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MEMORANDUM

To: Donna E. Shalala, President

From: Richard L. Williamson
Chair, Faculty Senate

Date: April 25, 2012

Subject: Faculty Senate Legislation #2011-53(B) – Establishment of a Master's Degree Program in Genomic Medicine (MSGM) in the Miller School of Medicine

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At its April 18, 2012 meeting, the Faculty Senate unanimously approved the Miller School of Medicine's proposal to establish a Master of Science degree program in Genomic Medicine. The educational mission of this program is to graduate clinicians with the ability and desire to integrate genomic knowledge into clinical practice. This program is a 30 semester-hour program comprising 24 credit-hours of coursework and 6 credit-hours of research practicum. It is structured to allow the completion of both the traditional MD curriculum and the MSGM program in four years.

The supporting materials are enclosed for your reference.

This legislation is now forwarded to you for your action.

RW/rh

Enclosure

cc: Thomas LeBlanc, Executive Vice President and Provost
Pascal Goldschmidt, Senior Vice President and Dean, Miller School of Medicine
William Scott, Professor and Vice Chair, Department of Human Genetics

CAPSULE: Faculty Senate #2011-53(B) – Establishment of Master's Degree Program in Genomic Medicine (MSGM) in the Miller School of Medicine

PRESIDENT'S RESPONSE

APPROVED: _____ DATE: 4/30/12
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: DEAN GOLDSCHMIDT

EFFECTIVE DATE OF LEGISLATION: IMMEDIATELY
(if other than June 1 next following)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED): _____

Proposal for a Master's Degree Program in Genomic Medicine

Executive Summary

The practice of medicine increasingly involves consideration of the genetic bases of disease pathogenesis and response to treatment. This practice is variously termed "personalized" or "genomic" medicine," or is part of a broader approach called "translational medicine". The core idea is that an individual's genetic background can be used to tailor or refine medical care, emphasizing prevention strategies among the most susceptible individuals and targeted therapies to individuals most likely to respond to a particular treatment. Because this work cannot realistically be done by a handful of qualified medical geneticists, it is critical to train physicians and other clinical professionals to interpret clinical tests based on genomic data, and to understand how to use this information to provide optimal patient care.

The educational mission of the Master of Science in Genomic Medicine (MSGM) program at the University of Miami Miller School of Medicine (UMMSM) is to graduate clinicians with the ability and desire to integrate genomic knowledge into clinical practice. Graduates will be trained in the use of detailed family genetic history, diagnostic genomic tests, high throughput sequencing and pharmacogenomic knowledge. The MSGM degree will prepare students to be leaders in the adoption and integration of these methods in routine clinical care.

UMMSM is the ideal setting for such a pioneering program. The recent significant investment in world-class genomics research facilities at the Hussman Institute for Human Genomics, coupled with the creation of the Dr. John T. Macdonald Foundation Department of Human Genetics, provides a rich environment for this training program. The continued success of the Four Year Pathway in Human Genetics and Genomics (initiated in 2005) demonstrates the interest of many UMMSM medical students in genomics and genomic medicine. A critical mass of clinical and research faculty and clinical and research laboratory facilities exists for the proposed program. UMMSM has sufficient library resources to support the instructional component, and administrative and programmatic space exists within the department and institute's facilities in the Biomedical Research Building.

The proposed MSGM program is a 30 semester-hour program comprising 24 credit-hours of coursework and 6 credit-hours of research practicum. Students will be introduced to the program during the medical school application and interview process, and interested students will be recruited after admission to medical school to apply to the MSGM program. Students will begin MSGM studies in January of the second semester. The program is structured to allow the completion of both the traditional MD curriculum and the MSGM program in four years. Students completing the MD degree will go on to further training in residency programs. Completion of the MSGM degree will demonstrate a commitment to incorporating genomic knowledge into clinical care, and potentially increase the likelihood of matching to residency programs looking for

such backgrounds. MSGM graduates would be prepared to lead the incorporation of genomic medicine approaches in their own clinical practices after completing training.

To allow the completion of the MSGM program in the same four years as the MD degree, we have structured instruction in four primary components: 1) **a self-paced supplemental component to each didactic course,** involving directed readings and online video lectures that the students can review at any time, maximizing flexibility. This component mirrors the existing system used in the undergraduate medical curriculum, with which the students are already familiar. 2) **weekly small group discussions** to emphasize topics covered in the online videos, using a classical "case study" format to illustrate an application of genomic information in a disease involving the organ system being discussed at that time in the medical curriculum. 3) **clinical experience through a genomic medicine clerkship** in the 3rd or 4th clinical year 4) **a practicum project** conducted in the final two years, culminating in a master's paper and oral presentation.

The faculty for the MSGM program will be drawn from the existing faculty in the Dr. John T. Macdonald Foundation Department of Human Genetics. Sufficient numbers of clinical and research faculty exist to fulfill instructional requirements, and most courses will be team-taught, minimizing the instructional load for any one faculty member.

The financial model for this program is similar to that used for the recently developed MD/MPH Program. MSGM program support would be drawn from 1) out-of-state tuition charges for enrolling MD students, 2) a pending grant from the Hayward Foundation, and 3) faculty and administrative support from the Department of Human Genetics.

The MSGM program would be unique; no other university in the US currently offers a master's degree with a focus on clinical training in genomic medicine. Other master's degrees in genetics are research degrees or lead to certification in genetic counseling. None is structured to be completed contemporaneously with a medical degree. Establishing such a program would place UMMSM at the forefront of educational efforts in genomic medicine, providing a rare opportunity for our graduates to master these competencies during medical school training.

