Fourth External Review, October 11, 2024

Graduate Program: “The Molecular Basis of Human Diseases”

University of Crete Medical School

Introduction

The Graduate Program on “The Molecular Basis of Human Diseases” at the University of Crete has now passed 20 years of operation and has trained nearly 200 students during this time. It has adhered to its original central aim of promoting translational research by bridging the gap between basic scientists and clinical doctors. It continues to do this by combining basic and translational science training in its courses and highlighting the molecular and cellular basis of human diseases in its curriculum, including laboratory experience. Nine courses are offered in various exciting areas of biomedical sciences over the course of the first two semesters, each headed by highly committed course directors and faculty with high expertise in the topics. Over a dozen prominent scientists are brought in as faculty from other countries to further enrich the curriculum. The Program also offers excellent laboratory training in basic and translational sciences through thesis research in laboratory groups in Greece and other countries, including Europe and the United States. The faculty of the Program has grown increasingly since its inception to a total of 75 , with 5 faculty joining in the last 5 years. It was the first graduate program in Greece in which English was the primary language of teaching. Upon successful completion of the courses and research thesis, the Program confers the Masters Degree in “Molecular Basis of Human Diseases” and has a 98% success rate in students completing requirements for this degree. With this degree in hand, many students continue their training towards the PhD degree, working in superb laboratories in Greece and around the world.

The Program is now acknowledged to be among the very top graduate programs in the country for a Masters degree, and is known for its unique qualities and innovations. Among these are: 1. the mix of students with BSc and MD degrees in the same class and the combinations of faculty with PhD and MD degrees that bring a highly integrated view of the biomedical sciences, blending basic and clinical science as one. 2. an emphasis on new methodologies and tools for deep investigation of molecular and cellular mechanisms, 3. high priority for training in critical thinking and critical evaluation of literature. 4. the training of students in writing research papers and review articles, and presenting analyses of published work to faculty and students to enhance communication skills. In addition to these features, a major attractant to this Program is the opportunity to choose outstanding laboratories in Greece and abroad for thesis work, based on the laudable efforts of the Program to forge collaborative arrangements with top laboratories internationally. The Program continues to be committed to the concept that achievement by students must be at the very top tier, comparable to those at the best universities worldwide. The Program aspires to spawn future scientific leaders in Greece through rigorous academic preparation combined with research experience at the cutting edge of biomedical science.

In summary, the Graduate Program in “Molecular Basis of Human Diseases” at the University of Crete Medical School is now a well-established and distinguished Masters Degree awarding enterprise. It is highly regarded for preparing students for continuing to PhD training and moving to productive careers in Academia, Research Institutes, Biotechnology Companies and large Pharmaceutical Corporations.

Leadership and Faculty of the Program

The evolution of the MBHD Graduate Program to national prominence can be traced to the zeal and continued commitment of several founding scientist leaders, who themselves are outstanding accomplished biomedical investigators. Among these prominent visionaries are the founding Program Director Professor Dimitris Boumpas, former Professor of Internal Medicine at the University of Crete, who became Professor

at the University of Athens while maintaining his strong support of the MBHD graduate Program; Professor of Biochemistry Dimitris Kardassis, previous Director of the Program who currently serves on the Management Coordinating Committee; and Professor Vassilis Zannis, a former University of Crete and Boston University distinguished scientist and academic leader, who has been a major driving force in establishing the Program and sustaining its vitality as a Course leader. These founding leaders are joined in their strong support and commitment by the current Director of the MBHD Graduate Program, Professor of Rheumatology Prodromos Sidiropoulos, and members of the Management Coordinating Committee, Professor of Clinical Chemistry Cristos Tsatsanis, Professor of Parasitology, Clinical Microbiology and Microbial Pathogenesis Georgios Chamilos, and Professor of Biochemistry Panagiotis Verginis. These superb biomedical scientists are in turn joined by several other distinguished faculty who act as Course leaders in the Program, including George Bertsias, Aristidis Eliopoulos, Ioannis Zaganas, Charalambos Pontikoglou, and Eirini Dermitzaldi. Each of the course leaders is a scientific expert in the course topic, bringing great expertise specifically to each field covered.

