited Disease and basic laboratory techniques. Lab rotations are then offered prior to a student choosing a project mentor and pursuing a research project, which may be performed at the University of Crete or an outside University. Following the successful completion of the Masters degree, a student may elect to continue on a research project for several more years in pursuit of the PhD degree.

A total of 164 students have been enrolled in the Program since its inception, including 48 students who had already achieved the M.D. degree. Many of the students have elected to perform their Masters degree research project abroad, having done so at top universities such as Harvard Medical School, New York University, Temple University and Boston University. There has been a good distribution of students in terms of gender and a nearly perfect record of graduation to the Masters degree. Achievements by the students in the Program have been outstanding, as evidenced by many dozens of original, peer reviewed publications as co-authors since the last External Review in 2011. Their publications include several in the highest impact journals such as Nature Medicine, Cell, The Journal of Clinical Investigation and Immunity. Further demonstration of high achievement has been the outstanding accomplishments of the Program graduates following completion of their degree, as exemplified by attaining excellent postdoctoral positions (e.g., UCLA, Columbia and NYU), appointments as Assistant Professors

(e.g., Columbia University and University of Crete) and positions at Novartis. These metrics firmly demonstrate that graduates of this Program are operating at the leading edge of their respective fields in laboratories around the world, a truly outstanding mark for the Program.

Meetings with the Program leaders and past and current students during a full day of on site presentations and discussions at the University of Crete (October 7, 2018) convinced the External Review Committee that continuous effort has been made over the years to steadily improve and refine the above curriculum. The recommendations of previous External Reviews have been taken seriously and acted upon, and the resulting evolution of the Program is now at the point where there is great satisfaction by the students as well as the faculty. Importantly, the students emphasized how much they appreciated the demonstrated commitment and steadfast perseverance of the leadership of the Program, including Professor Zannis, and in particular the efforts of the Director, Professor Kardassis, in support of the program and in mentoring of students. To a very large extent, the Program curriculum is at a quite mature stage and superbly fosters the scientific development, maturity and research capability of its students.

### **Recommendations of the External Review Committee**

The External Review Committee was impressed by the substantial evidence of high accomplishment of the Program faculty and students over the past 7 years. The Program obviously remains vibrant, effective and innovative in promoting its students' scientific training in contemporary biomedical fields. The faculty are to be congratulated for a terrific effort and for outstanding stewardship of this graduate Program. The Program should serve as a model to be emulated by other universities for training basic scientists and medical doctors in the fundamentals of effective research strategies, approaches and methods. We congratulate all involved in making this Program outstanding. The University of Crete and the Medical School should note that there is a huge return on investment in this graduate Program, and when funds become available the Program deserves such investment.

In the context of the overall outstanding success of the Program, the External Review Committee also noted a number of issues that should be considered by the Program Management Team for further improvements:

### **1. Enhance the number of MD students in the Program.**

Both the faculty and the past and current students of the Program acknowledge the significant advantages of enrolling MDs along with B.Sc. students in the Program. These advantages include the enrichment for both types of students by the other type, based on their differing skills. The basic science students voiced their high appreciation for the presence of MDs in the class, as they provide clinical information about the diseases they are studying and practical information that comes from time spent in the clinic. Conversely, training in the Program of MDs provides them with the skills that are needed to both practice and advance knowledge on treatments of patients. The future of clinical practice is personal, precision medicine based on individual differences in the human genome and the individual responses to disease. Such individual genomic differences will dictate the best treatments, the best medications and the best approaches to individual disease states. Physicians who are highly trained in genetics and molecular mechanisms of disease, as this Program offers, will be at the forefront of medical practice and will be prepared to move onto the PhD degree and a successful career in academic medicine. In spite of these positive features, the number of MDs attracted to the Program has fallen, likely based on the extra 2 years it takes to obtain the Masters degree, the pressure to move on to the clinic to complete training and perhaps lack of understanding on how powerful this extra training will be for their careers. Thus, for all the above positive reasons to increase inclusion of medical personnel, the faculty should redouble their efforts to attract more MDs into the graduate Program. We recommend considering the following approaches to accomplish this:

- a. **Reduce the extra time it takes an MD to obtain the Masters degree.** The graduate Program coursework should be integrated into the medical curriculum such that medical student elective time can be used for taking coursework in the Masters Program. During the

current faculty effort to modify the medical curriculum, the Program faculty leadership should make proposals to incorporate a scientific track in the medical curriculum which is based on taking the graduate Program courses. This would potentially reduce the time it takes for MDs to obtain the Masters degree to only 1 extra year, which would consist of the laboratory project work for the thesis.