Proposal for a Master's Degree Program in Genomic Medicine

1. Rationale

a. Title of Degree: Master of Science in Genomic Medicine

b. Purpose and Goals:

The mission statement of the MS in Genomic Medicine program is:

> *"The educational mission of the Master of Science in Genomic Medicine (MSGM) program at the University of Miami Miller School of Medicine (UMMSM) is to graduate clinicians with the ability and desire to integrate genomic knowledge into clinical practice. Graduates will be trained in the use of detailed family genetic history, diagnostic genomic tests, high throughput sequencing and pharmacogenomic knowledge. The MSGM degree will prepare students to be leaders in the adoption and integration of these methods in routine clinical care."*

Program Goals

The goals of the MSGM program are to:

- Build upon the strengths of the existing genomics PhD and residency training programs to produce an innovative degree program designed to prepare health professionals for the practice of genomic medicine.
- Define and teach the competencies required of a clinician intending to incorporate genomic medicine approaches in clinical practice.
- Promote career choices in clinical, administrative, research and policy formulation in genomic medicine.
- Graduate leaders for the coming evolution in clinical practice that will increasingly utilize the tools of genomic medicine in the care of the population.

c. Demand/Job Market

The practice of medicine increasingly involves consideration of the genetic bases of disease pathogenesis and response to treatment. This practice is variously termed "personalized" or "genomic" medicine, or is part of a broader approach called "translational medicine." The core idea is that an individual's genetic background can be used to tailor or refine medical care, emphasizing prevention strategies among the most susceptible individuals and targeted therapies to individuals most likely to respond to that particular treatment. Because this work cannot realistically be done by a handful of qualified medical geneticists, it is critical to train physicians and other clinical professionals to interpret clinical tests based on genomic data, and to understand how to use this information in providing optimal patient care.

Evidence that UM medical students *want* additional training in genetics and genomic medicine comes from the strong, consistent interest in the Four-year Pathway in

Genetics and Genomics. Created in 2006 as one of the first such pathways at UMMSM, the Pathway recruits first-year medical students to participate in additional genetic-themed didactic and practical learning experiences during their four years of medical school. The centerpieces of this Pathway are the summer research experience and scholarly portfolio produced during the fourth year, prior to graduation. In this six year span, the Pathway has enrolled 51 students and 9 have graduated having completed the Pathway requirements.

Students completing the MD degree go on to further training in residency programs. Completion of the MSGM degree would demonstrate a commitment to incorporating genomic knowledge into clinical care, and potentially increase the likelihood of matching to residency programs looking for such backgrounds. Individuals graduating the program would be prepared to lead the incorporation of genomic medicine approaches in their own clinical practices after completing training.

The MSGM program would be unique; no other university in the US currently offers a master's degree with a focus on clinical training in genomic medicine. Other master's degrees in genetics are research degrees or lead to certification in genetic counseling. None is structured to be completed contemporaneously with a medical degree.

d. Relationship to other fields and interactions with other programs and departments

Faculty for the MS in Genomic Medicine will largely come from the Dr. John T. Macdonald Foundation Department of Human Genetics, which also directs the Residency Program in Medical Genetics, the Four-year Pathway in Genetics and Genomics, and provides the core teaching faculty for the Interdepartmental PhD program in Human Genetics and Genomics. However, additional UMMSM faculty with clinical or research interests involving genetics and aspects of genomic medicine are anticipated to participate in teaching and mentoring of students through the genomic medicine practicum experience. As the program develops, students in other clinical doctoral training programs (such as Nursing, Physical Therapy, Psychology) may also become interested in pursuing this degree; incorporating faculty from these programs into the MS program faculty would help tailor instruction for these students. Finally, the genomic medicine practicum may be conducted in many settings with faculty from many clinical or basic science departments.

e. Relationship to undergraduate and professional programs

The MS in Genomic Medicine curriculum will be closely aligned with the traditional MD curriculum, and is designed so that a student can complete both the MD and MS in a four-year period. As a degree program focusing on clinical application of genomic data, tailored for medical students with the goal of completion concurrent with the MD, the MS in genomic medicine is distinct from the recently established MS degree in Clinical and Translational Science (which is a research degree targeted to post-graduate trainees and junior faculty). The program is also clearly distinct from the Medical Genetics residency program (focused on clinical training) and PhD in Human Genetics and Genomics (focused on research training).The program does overlap somewhat the

Four-year Pathway in Genetics and Genomics. However, the MS program is intended to provide a more thorough didactic and training experience than the pathway, thus culminating in an additional graduate degree.

2. Resources

a. Library

The University of Miami libraries have adequate resources to support this program. In collaboration with Calder Medical Library staff (led by Jo Ann Van Schaik), we conducted an evaluation of printed and online resources available to support this program. Briefly, we used a set of keywords (Genetics, Genomics, Proteomics, Metabolomics, Genomic medicine, Personalized medicine, Medical genetics, Biochemical genetics, Cytogenetics, Molecular genetics, Clinical genetics, and Pharmacogenetics) to search the library holdings for resources. The resulting lists show 47 book titles and 137 journals are accessible through the library, and a survey of the titles determined that most of the key textbooks and journals in the genetic field are available. Additionally, the Calder Library maintains a Portal for Genomics on the library homepage (calder.med.miami.edu/portals/genomics), which facilitates access to many online databases and genomics resources of interested to this program. These resources are a solid and adequate foundation for the instructional needs of this program. These holdings have also met the research needs of most program faculty members in the past five years.

Additional resources that are needed to support this program include purchasing updated versions of some of the book titles as new editions are released, and perhaps additional titles in rapidly developing fields such as pharmacogenetics and bioinformatics. These are estimated to cost $200-300 per year (assuming 1-3 titles of varying cost). However, at present, no additional special collections are **required** to support this program.

b. Laboratory Facilities, Equipment, and Space:

The University of Miami and the State of Florida have committed substantial resources to developing state-of-the-art genomics and computational laboratories through the Dr. John T. Macdonald Foundation Department of Human Genetics, Hussman Institute for Human Genomics and Center for Computational Science. These research organizations are critical elements in the environment necessary to train students in genomic medicine.

<u>The Dr. John T. Macdonald Foundation Department of Human Genetics and Hussman Institute for Human Genomics</u>

The Dr. John T. Macdonald Foundation Department of Human Genetics (DHG) and Hussman Institute for Human Genomics (HIHG) occupy 72,000 square feet of office and laboratory space in the Biomedical Research Building at the Medical School campus. The DHG Division of Clinical and Translational Genomics occupies approximately

20,000 square feet of laboratory and office space at the Mailman Center for Child Development.

Clinical resources will be provided by the Division of Clinical and Translational Genetics which is an integral part of the Dr John T MacDonald Foundation Department of Human Genetics. Its eleven board-certified clinical faculty and genetic counselors provide state-of-the art clinical services for up to 100 children and adults with genetic diseases every week. The medical students will have the opportunity to attend one of the following outpatient clinics: cancer genetics clinic, general genetics clinic, metabolic disease clinic, deafness clinic, muscular dystrophy clinic, Huntington's disease clinic, neurogenetics clinic and are encouraged to participate in the in-patient consultation service for JMH and UMH.