The above faculty leaders are the vanguard of a robust group of 40 faculty from the University of Crete and 35 faculty who visit from other Greek or foreign universities, including NYU, Imperial College London, University of Massachusetts Chan Medical School, Boston University, Northeastern University, Temple University, University of Cincinnati College of Medicine, Karolinska Institute, University of Cyprus, Harvard Medical School, Mount Sinai School of Medicine, University of North Carolina, University of Minho and the University of Athens. 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 Program is also ably and strongly supported by the superb administrative efforts of Mary Adamaki, who is a talented coordinator and administrator of all aspects of the Program.

A full day meeting of the External Evaluators with Program Director Prodromos Sidiropoulos, MD, PhD, Program faculty leaders and several of the Course leaders revealed the depth of innovation, enthusiasm and motivation for the MBHD Graduate Program. Professor Eleni Papadaki, former member of the Management and Coordinating Committee and currently Dean of the Medical School, provided an overview of the Graduate Programs in the Medical School, highlighting the broader context in which the MBHD Graduate Program operates. This was an exciting lecture, as it opened the possibility of greater interactions among students of different Programs that overlap in some key areas of mutual interest. Professor Maria Vamvakaki, Vice Rector of Academic Affairs, provided further important context and perspectives of graduate studies at the University of Crete, and Professor Vassilis Zannis provided exciting success stories of many of the graduates of the MBHD Graduate Program who have gone on to accomplish major advancements and excellent careers. Professor Diomedes Logothetis of Northeastern University and Professor Panagiotis Verginis of the University of Crete provided insights into the courses and experiences of the students. Professor Verginis provided important insights into how his course focused on skills of critical thinking and critical analysis of publications, an impressive aspect of the student experience. Dr. Silvia Corvera, Professor of Molecular Medicine at the University of Massachusetts Chan Medical School presented a detailed overview of a competency-based approach for world class graduate training, which opens the way for further consideration of implementing new metrics for assessing student outcomes. Finally, Professors Boumpas and Kardassis provided critical appraisals of the MBHD Graduate Program from their perspectives as former Directors. The strengths and challenges outlined by Professor Kardassis served as a thoughtful and valuable self-appraisal of the Program for the Evaluators to assess and discuss. Overall, the Evaluation Committee members thank Director Prodromos Sidiropoulos and all the participants for a stimulating day of information exchange and discussions, which led to

a deep understanding of the MBHD Graduate Program accomplishments and its challenges.

The Curriculum and Student Experience

The MBHD Graduate Program includes a curriculum of formal courses that includes 9 modules over the course of the first academic year: Metabolic and Cardiovascular Disease; Autoimmunity and Infectious Disease; Biostatistics, Clinical Methodology and Epidemiology; Neoplasmatic Diseases; Writing and Presentations, Ethics and Lab safety; Neuropsychiatric Diseases; Regenerative Medicine and Stem cells; Introduction to Basic Research Methodology; and Graduate Laboratory Training. 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 3 or more years in pursuit of the PhD degree. An impressive number of MBHD students are pursuing the PhD degree in excellent laboratories in numerous countries outside of Greece, including Germany, Austria, Switzerland, Spain and the United States. The publication output and record of past and present students continues to be consistent and of high quality, including publications in journals such as Nature Communications, Blood, Genomics, and Frontiers in Endocrinology. 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. The successes of the Program outlined by Professor Zannis in his presentation shows that a large number of graduates occupy Professorships and industry positions of high rank, which also attests to the excellent training they have received in the MBHD Graduate Program.

