

# MD/MS IN GENOMIC MEDICINE

## Be a part of the future of genomic and personalized medicine!

This 4-year concurrent master's degree in Genomic Medicine will provide you with the background, knowledge, and understanding to integrate the ever expanding field of genomics into your practice. No matter which medical specialty you choose, genomic medicine is increasingly becoming an integral part of patient care with the use of predictive clinical sequencing, pharmacogenetics, and whole genome analysis.

### Educational Mission of the MD/MS Program in Genomic Medicine

The educational mission of the program is to graduate clinicians with the ability to integrate genomic knowledge into their clinical practice. In collaboration with the Hussman Institute for Human Genomics, graduates will be trained in human genetics, family history, diagnostic genomic tests, high throughput sequencing, pharmacogenomics and the newest genomic concepts and approaches. The MD/MS degree will prepare students to be leaders in the adoption and integration of these methods in routine clinical care.

### The MD/MS degree program in Genomic Medicine will provide:

- Both degrees obtained during 4 year MD degree
- Integrated and innovative training in both clinical and human genomics
- Online coursework coupled with small group learning sessions for smooth integration into your schedule
- Hands-on experience analyzing and interpreting genome sequence data
- Capstone experience featuring clinical case descriptions, journal club, and individual research projects

### Applying for the MD/MS Program in Genomic Medicine: Online application (<http://biomed.med.miami.edu/apply/apply-md-ms-in-genomic-medicine/>)

- Applicants must be accepted first-year medical students in the UM Miller School of Medicine. The first block of MS courses begin in the 1st academic semester (fall) of the first year.
- Applications are due by June 1st of each year.
- The academic prerequisites are the same as those for the regular MD program.
- Graduate Record Exam (GRE) test scores are not required to apply to the program.
- Applicants will be notified of their acceptance status no later than June 30th for coursework that will begin in the Fall semester of the first year of medical school.
- Tuition is equal to UM Miller School of Medicine dual degree tuition.

For additional information (<http://medgen.med.miami.edu/education/msgm/>), please contact Laura Aladro, Manager of Programs, [laura.aladro@med.miami.edu](mailto:laura.aladro@med.miami.edu) (<http://bulletin.miami.edu/graduate-academic-programs/medicine/md-ms/laura.aladro@med.miami.edu>)

## Curriculum Requirements

Students will complete all GNM courses and follow the NextGenMD curriculum listed below.

Code	Title	Credit Hours
<b>MD Requirements</b>		<b>136</b>
Refer to the link below for more information on the MD Dual/Joint Degree Program requirements. <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/md">https://bulletin.miami.edu/graduate-academic-programs/medicine/md</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/md/">https://bulletin.miami.edu/graduate-academic-programs/medicine/md/</a> )		
<b>MS Requirements (30-35 credits)</b>		
GNM 602	Clinical Applications of Genomic Medicine II	3
GNM 605	Research Ethics	1
GNM 610	Clinical Applications of Genomic Medicine I	3
GNM 630	Clinical Applications of Genomic Medicine III	4
GNM 631	Genomic Medicine Laboratory	3
GNM 660	Computational Methods for Genomic Medicine	3
GNM 680	Genomic Ethics and Public Policy	3
GNM 690	MSGM Capstone	6-12
MDR 890	Genetics and Metabolic Diseases (two 2-week rotations are required for a total of 4 credits)	4
<b>Total Credit Hours</b>		<b>166-172</b>

## Plan of Study- Medical

Students will complete all GNM courses and follow the NextGenMD curriculum listed on the MD Program curriculum tab. (<http://bulletin.miami.edu/graduate-academic-programs/medicine/md/#curriculumtext>)

## Plan of Study- Genomic Medicine

The Master's in Genomic Medicine (MSGM) coursework is concurrent with the UM Miller School of Medicine MD Program beginning in fall semester of the first year and ending upon completion of the MD program in the 4th year. Each course is made up of self-guided online instruction and reading and in-person small group work. In Phase 1 and 3 of the medical school curriculum, self-guided instruction is expected to require approximately 3 hours per week of time commitment. Small group work is an additional 3-hour block of time per week that will be determined upon the MD program schedule for that semester. Up to 3 additional hours per week may be required for assignments, projects, and review. Years 3 and 4 contain a clinical clerkship elective and the MSGM Capstone that will culminate in a written portfolio and public presentation of the Capstone experience.

<b>Year One</b>		
<b>Fall</b>		<b>Credit Hours</b>
GNM 610	Clinical Applications of Genomic Medicine I	3
GNM 660	Computational Methods for Genomic Medicine	3
<b>Credit Hours</b>		<b>6</b>
<b>Spring</b>		
GNM 680	Genomic Ethics and Public Policy	3
GNM 631	Genomic Medicine Laboratory	3
<b>Credit Hours</b>		<b>6</b>
<b>Summer</b>		
GNM 605	Research Ethics	1
<b>Credit Hours</b>		<b>1</b>
<b>Year Three</b>		
<b>Fall</b>		
MDR 890	Genetics and Metabolic Diseases (two 2-week sessions - 2 credits each (shared credits with MD Program (taken anytime during Year 3 and/or Year 4; Phase 3))	4
<b>Credit Hours</b>		<b>4</b>
<b>Spring</b>		
GNM 631	Genomic Medicine Laboratory	3
GNM 602	Clinical Applications of Genomic Medicine II	3
<b>Credit Hours</b>		<b>6</b>
<b>Year Four</b>		
<b>Fall</b>		
GNM 690	MSGM Capstone (Taken anytime during Phase 3)	6-12
<b>Credit Hours</b>		<b>6-12</b>
<b>Total Credit Hours</b>		<b>29-35</b>

The MSGM curriculum is designed to provide mastery of the 18 Core Competencies in Genetics Essential for All Health Professionals as outlined by the National Coalition for Health Professional Education in Genetics (NCHPEG, 2007), plus additional competencies specifically directed towards genomic medicine and anticipated new opportunities that will become available during the course of training.