Housed within the DHG and HIHG are several resources that will facilitate practical training in genomic medicine:

The Biochemical Genetics and Clinical Molecular Genetics Diagnostics Laboratory (CMGDL) are Clinical Laboratory Improvement Amendments (CLIA) certified diagnostic laboratories affiliated with DHG and HIHG. These laboratories perform diagnostic tests for many genetic risk factors for Mendelian and complex diseases, as well as pharmacogenetic tests. These laboratories are important sites for practical training of MSGM students in genomic medicine laboratory procedures and interpretation of test data.

HIHG Center for Genomic Medicine (CGM): The CGM maintains two core facilities relevant to education in genomic medicine:

> Patient Ascertainment Section: This section provides expertise and support for the enrollment of human subjects in genetic research studies. Included in this section are faculty and staff with expertise in ethical, legal, and social issues (ELSI) surrounding genomic research and clinical applications of research results. This expertise is important for discussions of ELSI in the context of genomic medicine.
>
> Biorepository: The biorepository offers high-throughput processing and storage of blood, DNA, RNA, and tissue samples for genomics research. The facility has 4000 square feet to house an automated DNA extraction facility, robotics for allocation and manipulation of samples, and freezers for specimen storage. The biorepository utilizes the Nautilus laboratory information system to track receipt and allocation of each specimen. An important recent addition to the facility is the Brooks Life Sciences A3+ SmaRTStore (automated freezer sample system), which is one of only five such systems in the country. Such equipment will be essential in implementing genomic medicine on large scale, and students will have the opportunity to observe (and potentially receive samples from) this system.

HIHG Center for Genomic Technology (CGT): Four research cores (genotyping, sequencing, microarray, and research & development) are housed in the 10,000 square

foot CGT. The two cores most relevant to genomic medicine education are genotyping and high-throughput sequencing.

The CGT Sequencing Core houses 5 Illumina HiSeq 2000, 2 LifeTechnologies Solid 4s and 1 Ion Torrent PGM next-generation sequencing (NGS) systems, as well as a LifeTechnologies 3730xl and 3130xl for capillary sequencing. Sample library preparation and sequence capture for NGS is fully automated via the use of 2 Caliper Sciclone G3 and 1 Caliper Zephyr liquid handling workstations. The current library preparation capacity for whole genome sequencing is 600 samples per week or 300 samples per week for exome or custom capture preparations. The CGT has extensive experience with all Illumina, Agilent and Nimblegen library preparation and capture protocols for both DNA and RNA.

The Genotyping Core features a number of genotyping platforms ranging from low and medium to high-throughput. The Illumina Infinium and Golden Gate protocols are fully automated with 4 Tecan robots and 1 iscan system, with a capacity of over 1000 samples per week. 2 Affymetrix GeneChip Scanner 3000 Systems and 8 GeneChip Fluidics Station 450s (Genotyping & Gene Expression) allow for a capacity of 500 samples per week. Additional genotyping platforms at the CGT include LifeTechnologies Taqman and Open Array systems as well as Sequenom's MassARRAY Analyzer system. The research results obtained from these cores are translated into clinical tests in the molecular diagnostics laboratory (described above). Data from those clinical tests will be used in practical training on pharmacogenetics and in the genomic medicine laboratory. Students doing their research practica on pre-diagnostic research questions (e.g. identifying genetic markers of disease) may work with data from these facilities.

The HIHG Center for Genetic Epidemiology and Statistical Genetics (CGESG) provides state-of-the-art core resources to manage high-throughput genotype and sequencing data in large familial and case-control datasets. The Center includes faculty researchers with expertise in genetic epidemiology and statistical genetics; these resources will benefit computational and bioinformatics training components of the program. The Genetic Epidemiology Core provides all aspects of genetic analysis in human disease-gene mapping including preprocessing, statistical analysis and post-processing of genetic and related phenotypic data. Software for data analysis and computer simulation is available on four Sun x4150 servers running CentOS. Additional high-performance computing facilities are provided by CCS as described below.

Computational Laboratory Facilities: The DHG and HIHG computer network consists of approximately 260 personal computers running Windows XP, four Sun x4150 servers running Linux, one Sun Ultra SPARC running Solaris 10, a Sun T2000 Oracle database server running the Solaris 10 operating system, and a ten node, 80 CPU cluster running Linux to perform analysis of SOLiD Next Generation Sequencing analysis. Thirteen terabytes (TB) of storage is connected to the database server (HIHG Clinical Database System - PEDIGENE). All machines are kept current with virus protection software and security patches. The University of Miami Medical Information Technology department provides e-

mail services, supports all tape backups, provides the over 3 TB of storage on NetApp systems with nightly incremental snapshots, provides access to the computing environment by authorized users from outside sites using their secure Citrix gateway and virtual private network (VPN), and supports the University of Miami Medical Datacenter, which is a 24/7 monitored facility with uninterruptable power supplies, regular daily incremental backups, and HIPAA-compliant security measures for all computing resources other than desktop PCs and printers. The HIHG database is backed up several times per day to hard disk storage and nightly to tape. In addition, our systems reside behind the University of Miami Medical Information Technology firewall, providing an extra level of security. Data analysis can be run on Linux clusters, the four Sun x4150 Linux servers, and the UNIX server are administered by the Center for Computational Sciences (CCS), University of Miami. High-Performance computing is provided by access to a 576 CPU IBM Power5+ SMP cluster with over 1 TB RAM and 25 TB of High Performance parallel storage and a 5,000+ CPU Linux Cluster with 7.4 TB of aggregate RAM and 70+ TB of High Performance Parallel storage, all managed by CCS. .Most common genetic analysis programs and Bioinformatics tools are available on these Linux clusters, as well as the standard statistical software packages. Four hundred and fifty TB of storage is connected to the personal computer network and Linux cluster and servers. The storage system is regularly backed-up to tape by Medical IT and optimized for workflows. Access to this facility will facilitate student's use of genome sequence information in class and practical training exercises.

Additional laboratory facilities are available in the HIHG Center for Human Molecular Genomics (CHGM), which focuses on functional studies of genetic variation (gene regulation, epigenetics, RNA biology); these studies often are crucial to demonstrating the translational potential of a research result. The HIHG Center for Models of Human Disease (CMHD) provides expertise to show the relevance of variants to human disease by using cellular and animal models. Finally the HIHG Genome Innovation and Therapeutic Center (GIT-C) aims to translate genetic findings into potential therapeutic approaches. Students in the MSGM program will have the opportunity to pursue research projects with faculty mentors working in any of these centers, or additional laboratories on campus.