The Evaluators met with many Program students at a poster session held on Friday, October 11, 2024. The student presentations describing their posters were well done, informative and stimulated vigorous discussions with the Evaluators. All were impressive, and particularly meritorious were posters ranked in order authored by 1:

Despoina Kosmara (Bertias' lab), 2: Vassilis Nidris (Chamilos' lab), 3: Isidoros Axiotis (Kardasis lab), with honorable mention also going to Aikaterini Fyka (Eliopoulos' lab) and Neofotistou-Themeli (Sidiropoulos' lab). Some students also attended the presentations during the October 11th meeting, and made important comments on their experiences in the courses and Program in general. Their input was thoughtful and indicated a mature and intelligent disposition. This is also in keeping with the students' active participation in evaluations of the courses. Their evaluations over the last 5 years indicates a high level of appreciation for the lecturers and course formats, which mostly received grades of between 4 and 5 (with 5 being the highest score) from the students.

In summary, there is a high degree of evaluative interactions between students and faculty, with apparently open and honest critical input on both student performance and faculty teaching and leadership. This appears to be a very healthy environment for continued improvement of the Program, providing strong feedback from students on all aspects of the operation, which should be continued.

Recommendations of the External Review Committee

The Evaluation Committee unanimously believes the MBHD Graduate Program has risen to high distinction for exceptional accomplishment, and is a terrific asset for the University of Crete Medical School. Its steadfast commitment to outstanding training of the next generation of biomedical scientists is unwavering. In particular, the aims of the Program that go beyond simple didactic teaching of the principles, including analyses of the most recent literature, writing review articles, discussing the elements of critical thinking, and practicing scientific communication skills, greatly elevates its impact on the student experience. The MBHD Graduate Program has clearly achieved admirable prominence, and is poised for even greater accomplishments in the future if provided the requisite resources for growth and further improvements. **In this spirit, the Evaluation Committee makes the following recommendations that should be considered by the leadership and faculty of the Program:**

1. Enhance advertising the MBHD Graduate Program to attract more applicants and recognition by other institutions. The Program is a premier operation. Its graduates are thriving, the faculty is engaged, and the students love it. Its strengths lie in the strong connections with the basic science faculty at the University of Crete Medical School and at FORTH. Both institutions have state-of-the-art facilities and well known faculty to draw from. Another strength is the overall vision and ambition: to be the first such ranked program in Greece. Its reputation indeed is beyond Crete and Greece. However, its accomplishments are not as widely known as it deserves. The following new initiatives should be considered:

A. **Define the bold goal(s) of the program in clear brief language.** The website should have this goal (mission statement) in bold font seen in a first glance at the top of the website. It then should be communicated in all ways, including social media, journal ads, sent to faculty colleagues. Department Chairs around the world etc.
B. **Increase International collaborations that familiarize top laboratories around the world to faculty and students of the Program.**
C. **Advertisement, communication and outreach strategies should be** continually prioritized as the Program further develops, especially since the Program stopped advertising in major journals. Foreign students cannot find the program easily.
D. **A newsletter should be re-instituted as a way of increasing internal visibility, especially among medical students, as well as external visibility by sending to collaborators and organizations worldwide.** These newsletters should inform about student activities such as posters and talks presented at internal and external meetings.

2. **Initiate a process of renewal of the MBHD curriculum that adds attractive and updated features.** The current program is very strong with many admirable features, as discussed in this report. However, several aspects can be incorporated that will alleviate some of the acknowledged challenges. Also, such renewal would catalyze

faculty and student discussions, which is an enriching process. Instituting a Curriculum Renewal Task Force with faculty and a few top students for this purpose should be considered.