- b. **Articulate a better value proposition of why the MDs will benefit from the program.** This would include better advertising to the MD class, hopefully at the very start of their entry into medical school, or even before they enter, using electronic and hard copy write-ups. It is important to highlight the advantages and answer the question: What will you get out of this? The answers would include high level future training outside the country, higher perception of their training, the benefit from connections to other countries and being a much better and more effective doctor.
- c. **Advertise heavily to medical specialties that are likely to be more interested.** Such specialties as pathology and infectious disease may be more prone to hear the message. Perhaps better liaisons with the faculty in such specialties would help to spread the message. Personal contact with students in these specialties to articulate the advantages on a one to one basis may also help.
- d. **Institute a “Human Disease Research Workshop” in which all medical students attend.** Perhaps this could be done early in the first year of medical school in collaboration with a pharmaceutical company sponsor, where outside physician scientist speakers are invited. Importantly, MD alumni of the Program could be invited to mingle with current MD students and articulate the advantages of the Program, in which they had personal experience.
- e. **Consider enriching the B.Sc. student experience by clinical exposure.** In order to satisfy the expressed desire of the basic scientist students in the Program to be exposed to more clinical experience, consider new ways to accomplish this. For example, bringing physicians into the classroom and integrating their talks with a basic scientist who then cooperates on discussing a human disease would be enriching. Such joint lectures that integrate basic science with clinical insights would demonstrate the importance of such collaborations. The

Program should identify topics which physicians/residents can effectively teach or lead joint journal clubs on.

## **2. Increase Program connections internationally**

The Program has gained excellent momentum and outstanding accomplishment, and therefore will gain much by broadening its recognition in the world. Possible favorable outcomes from such increased international attention include opportunities for Program students to gain postdoctoral fellowships in excellent labs outside of Greece as well as opportunities for Crete faculty to collaborate with such laboratories. Equally important is the enrichment that students gain from their increased connections to internationally distinguished scientists. Program faculty should consider the following possible ways to enhance visibility of the Program and connect its students to the international stage:

- a. **Enhance pharmaceutical company connections to the Program.** Funding for guest lecturers and mini-symposia may be obtainable from the pharmaceutical industry, based on their interest in finding talent among the student body. Former students working within companies perhaps could help in forging such relationships with industry and catalyze funding for international connections.
- b. **Organize Invited lectures by international speakers by Skype and Webinars.** This could include asking alumni of the program who are working abroad to lecture to the students through such media. Perhaps they could also advise students through skype based on their experiences abroad.
- c. **Explore making arrangements with other universities to share digital tools and lectures.** Seminars by distinguished scientists at major universities are often available online or could be arranged to be video-recorded and made available on the web.
- d. **Seek ways to fund, support and expand the Program Newsletter.** The importance of the newsletter that reports periodically news and activities of the program is clearly apparent, and the Program needs to find mechanisms to continue this vital activity. The newsletter can be distributed to recipients internationally as well as locally, fostering continued broad interest and support for the Program.
- e. **Seek all available options for philanthropic funding to the Program.**

**3. Consider possible further modifications to balance Course topics.** There may be some major areas of biomedical science that are not adequately represented by the faculty at the University of Crete, but could be enhanced in the courses. One such area mentioned by a student during the External Review is cancer biology, and other such areas may be mesenchymal stem cell biology and big data analysis. It is always advisable to continue to tweak the course in light of the continuing evolution of molecular medicine, adding depth to certain topics as needed. Polling student interest in specific areas may be helpful in this regard, although students will of course be able to focus on their area of interest during their second year in the laboratory project. In addition, it may be advisable to institute rigorous “boot camp” sessions at the beginning of the Program to provide students with quantitative skills and computational methods to deal with big data sets. The External Review Committee applauds the Program faculty for having developed an excellent curriculum of relevant courses at this point, and has full confidence that the faculty will continue to consider adjustments and modifications as deemed beneficial.

**Submitted by the External Review Committee:**

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