The state-of-the-art laboratory facilities described above can easily support the needs of this program for laboratory training and data analysis. No additional laboratory resources are required.

c. Other Resources

The DHG has dedicated office space for the program director and program coordinator for administration of the program. A classroom dedicated to graduate courses (BRB 607) has been created (capacity: 20) and will be used for small group instructional sessions. Other conference rooms in the DHG and HIHG may be used as needed for other small group meetings. Students working on research rotations and practicum will

be provided wet or dry laboratory space in the mentor's area in which to conduct their project. No additional resources are required to establish the program.

3. Curriculum

a. Divisions of the Discipline

Human Genetics is a discipline with three primary components: clinical genetics, molecular genetics, and computational genetics. The MSGM program will familiarize students with all three aspects of genetic data, providing knowledge to facilitate application of each type of data in a clinical setting. Therefore, while the program as a whole includes instruction in all three components, as a program geared toward clinicians, it emphasizes utilizing knowledge gained from genomic research in a clinical setting.

b. Adequacy of present undergraduate and graduate curricular structure

The development of this program is a response to a gap in current undergraduate and graduate medical training that is unlikely to be met through revisions to the medical curriculum to increase genetic knowledge. The current MD curriculum includes basic genetics in a first-year course, "Molecular Basis of Life." However, the routine use of genomic data in clinical decision making requires familiarity with more advanced genetic concepts, research approaches, and genomic tools that are not included in this coursework. To date, interested and motivated MD students have elected to participate in the Four Year Pathway in Medical Genetics and Genomics. However, many students have stated that they did not participate (or stopped participating after enrolling) because the Pathway did not culminate in an additional degree or certification. The proposed degree program addresses these concerns by enhancing didactic and practical instruction in genetics and genomic medicine that culminates in a MS degree. The curricular structure of the PhD program in Human Genetics and Genomics provides a research-oriented training in human genetics experimentation and data analysis; while some courses within that curriculum overlap the proposed program in subject matter, the goals of the MSGM program require coursework tailored to these objectives.

c. Required changes, additions and deletions from current program

The MSGM program is designed to be completed during the course of a four-year medical degree. As such, the curriculum comprises new courses developed specfifically for this program. To fit within the medical curriculum schedule, the didactic courses are designed as a mixture of self-paced, online modules, directed readings and weekly small-group discussions.

d. Current or anticipated work with other parts of UM or external agencies

At present, there are no anticipated work opportunities with other parts of UM or external agencies, other than might be arranged as part of a student's practicum experience culminating in a master's paper. Practicum settings are most likely to be

arranged within UM Miller School of Medicine; however, it is possible that a suitable experience in an external setting is identified and approved by the program committee.

e. Detailed Description of the Program

Program Requirements

The proposed MSGM program is a 30 semester-hour program comprising 24 credit-hours of coursework and 6 credit-hours of research practicum. The program is structured to allow the completion of both the traditional MD curriculum and the MSGM program in four years. The program provides:

- Integrated and innovative training in both clinical and human genomics
- Opportunities for genomic research or clinical practicum to complete the required master's paper

Admission Requirements

Students will be introduced to the MSGM program during the medical school application and interview process, and interested students will be recruited after admission to medical school to apply to the MSGM program. Students will begin MSGM studies in January of the second semester of medical school. Applicants from the incoming medical school class wishing to enroll in this program will submit an application with a 400 word letter of intent describing the applicant's interest in genomic medicine. Applications will be reviewed by the MSGM steering committee (see below), and students will be admitted based on the application, a review of the medical school application (college transcripts, MCAT scores, recommendation letter), and personal statement. In situations in which the steering committee is unsure whether to admit a student to the program, a personal interview may be scheduled and additional references sought.

Requirements for the Degree

- Completion of 24 semester-hours of coursework
- A passing grade on the comprehensive examination based on the core coursework
- Completion of 6 research practicum semester-hours and a master's paper describing the research practicum
- Oral presentation of the master's paper
- Other requirements as listed in the Graduate Bulletin under "The Master's Degree-General"

Mission and Learning Objectives

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

1. basic human genetics terminology.
2. the basic patterns of biological inheritance and variation, both within families and within populations.
3. basic knowledge of genomic techniques, including next generation sequencing techniques, allowing informed application of these techniques to clinical medicine.
4. how identification of disease-associated genetic variations facilitates development of prevention, diagnosis, and treatment options.
5. the importance of family history (minimum three generations) in assessing predisposition to disease.
6. the interaction of genetic, environmental, and behavioral factors in predisposition to disease, onset of disease, response to treatment, and maintenance of health.
7. the difference between clinical diagnosis of disease and identification of genetic predisposition to disease (genetic variation is not strictly correlated with disease manifestation).
8. 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.
9. the potential physical and/or psychosocial benefits, limitations, and risks of genetic information for individuals, family members, and communities.
10. the resources available to assist clients seeking genetic information or services, including the types of genetics professionals available and their diverse responsibilities.
11. the ethical, legal and social issues related to genetic testing and recording of genetic information (e.g., privacy, the potential for genetic discrimination in health insurance and employment).
12. one's professional role in the referral to or provision of genetics services, and in follow-up for those services.

Basic Genetic Skills

13. gather and use clinically genetic family history information, including at minimum a three-generation history.
14. 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.
15. explain effectively the reasons for and benefits of genetic services.
16. use information technology to obtain credible, current information about genetics.
17. 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

18. understand next-generation sequencing and medical sequencing
19. understand basic bioinformatics and key terms important for clinical use.
20. understand basic pharmacogenetics terms important for informed clinical use.

Attitudes

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

Assessment Methods of Student Attainment of Learning Objectives

Each course will assess attainment of learning objectives through a combination of assigned homework, papers or projects, and examinations. The mastery of all core competencies will be assessed by a comprehensive written examination created by core course directors and graded by the teaching faculty. The application of these core competencies during the research practicum will be assessed by two readers of the master's paper (the research mentor and one other program faculty member) and their evaluation of the oral presentation of that paper.

Course Descriptions and Schedule

Because of the unique structure of this curriculum, all proposed courses are new offerings. However, lectures and other materials from existing courses in the PhD and medical genetics residency curriculum will be used in online instructional modules and self-directed readings.