A. **Incorporate the most up to date technologies into the courses in an organized manner.** State of the art technologies that have transformed medicine (omics, artificial intelligence, imaging, smart wearables, etc) are not currently addressed in as much detail as is needed. A list of such technologies could be put together through group faculty/student discussions, and then such technologies could be strategically placed into the individual courses, one or two into each course, that eliminates redundancy but covers a broad range of techniques.
B. **Consider streamlining the course content to decrease the time taken to complete the courses and increase the time spent in the labs.** Students and some faculty feel the course work is overwhelming at present, with burnout setting in after the first semester. The faculty should consider reducing the number of course topics to reduce the load. **A competency-based approach** as discussed by Professor Corvera on October 11, could be very helpful in this regard, since setting the coursework to efficiently address the agreed upon competencies may reduce the time frame required to reach the goals. Furthermore, having clearly articulated expected competencies will enhance the attractiveness of the Program.
C. **Foster student leadership by assuring the students that their efforts will translate into actions.** The students and the Program would benefit from students taking charge of some enriching activities. For example, they could organize a robust seminar program that operates by zoom and includes world class speakers. Scientists are honored by invitations by students to lecture, and zoom seminars are inexpensive and exciting. The students get to learn how to host distinguished scientists, which also gives them visibility in seeking PhD training and future postdoc opportunities.

3. Make the MBHD Graduate Program more attractive to medical students. It is generally agreed that having medical students in the Program is desirable for several important reasons, including bringing added expertise in translational aspects of the basic science content. Attracting medical students into the Program was a previous recommendation that has not been successfully addressed, as there are no MDs in the first year of the Program this cycle, and the Evaluation Committee acknowledges the difficulties in doing so. However, some further approaches should be attempted in addition to the previous specific recommendations:

A. **Decrease the overall time requirement to obtain the PhD following the Masters degree.** If a competency-based approach were instituted, the time requirement of 3 years after the Masters degree could be eliminated. This would also be attractive to students without the MD degree, as the time requirement is artificial and the PhD degree competencies could be achieved by some students more rapidly. The long time frame for training prior to entry into a faculty or industrial position is a problem beyond Greece, and the Program could lead the way in addressing this problem by creative approaches.
B. **Incorporate some Program material into the medical school curriculum.** Perhaps this could be done formally or perhaps science/social events could be held that would attract medical school student attention. Also, might there be a way to incorporate material into the Graduate Program that is considered essential for some MD career tracks at the Medical School? Perhaps some labs could be open to medical students to work in the summer. The personal value of the Program should be made clear to the students, and incentives perhaps could be instituted such as higher position title and/or salary when taking a position in the clinic.

4. Redouble efforts to obtain more funding for the Program. There are currently too few laboratories that can take on students for their thesis research. While the above recommendations can be initiated without a large influx of resources, it is also acknowledged by the Evaluators that lack of adequate funding for research is a major

obstacle for the Program. Efforts by the leadership and faculty to increase funding have been made to higher authorities without much success, nor has there been success at reducing the layers of bureaucracy in ordering reagents and operating a laboratory. **This problem also extends to the issue of Brain Drain from Crete and the country, a major loss of talent for Greece.** Better funding from faculty and/or the University is necessary for long term sustainability of the Program, and the University in particular should assume additional responsibility for increasing funding. Although frustrating, perhaps additional efforts could also be made to indirectly increase resources as follows.

A. **Increase efforts to connect with Biotechnology and Bio-Pharma companies in Greece.** Increased advertising and marketing of the Program as described in item 1 above will help in this regard. However, continued efforts at contacting key top scientists at such companies to explain the potential source of talent that can come from the Program may yield connections that could lead to investments into the Program. The recently approved law in Greece that allows partnerships between industry and academia in supporting graduate studies should be utilized by the Program.
B. **Increased efforts to connect with academic collaborators internationally.** Such collaborations can often lead to funding opportunities that are not available to individual scientists in Greece. These types of collaborations also serve to increase the recognition of the Program and the talent within. Students should be encouraged to contact potential collaborators in their thesis work, which will also foster connections to students and postdocs in such laboratories.

As a final note to the leadership of the Program, we suggest that priorities among the above recommendations are decided upon for focused effort, and that progress is tracked by an internal group to assure advancement is made in those areas.

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