### Knowledge

- basic human genetics terminology
- the basic patterns of biological inheritance and variation, both within families and within populations
- how identification of disease-associated genetic variations facilitates development of prevention, diagnosis, and treatment options
- the importance of family history (minimum three generations) in assessing predisposition to disease
- the interaction of genetic, environmental, and behavioral factors in predisposition to disease, onset of disease, response to treatment, and maintenance of health
- the difference between clinical diagnosis of disease and identification of genetic predisposition to disease (genetic variation is not strictly correlated with disease manifestation)

- the various factors that influence the client's ability to use genetic information and services, for example: ethnicity, culture, related health beliefs, ability to pay, and health literacy
- the potential physical and/or psychosocial benefits, limitations, and risks of genetic information for individuals, family members, and communities
- the resources available to assist clients seeking genetic information or services, including the types of genetics professionals available and their diverse responsibilities
- the interconnection scientific, socio-ethical and policy issues arising in the context of genomic medicine (e.g. genetic services and testing through the life cycle, informed consent and privacy, patents, discrimination, insurance, etc.)
- one's professional role in the referral to or provision of genetics services, and in follow-up for those services

#### **Basic Genetic Skills**

- gather and use clinically genetic family history information, including at minimum a three-generation history
- identify and refer clients who might benefit from genetic services or from consultation with other professionals for management of issues related to a genetic diagnosis
- explain effectively the reasons for and benefits of genetic services
- use information technology to obtain credible, current information about genetics
- assure that the informed-consent process for genetic testing includes appropriate information about the potential risks, benefits, and limitations of the test in question

#### **Genomic Skills**

- understand next-generation sequencing
- understand basic bioinformatics and key terms important for clinical use
- understand basic pharmacogenetics terms important for informed clinical use

#### **Attitudes**

- appreciate the sensitivity of genetic information and the need for privacy and confidentiality
- understand the added concerns brought forward by the availability of clinical high-throughput sequencing
- appreciate the difference in cultural approaches to genetic information
- seek coordination and collaboration with an interdisciplinary team of health professionals

#### **GNM 602. Clinical Applications of Genomic Medicine II. 3 Credit Hours.**

The Clinical Applications of Genomic Medicine series provides genomic medicine case studies and systems-based learning. Topics covered in the fall include cardiovascular, respiratory, renal/urinary, gastrointestinal/nutritional systems.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

#### **GNM 605. Research Ethics. 1 Credit Hour.**

This course introduces foundational concepts in research ethics in preparation for conducting the genomic medicine practicum. Online Human Subjects Research and Responsible Conduct of Research training through the CITI program website will be supplemented with three hours of in-person discussion sessions.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

#### **GNM 610. Clinical Applications of Genomic Medicine I. 3 Credit Hours.**

This course provides introductory background for understanding genomics, genomic techniques as well as provides genomic medicine case studies and systems-based learning. Initial topics include basic concepts of genomic medicine, genomic techniques involved in clinical applications, integration of genomic medicine into clinical setting, importance of translational research, benefits for patient and physician, transitioning with the medical curriculum into case studies. This course is focused on complex genetic disorders, and use of web-based tools to use in clinical work.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GNM 630. Clinical Applications of Genomic Medicine III. 4 Credit Hours.**

The primary objective of this course is to prepare students to evaluate the clinical utility of a genetic test and apply that information in a clinical setting. Illustrations of these concepts are drawn from the systems-based curriculum spanning December (ophthalmology and dermatology) and spring (rheumatology, infection & immunity, hematology & oncology, diabetes & metabolism, endocrinology & reproductive medicine). The class will meet once each week (2 hours each session), for literature-based discussion sessions and case-based learning.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GNM 631. Genomic Medicine Laboratory. 3 Credit Hours.**

Students will rotate in the molecular genetics and biochemical genetics diagnostic laboratories, gaining experience with genomic testing in a clinical setting and interpretation and communication of results.

**Components:** LAB.

**Grading:** CNC.

**Typically Offered:** Spring.

**GNM 660. Computational Methods for Genomic Medicine. 3 Credit Hours.**

The objective of this course is to gain a working knowledge of computational methods utilized in primary and secondary analysis of genomic technologies and apply these to a clinical setting. This will prepare students to perform practical data analysis in the GNM 631 course offered in Spring.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**GNM 680. Genomic Ethics and Public Policy. 3 Credit Hours.**

This course provides an introduction to the scientific, socio-ethical and policy issues arising in the context of genomic medicine. It is designed to improve your critical thinking and give you the tools to evaluate the wide range of challenges that genomic medicine brings to individuals and societies alike. We will cover a broad spectrum of topics, from the history of eugenics, to genetic testing and screening through the life cycle (i.e. pre-implantation and pre-natal testing, newborn, population and carrier screening, direct-to-consumer genetic testing), as well as bioethical (i.e., informed consent, privacy, confidentiality, etc.), policy (i.e., professional duties, patents, discrimination, etc.), and societal issues (i.e. health disparities).

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GNM 690. MSGM Capstone. 6-12 Credit Hours.**

The purpose of the Capstone Segment is to provide the research and clinical application aspects of training. It can be initiated at any point after admission to the MSGM Program, and results in 6 credits earned in Spring of Year 4. All components (case reports, mentored research project, genomic medicine education) will be summarized in a portfolio of work and presented at the end of the Capstone.

**Components:** LAB.

**Grading:** SUS.

**Typically Offered:** Spring.