(1 credit = 6 hrs in-person small group discussion, 6 hrs online instruction and self-directed reading each unless noted)

Spring Semester, Year 1 (6 credits)

Fundamentals of Genomic Medicine (2 credits, first half-semester)

This course provides an introduction to basic concepts, terminology, and clinical skills important in genomic medicine. Topics include: Introduction to genomic medicine and how it augments and differs from traditional medicine, principles of human genetics, Mendelian and non-mendelian inheritance patterns, complex diseases, genetic variation and gene expression, taking family history, genetic testing guidelines, evaluating genetic tests, using family and personal history in risk assessment, making referrals based on risk, genetic counseling, psychosocial impact of genetics/genetic testing, informed consent.

Genome Ethics and Public Policy (2 credits, second half-semester)

This course builds on Fundamentals of Genomic Medicine, taking a case-based approach to discussing ethical, legal and social issues related to genomic medicine. Topics include genetic testing, living with a genetic diagnosis, factors influencing the use of human genetic information, direct-to-consumer testing, role of society in regulating the use of testing and genetic information, implications for people with disabilities, role of the media in public education, legal issues associated with the use of genetic information.

Clinical Applications of Genomic Medicine I (2 credits, full semester)

The Clinical Applications of Genomic Medicine series provides genomic medicine case studies and systems-based learning paralleling the medical school core curriculum. Initial topics include integration of genomic medicine into clinical setting, importance of translational research, benefits for patient and physician, transitioning with the medical curriculum into case studies and examples on Neuroscience and Behavior and Cardiovascular disease.

Summer, Year 1 (3 credits)

Genomic Medicine Laboratory (3 credits)

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. Practical experience in the laboratory will be augmented by didactic instruction in genetic testing and laboratory procedures, technological platforms (e.g. sequencing technologies, genotyping, mass spectrometry), types of tests, ordering tests, ethical issues, and reporting of results.

Fall, Year 2 (6 credits)

Computational Methods for Genomic Medicine (3 credits)

This course will build on the experience gained in Genomic Medicine Laboratory to provide instruction on basic biostatistical terminologies and tests for clinical genetics data and risk assessment and bioinformatics tools used to provide medical annotation and clinical interpretation.

Clinical Applications of Genomic Medicine II (3 credits)

The Clinical Applications of Genomic Medicine series provides genomic medicine case studies and systems-based learning paralleling the medical school core curriculum. Topics covered in the fall include respiratory system, nephrology, gastroenterology and nutrition.

Spring, Year 2 (6 credits)

Clinical Applications of Genomic Medicine III (4 credits)

The Clinical Applications of Genomic Medicine series provides genomic medicine case studies and systems-based learning paralleling the medical school core curriculum. Topics covered in the spring include rheumatology and infectious diseases, Hematology and Oncology, Endocrinology and Reproduction, Opthalmology and dermatology.

Pharmacogenetics (1 credit)

This course covers pharmacogenetics as a special case of genomic medicine that will be practiced in every setting. The course provides an overview of known drug/gene interactions, interpreting test results, and integrating these results into clinical practice.

Research Ethics (1 credit)

Prior to conducting research as part of the genomic practicum, students will receive training in the responsible conduct of research, protection of human subjects, obtaining regulatory approval,

Years 3 & 4 (9 credits)

Genomic Medicine Clerkship (3 credits)

Students will complete an elective clerkship in genomic medicine or medical genetics completed as part of the MD curriculum.

Genomic Medicine Practicum (6 credits)

Students will choose a mentor and complete a clinical or research practicum focusing on an aspect of genomic medicine. This experience will culminate in a written master's paper and public presentation of the practicum experience.

Estimated Teaching Load for Program Faculty

As in the PhD program in Human Genetics and Genomics, the majority of the didactic courses will be team-taught by two or three program faculty, covering topics concordant with their training and expertise. As can be seen in section 4, many members of the program faculty are qualified to contribute to multiple courses. Currently, we anticipate that program faculty will teach the equivalent of 1-2 semester hours per year. When added to existing PhD and medical school teaching commitments, no faculty member will have a teaching load greater than 5 semester-hours per year.

f. Teaching: What kinds of teaching will prevail in the program, i.e., clinical, classroom, independent research, seminars, online, etc., and in what proportion?

The proposed training program is designed to fit within "free periods" of time in the traditional MD curriculum and enable students to complete both degrees in 4 years. To accomplish this goal, we have adopted a course structure that provides a portion (~50%) of didactic instruction online and through self-directed readings. These are complemented and integrated by in-person small group discussion sessions (50%) to emphasize concepts through discussions of the literature and review of case-studies.

Other courses emphasize practical training (80%) in areas of the discipline, including clinical laboratory and independent research projects, complemented by a small amount of didactic instruction (20%).

g. Describe the expected distribution of graduate students among advisors.

While it is difficult to project what aspect of genomic medicine will most interest students, the program will make an effort to encourage a broad distribution of students across faculty mentors. We project that as the program builds, each faculty mentor will supervise the practicum of 1-2 students at a given time.

h. Describe any colloquia series, special seminars, or conferences that will be held.

The MSGM program will benefit from existing seminar series organized by the DHG and HIHG: 1) a biweekly seminar series on Tuesday afternoon featuring UM genomic researchers reporting on work in progress – this series will be useful for students seeking to identify research mentors; 2) a distinguished speaker series, featuring 4-5 prominent genomic researchers from other institutions, held several times each year at noon.

i. Include Learning Outcomes Assessment Plan (see PDF Attachment 1).

4. **Faculty**:

a. Include the complete C.V. of each faculty member who will participate in the program. The graduate teaching experience and grants received of the person concerned should be included in each C.V.

The complete UM CVs for core program faculty are attached (PDF Attachment 2, alphabetized by last name). Most of the faculty is active in the existing PhD program in Human Genetics and Genomics, with additional faculty actively participating in the Medical Genetics residency training program. These faculty span all three core areas of expertise in genetics (summarized below), and provide a solid basis for training the students in the MSGM program.

Clinical and Medical Genetics: Olaf Bodamer, MD, Jeffery Vance, PhD, MD, Parul Jayakar, MD, Mustafa Tekin, MD, Deborah Barbouth, MD, Stephanie Sacharow, MD, Massimo Morra, MD, Virginia Carver, PhD, Susan Hahn, MS, CGC.

