

Master's Degree in Biomedical Omics

Background

Sequencing of the human genome opened a new era of biomedicine that will lead to an unprecedented revolution in the understanding of diseases and, consequently, in prevention and treatment strategies as well as in healthcare system organization. The founding element of this revolution is the possibility to decode diseases on the basis of causal genetic and environmental mechanisms. The most striking practical application is the development of treatment modalities exploiting agents that act directly on the molecular mechanisms implicated in disease and the quantification of genetic and environmental risk (precision medicine). The impact of precision medicine is most evident in oncology. Numerous drugs targeting specific genomic alterations or immune surveillance mechanisms responsible for tumor growth (targeted- and immune-therapies) are employed routinely in cancer therapy and have radically changed the natural history of specific tumor types.

One of the critical features of precision medicine is the possibility to quantify biological or clinical phenotypes through so-called “omics” analyses (genomics, epigenomics, proteomics, metabolomics, microbiomics, digital imaging, radiomics and radiogenomics). The availability of quantitative analysis tools favors the transfer of disease risk assessment from a population to an individual, and the choice of treatment from disease to patient (personalized medicine). Omics analyses have, therefore, pervaded the scientific approach in both basic and clinical research and in routine clinical diagnostics. Consequently, most hospitals and research institutions (both academic and industrial) have already set up laboratories dedicated to omics analyses, or intend to do so.

The staff employed in such laboratories are expected to perform extremely complex and specialized tasks, including: i) understand the scientific/clinical question at the basis of the requested analyses in order to select appropriate laboratory protocols; ii) carry out the selected omics analysis; iii) interpret results in order to evaluate whether the analyses answered the scientific questions posed (and possibly modify the protocols used for the analysis itself). Moreover, they must adapt standard protocols to the local scientific and logistic needs, and incorporate continuous technological advances in the field. Although the required skills are specialized and complex, there is currently no university course specifically designed to train professionals in omics sciences. To date, the members of omics laboratories are generally researchers that decide to work in this emerging field. This solution is not always optimal and there is growing demand for expert personnel. The Master's Degree in Biomedical Omics has been designed with the aim of filling this gap.

About the course

The Master's Degree (Laurea Magistrale) in Biomedical Omics is an international program organized by the Department of Oncology and Hemato-oncology (DIPO) of the University of Milan. The course aims to train specialists in omics technologies who will work in clinical or research omics laboratories or biotech companies. Accordingly, graduates will develop key competences including the ability to design experiments, manage the work flow, analyze and interpret omics data, as well as create applications for future developments in omics approaches in the medical field.

Students will be exposed to the international community of omics scientists and teachers. They will participate in laboratory activities and become familiar with medical diagnostic pipelines. Technology transfer, legal and social implications of omics data generation and science communication, including specific training in public speaking, will also be fostered.

The program will recruit a maximum of 40 students a year. Candidates must hold a Bachelor's degree (Laurea Triennale) in biology, biotechnology, chemistry or pharmaceutical sciences. Faculty will include university professors and international omics experts. All activities will be held in English.

The Master's Degree in Biomedical Omics will be promoted through a press conference to be held in March 2020 and will have a dedicated web site.

The Master's program was approved by the Senato Accademico of the University of Milan on January 14, 2020 and has been submitted to ANVUR and CUN (decision expected by the end of February). It will start in the academic year 2020-20 (September 2020).

Main topics covered by the program

- Omics:
 - o Genomics and Epigenomics (including transcriptomics and metagenomics)
 - o Proteomics and metabolomics
 - o High-content and high-throughput imaging (including radiomics)
 - o High-throughput screening
 - o Bioinformatics and biostatistics
- Clinical applications of omics technologies: molecular diagnostics, patient stratification, clinical trial definition and disease risk-assessment in oncology, hematology, cardiology, neurodegenerative disease and medical genetics.
- Legal, ethical and economic implications of omics analyses
- Technology transfer
- Lab management
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Educational Activities

The course is divided into three types of educational activities:

1) Theoretical activities (University of Milan at Filarete).

- a. Upfront and web-based lecture series
- b. Thematic seminars
- c. Journal clubs. Innovations in the field of omics technologies will be discussed regularly through journal clubs elaborated by the students. This will represent a crucial activity given the lack of textbooks and the rapid evolution of the field.
- d. International seminars. Six seminars held by international speakers will be organized on specific topics each year.

2) Laboratory Activities (partner institutions).

- a. Rotations in omics laboratories. Each student will rotate in a minimum of four omics laboratories for 2-3 months. Genomics and proteomics will constitute mandatory rotations, while others will be elective.
- b. Thesis project. Each student will carry out a thesis project for the duration of one year (*i.e.*, the entire second year of the program).

3) Clinical Activities (partner institutions).

Students will be exposed to the activities of the Molecular Tumor Board of the research hospitals partnered with the program.

Opportunities for graduates and partners

We envisage the institution of a graduation day to become a key event of the program. It will comprise an *Annual Undergraduate Research Symposium*, where graduating students will present their thesis work. Such an event will provide an opportunity to disseminate and market the program and all partners, while for the graduates it will become a job marker. Efforts will be made to publicize the event and involve scientists from other research hospitals and biotech companies.

Partners

Partner institutions currently include IRCCS Istituto Europeo di Oncologia (IEO) and Istituto Nazionale di Genetica Molecolare (INGM). Other Institutions that have been contacted or will be contacted include: i) Institutions that are already DIPO sites (Istituto FIRC di Oncologia Molecolare, Policlinico di Milano, Ospedale Niguarda, Ospedale Sacco); Biotech Companies or Life-Science Pharma in the area of Milan through their organizations (AssoBiotech and AssoLombarda).