Molecular Genetics: Stephan Zuchner, MD, John Gilbert, PhD, Derek Dykxhoorn, PhD., Juan Young, PhD, Katherina Walz, PhD, Gaofeng Wang, PhD, Liyong Wang, PhD, Claes Wahlestedt, MD, PhD, Mohammed Faghihi, PhD, Jose Silva, PhD, Dale Hedges PhD, Nagi Ayad, PhD.

Statistical Genetics: William Scott, Ph.D., Susan Blanton, Ph.D., Eden Martin, PhD, Margaret Pericak-Vance, PhD, Gary Beecham, PhD., Evadnie Rampersaud, PhD, Jacob McCauley, PhD.

b. Estimate the need for additional faculty, including in each instance

The existing faculty in the DHG and HIHG are sufficient to meet the needs of this program. No additional faculty hires are required.

c. Describe the interaction of the proposed program with other graduate programs, e.g., thesis and dissertation committees.

Faculty outside the core program faculty may participate as guest lecturers in core courses, as second readers of master's papers (if warranted by their expertise). Faculty wishing to serve as research practicum supervisors or more actively in didactic training would need to join the program as teaching faculty. As the research practicum culminates in a master's paper and oral presentation, rather than a thesis, we will not have outside faculty members of thesis examination committees.

5. Students:

a. Estimate the number of students in the program and the pool from which they will be selected.

Students will be recruited from each new class of medical students in the fall of their first year. Based on historical interest in the four-year Pathway in Medical Genetics and Genomics, we project enrolling 7-10 students per year in the MSGM program. Once established, we will examine the feasibility of extending the program to students in other clinical doctoral programs (nursing, physical therapy, psychology).

b. Describe requirements for admission to and expected retention of students in the proposed program.

As students will already be admitted to the MD program at UMMSM, we will follow an admissions process similar to that used in the four-year Pathway program. That process, described in more detail in section 3e, focuses on the student's academic record and personal statement about his/her interest in training in genomic medicine. An admissions subcommittee of the program Steering Committee will review all applications and interview applicants and make recommendations to the full program Steering Committee, which will then offer admission to qualified applicants.

c. Describe the anticipated need for and specific use of teaching assistants and research assistants in the program. Include the number and estimated stipends for each assistant (indicate stipend level and whether 9-month or 12-month).

Instruction in this program will primarily be performed by faculty with administrative support from the program office. The program offers additional teaching opportunities for PhD students in Human Genetics and Genomics, who are required to complete a teaching practicum as as part of their degree requirements. HGG student their stipends are covered from other sources and therefore no additional funds are needed for teaching and research assistants.

6. Administration

a. Estimate the anticipated administrative increments imposed by addition of this program

This program will utilize the existing graduate programs office and infrastructure maintained by the DHG for the PhD and Medical Genetics residency programs. However, the unique structure of the program, with multi-modal instruction (online, self-directed, and in-person lectures) requires programmatic and administrative support beyond what is currently available. Therefore, we have budgeted support for 50% of a genetic counselor (MS, board-certified or eligible) to assist course faculty in developing instructional materials and to assist the program director with administrative tasks.

Additional line-items in the start-up budget cover technical supplies needed to record lectures or "webcasts" for use in instruction, maintaining the computer infrastructure needed to provide this content to students, and to support an additional distinguished speaker working in the field of genomic medicine.

b. Describe the arrangements for administration and for academic direction of the program

The program will be administered by a Steering Committee and a Program Director, who will serve as its Chair. The steering committee will have six members elected at large from the program faculty. Members will be elected for three year terms, with two members rotating off each year.

The Program Director will be appointed by the Senior Associate Dean for Graduate and Post-doctoral Studies, after consultation with the Steering Committee. The Program Director will serve a (renewable) five-year term and may be removed at any time by the Senior Associate Dean for Graduate and Postdoctoral Studies or a vote of four members of the Steering Committee. The Program Director is responsible for overall leadership of the program, carrying out the decisions of the Steering Committee, representing the program to University administration, and overseeing budgetary, recruiting, teaching, and student progress.

The Steering Committee will meet monthly to discuss academic and policy decisions and to evaluate applications for membership (by both students and faculty) in the program. The Steering Committee will meet regularly with the Miller School Senior Associate Dean for Undergraduate Medical Education and Associate Dean for Pre-Clinical Curriculum to coordinate program activities with the first- and second- medical curriculum. Members of the program are encouraged to work through Steering Committee members to address issues of concern; however, any full faculty member may request to address the Steering Committee by writing the Program Director.

An annual meeting of the program faculty will be held to discuss matters of interest to the entire faculty.

The criteria for full faculty membership are modeled on the criteria used in the PhD program in Human Genetics and Genomics. These criteria will be monitored by the steering committee, which will make final decisions on faculty membership: Some of these requirements will be waived for new junior faculty and recruits who have high promise for teaching and mentoring graduate students but have not had adequate time to establish an independently funded research program.

1) To have established an ongoing, independent research program in some area of human genetics and genomics relevant to the practice of genomic medicine;
2) To have published human genetics and genomics research results in peer-reviewed journals;
3) To have an interest in training and teaching graduate students in genomic medicine demonstrated by teaching in human genetics and genomics program courses, other courses, seminars, and journal clubs taken by graduate students;
4) To have trained medical, graduate or postgraduate students in medical genetics and genomics.

Faculty wishing to join the MSGM program will submit to the steering committee an application consisting of a curriculum vitae and a short cover sheet outlining areas of expertise and aspects of the program in which the faculty member would participate. A two-thirds affirmative vote of the steering committee is needed to accept a faculty member. Appeals of negative decisions on faculty membership can be made to the Sr. Associate Dean for Graduate and Postdoctoral Studies.

7. **Budget (three-year)**: Provide a three-year projected budget commencing with the year the program gets under way. Each year's budget should include all anticipated income (use current-year tuition credit costs and projected overhead) and all anticipated incremental costs, e.g., new faculty with fringe, library additions, teaching assistantships, laboratory equipment, staff, travel funds, etc.

The annual costs for the MSGM program fall into two main categories: personnel (program administration and teaching) and supplies. As documented in earlier sections, adequate classroom, office, and laboratory space exists to support the program. The three-year totals in the tables below take into account a ramp-up of costs each year, as new classes are developed and offered for the first class.

Program Expenses

[Budget information redacted for web version of legislation.]

[Budget information redacted for web version of legislation.]

Program Revenue

MD students enrolling in the MSGM program will be charged the UMMSM out-of-state-tuition, $10,000 of which (the difference in in-state and out-of-state-tuition) will be allocated by the Dean of the Miller School of Medicine for program support.

In year 3, we project having enrolled enough students (24 total, at 7-10 per year) for the program to be self-sustaining from tuition revenue.

A grant has been received from the Haywood Foundation providing $100,000 in the first year with the potential to renew in subsequent years to support the program during this start-up phase. Coupled with tuition receipts, the program should be adequately funded in these first two years. Any shortfall in tuition revenue or grant funding will be covered by the Dr. John T. Macdonald Foundation Department of Human Genetics.

8. **Comparisons**: Compare the proposed program at the University of Miami with five high-quality, established programs at comparable universities. In the comparisons, include only the sections and subsections from items #1 through #7 above that are appropriate.

As discussed in section 1, the MS in Genomic Medicine would be the first of its kind. Therefore there are no comparable programs with which to thoroughly compare this proposed program. The closest comparison that can be drawn is with other medical schools offering a MS in genetics; however in each of these cases, the curriculum is a subset of the reuired coursework for a PhD and focuses on training for a research career

9. Letters of Support

Dr. John T. Macdonald Foundation Department of Human Genetics (Dr. Jeffery M. Vance, Chair)

Miller School of Medicine

Medical Faculty Council (Dr. Norman Altman, Speaker)

Dr. John Bixby, Sr. Associate Dean of Graduate and Postdoctoral Studies

Dr. Pascal Goldschmidt, Senior Vice President for Medical Affairs and Dean

Graduate School Council (Dr. Terri Scandura, Dean)

UHealth
UNIVERSITY OF MIAMI HEALTH SYSTEM

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

MEMORANDUM

To: Richard Williamson, J.D.
Chair, Faculty Senate

From: Jeffery M. Vance, Ph.D., M.D.
Chair, Dr. John T. Macdonald Foundation Department of Human Genetics

RE: Proposed Master of Science in Genomic Medicine Program

Date: March 26, 2012

I am writing to confirm the support of the Dr. John T. Macdonald Foundation Department of Human Genetics for the creation of a Master of Science in Genomic Medicine degree program. As described in the proposal, the program would be housed in this department, and draw the majority of the program faculty from our existing faculty. Existing classroom and administrative space exist for the program in the department, and the program will be initially supported by a grant from the Hayward Foundation (please see enclosed letter of award).

The proposed program fills an important need in clinical education at the University of Miami, providing the opportunity for undergraduate medical students to complete additional training in the emerging discipline of genomic medicine. The faculty of the Dr. John T. Macdonald Foundation Department of Human Genetics endorsed the creation of the program and is committed to its future success.

Jeffery M. Vance M.D., Ph.D.
Professor and Chair, Dr. John T. Macdonald Foundation
Department of Human Genetics
Professor of Neurology
Director, Center for Genomic Medicine, Hussman Institute for Human Genomics
Miller School of Medicine, University of Miami

cc: William K. Scott, Ph.D., Professor

DR. JOHN T. MACDONALD FOUNDATION DEPARTMENT OF HUMAN GENETICS
Leonard M. Miller School of Medicine · PO Box 019132 (M860) · Miami, FL 33101
Location: 1501 NW 10 Ave, Biomedical Research Building, Suite 619 (M860) ·Miami, FL 33136
Direct: 305.243.2283 · JVANCE@MED.MIAMI.EDU

John and Winifred Hayward Foundation
c/o Regions Morgan Keegan Trust
P.O. Box 2918
Clearwater, Florida 33757-2918

Please Reply Directly to:

January 11, 2012

Jeffery M. Vance, PhD, MD
Chairman, Dr. John T. Macdonald Foundation Department of Human Genetics
University of Miami Miller School of Medicine
1501 NW 10th Avenue, BRB 619 (M-860)
Miami, FL 33136

Dear Dr. Vance:

We are pleased to notify you that after reviewing your proposal, the Hayward Foundation will award the University of Miami $100,000.00 to support the creation of a master's degree program in Genomic Medicine. Consistent with your proposal budget, these funds are intended to partially support the efforts of the founding program director, program coordinator, and teaching faculty during the first academic year of the proposed program (July 2012-June 2013). Support for future years may be considered but is not guaranteed under this award.

The Hayward Foundation is excited to be a part of this innovative approach to preparing medical students to apply the tools of genomic medicine in practice. We look forward to seeing the program develop and grow.

Sincerely,

W. R. LaRosa, M.D.
Trustee

UHealth
UNIVERSITY OF MIAMI HEALTH SYSTEM

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

March 9, 2012

Professor Richard Williamson
Chair, Faculty Senate
University of Miami

Dear Professor Williamson,

This is to inform the Faculty Senate that the Medical School Faculty Council met on January 24, 2012 to review the Master's Degree Program in Genomic Medicine, presented by Dr. William Scott. The Council members discussed the new program in detail and voted to approve it.

Respectfully Submitted,

Norman H. Altman, V.M.D.
Speaker, Medical School Faculty Council

Office of Faculty Affairs
1611 NW 12th Avenue, Suite J (D2-6), First Floor, Park Plaza West Garage | Miami, FL 33136
Ph: 305-243-6551 | Fax: 305-243-5574

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

February 29, 2012

Dr. Richard Williamson
Chair, Faculty Senate
325 Ashe Building
Coral Gables, Florida 33146

Dear Richard,

I am pleased to present to the Faculty Senate a proposal to create a new MS degree in Genomic Medicine. In my role as Sr. Associate Dean for Graduate & Postdoctoral Studies, I strongly support this proposal.

Modern medicine increasingly involves consideration of the genetic bases of disease and differential responses to treatment. This practice is variously termed "personalized" or "genomic" medicine". The idea is that an individual's genetic background can be used to tailor or refine medical care, emphasizing prevention strategies among the most susceptible individuals and offering targeted therapies to individuals most likely to respond to a particular treatment. Because such practices cannot be left to a handful of medical geneticists, it is critical to train physicians and other clinical professionals to interpret clinical tests based on genomic data, and to understand how to use this information to provide optimal patient care. With this principle in mind, the goal of the proposed MS program is to graduate clinicians with the ability and desire to integrate genomic knowledge into clinical practice. This program proposal was developed by Dr. Bill Scott, a professor of Human Genetics, in conjunction with medical school colleagues.

UMMSM is the ideal setting for such a pioneering program. The recent significant investment in world-class genomics research facilities at the Hussman Institute for Human Genomics, coupled with the creation of the Dr. John T. Macdonald Foundation Department of Human Genetics, provides a rich environment for this training program.

The proposed MS program has obtained the support of the Medical School Council, the Dean, the Executive Dean for Research, and myself. Please let me know if the Senate requires any additional information. Dr. Scott and I look forward to meeting with the Senate to discuss any suggestions or concerns that might arise.

Yours Sincerely,

John L. Bixby, Ph.D.
Professor and Sr. Associate Dean

Office of Graduate & Postdoctoral Studies • Leonard M. Miller School of Medicine
1120 NW 14th Street Room 604.1 L/C M857 • Miami, Florida 33136
305-243-1094 • Fax: 305-243-3593 • E-mail: ogs@med.miami.edu

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of MEDICINE

Pascal J. Goldschmidt, M.D.
Senior Vice President for Medical Affairs and Dean
Chief Executive Officer, University of Miami Health System

MEMORANDUM

To: Richard L. Williamson, J.D.
Chair, Faculty Senate

From: Pascal J. Goldschmidt, M.D.
Senior Vice President for Medical Affairs and Dean
Chief Executive Officer, University of Miami Health System

PJG

Date: March 22, 2012

Subject: Support for the Proposed Master of Science in Genomic Medicine Program

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I am writing to confirm the Miller School of Medicine's enthusiastic support for the creation of a Master of Science in Genomic Medicine degree program.

The proposed program, the first of its kind, would enhance undergraduate medical education at the University of Miami, providing the opportunity for medical students to complete additional training in the emerging discipline of genomic medicine. The faculty resources necessary for this program exist in the Dr. John T. Macdonald Foundation Department of Human Genetics and other departments throughout the medical school.

I have reviewed the budget and affirm that the program will receive the difference in in-state and out-of-state medical school tuition for each student enrolled, which will provide the resources for the program to become self-sustaining in three years. The department has secured a grant from the Hayward Foundation to partially support the program during the start-up phase, and the remainder of the necessary support in the first two years will come from a combination of tuition dollars and departmental funds.

The creation of this groundbreaking program is timely and the Miller School is committeed to its success. I offer my wholehearted support for its establishment.

S:\PJG Memos\Faculty Senate -- Bill Scot_Dean_support_03222012.DOCX

UNIVERSITY OF MIAMI
GRADUATE SCHOOL

Terri A. Scandura, Ph.D.
Dean of the Graduate School

Graduate School
P.O. Box 248125
Coral Gables, FL 33124-3220

Phone: 305-284-4154
Fax: 305-284-5441
graduateschool@miami.edu

MEMORANDUM

DATE: February 22, 2012

TO: Richard Williamson
Chair, Faculty Senate

FROM: Terri A. Scandura
Dean, The Graduate School

SUBJECT: New Degree Program – Master's in Genomic Medicine

At the February 16, 2012, meeting of the Graduate Council, the new Master's degree program in Genomic Medicine was approved unanimously by those present, the second reading was waived.

cc: John Bixby, Dean
William Scott, Graduate Program Director
Office of Planning, Institutional Research and Assessment

Program Assessment Plan

School/College/Division: Miller School of Medicine
Program/Administrative Unit: MS in Genomic Medicine, Dr. John T. Macdonald Foundation Department of Human Genetics
Program Contact: William K. Scott, Ph.D.
Academic Year: 2012-2013

Mission Statement/Program Objectives

The educational mission of the University of Miami Miller School of Medicine Master of Science in Genomic Medicine program is to graduate clinicians with the ability and desire to integrate genomic knowledge into clinical practice through use of detailed family genetic history, diagnostic genomic tests, high through-put sequencing and pharmacogenomic knowledge. The MSGM degree will prepare students to be leaders in the adoption and integration of these methods in routine clinical care. The objectives of the MSGM program are to:

- Build upon the strengths of the existing genomics PhD and residency training programs to produce an innovative degree program designed to prepare health professionals for the practice of genomic medicine.
- Define and teach the competencies required of a clinician intending to incorporate genomic medicine approaches in clinical practice.
- Promote career choices in clinical, administrative, research and policy formulation in genomic medicine.
- Graduate leaders for the coming evolution in clinical practice that will increasingly utilize the tools of genomic medicine in the care of the population.

Definition & Assessment of Intended Outcomes

Outcome 1: Students will achieve competency in molecular, clinical, and statistical genetics concepts applicable to the practice of genomic medicine.

Assessment Measure 1: Students will complete core coursework in applications of genetics in medicine, genome ethics and policy, computational genetics, genomic medicine laboratory methods, pharmacogenetics, and a clinical genetics clerkship. Student grades for each course will reflect the degree of mastery of material. Mean and median grades will be calculated for each class and monitored over time to assess temporal trends in achievement.

Assessment Measure 2: Students will successfully complete a comprehensive examination based on core coursework. Upon completion of core coursework (at the end of year 2), students will complete a written examination testing mastery of concepts. The proportion of students passing this examination on the first attempt (and overall) will be calculated for each class and monitored over time to assess temporal trends.

Assessment Measure 3: Upon completing the program, students will complete an exit interview with the graduate program director, in which the student will be asked to comment on the program's performance in teaching the core competencies.

Outcome 2: Students will complete an original practicum project designed to provide experience in the application of genetic findings in clinical practice.

Assessment Measure 1: Students will successfully compose a practicum paper and orally

present the results of a project that demonstrates the application of the principles of genomic medicine. Annual pass rates for the practicum paper will be recorded and tracked over time to assess temporal trends.
Assessment Measure 2: Practicum projects culminating in presentations at clinical meetings or written manuscripts will be recorded annually.

Outcome 3: Students will obtain employment as physicians incorporating genomic medicine principles into their clinical practices.

Assessment Measure 1: During the exit interview, students will be asked to provide a description of their residency matches and the potential for further training in and practice of genomic medicine.
Assessment Measure 2: Program graduates will be surveyed annually to update current employment and to record career progress.

Findings

- MSGM is a proposed program with no findings to date.

Discussions

- No evalution is yet possible.