



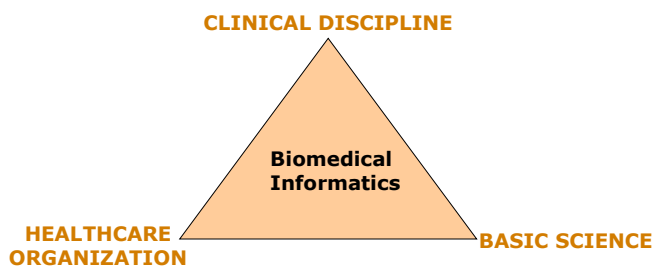
Vanderbilt University Biomedical Informatics Graduate Program (VU-BMIP) Proposal Executive Summary

Unique among academic health centers, Vanderbilt University Medical Center entrusts its Informatics Center to provide the essential information infrastructure for patient care, management, research, and education. This responsibility creates an unparalleled laboratory for informatics research, fast prototyping, and deployment of applied systems, in which students can learn how to exploit knowledge from a rigorous academic program in creating, implementing, and evaluating real-world applications.

Definition

Biomedical informatics is the field that studies biomedical information and knowledge: their structure, acquisition, integration, management, and optimal use. The field involves multidisciplinary research in, application development for, and administrative approaches to all aspects of health care delivery, biomedicine, and public health. Biomedical informatics adopts, applies, evaluates, modifies, and expands results from a variety of disciplines including Information Science, Computer Science, Library Science, Cognitive Science, Business Management and Organization, Statistics and Biometrics, Mathematics, Artificial Intelligence, Operations Research, Economics, and of course, basic and clinical Health Sciences.

Because biomedical informatics spans the spectrum from the theoretical to the applied, it has equally-developed “basic science” and “clinical” components. In addition, there is a strong component comprised of organizational theory and applications tailored to health-care systems and institutions.



Biomedical informatics expands beyond the narrow focus of biomedical computer systems design, application, and evaluation, by providing theory and tools for approaching health-related processes and research from an analytical and rational perspective. This is exemplified by its foundations in studies involving clinical problem-solving, research on improving diagnosis and therapy, the analysis of clinicians’ information needs, and its emphasis on solutions that embody the evidence-based practice framework.

Mission

The mission of the Vanderbilt Biomedical Informatics Graduate Program is to educate the next generation of leaders in biomedical informatics.

Specific Aims

The VU-BMIP aspires to achieve **Academic Excellence**: to provide a Biomedical Informatics degree program of the highest academic standards to meet the increasing local and national demand for high-quality biomedical informatics educated professionals, and to thereby contribute to the improvement of health for the benefit of our patients and for all. Academic Excellence is pursued through **Student Excellence**, **Research Excellence**, and **Educational Excellence**.

Through an interdisciplinary curriculum that emphasizes the integration of biomedical research, informatics, and health care, the program will prepare future leaders in the field with a deep understanding of biomedical informatics through a combination of coursework, participation in large-scale informatics project development, management, and evaluation, and directed and independent scientific research. Collaboration on ongoing research projects within the program and with the diverse faculty of Vanderbilt's basic, clinical, and engineering sciences departments will be highly encouraged and will provide in-depth experience with cutting-edge research as well as a broad understanding of the field. Emphasis on the analysis, development, and evaluation of highly integrated biomedical informatics systems will provide trainees with a lifelong appreciation of the role of information in the health sciences, and how information will be produced, managed, and used in the 21st century.

Concentration Areas

The curriculum offers six concentration areas: Clinical Systems, Decision-Support Systems & Medical Decision Sciences, Evidence-Based-Practice/Health Policy/Management and Administration, Computational Biology for Molecular Medicine, and Clinical Computational Biology.

Relationship of the Proposed Biomedical Informatics Program to Related Vanderbilt Programs

Biomedical Informatics, as an interdisciplinary field, occupies a position at the intersection of three overlapping spectra. The **first spectrum** ranges from “pure” basic biological science (i.e., bench and theoretical research related to basic molecular biology) at one end, to “pure” informatics (theoretical constructs and applied methods in informatics that are valid independent of the application domain) at the other end. The **second spectrum** ranges from “pure” clinical and health services research to “pure” informatics, and the **third spectrum** ranges from applied clinical practice to “pure” informatics.

The training of graduate students in Biomedical Informatics will occur along the three spectra, and will not all be provided through the proposed Degree Program. Some students, whose interests are closest to one of the basic biological sciences, may, for example, enter the School of Medicine’s Interdisciplinary Graduate Program (IGP), which provides core training in the basic biological sciences before students select a Ph.D. concentration area, and then take Biomedical Informatics courses as electives to supplement their basic biological science emphasis. Conversely, it is essential that students seeking primary degrees in Biomedical Informatics be well-grounded in their knowledge of bioinformatics and clinical informatics, and the core Biomedical Informatics courses offered that cover these areas can be supplemented by more advanced basic science (and computer science, BME, Nursing, etc) courses offered by other departments at Vanderbilt.

Curriculum Structure

A. All students will take five core Biomedical Informatics courses (Foundations of Biomedical Informatics and Evidence-Based Medicine, Medical Decision-Support Systems and Machine Learning, Health Care Organization and Management, Bioinformatics for Molecular Biology, Clinical Information Systems). Those who are pursuing an M.S. degree will not be required to take the four associated laboratories, while those who pursue a Ph.D. will do so.

B. All students will take the core courses in the remaining three areas (3 courses for the methods area, 3 for the biomedicine area, and 3 for the informatics area). Course requirements may be waived according to student background.

C. Students will be required to take additional electives within one or more areas so that they will have at least 27 credits of formal coursework for the M.S. level. A minimum total of 27 credits will be required for a thesis M.S. degree.

D. For the M.S. degree, a research project of appropriate scope should be planned, proposed, carried out, and defended according to University rules. M.S. degree students must complete a written thesis. A published paper may serve as the thesis at the discretion of the advising committee. In case of Ph.D. students

pursuing a Computational Biology for Molecular Medicine or Clinical Computational Biology concentration area, a M.S. degree may be awarded with no thesis provided that the thesis requirement will be replaced for a minimum of 9 extra formal coursework credits (subject to approval by the program).

E. All students must participate in the Informatics Center research seminars.

F. M.S. Students may participate in internships at external organizations during the summer of year 1.

In addition to the above, students pursuing a Ph.D. degree must:

G. Create a reading list on three areas of concentration. The list must be approved by an advising committee. After an agreed amount of time, the student will be given a written take-home week-long exam. After successful completion of the written examination, the student will have to pass an oral exam (typically covering material extending the scope of the written exam).

H. Select an advising committee for the doctoral research project, prepare a research plan, execute the research, prepare a written thesis, defend the thesis, and publish the results, as per University rules.

I. Take an additional two advanced elective courses.

J. In addition, the Ph.D. candidates will be required to be teaching assistants in at least one course, or in case their professional interests lie in positions in the industry, to take an additional elective on management, economics, or entrepreneurial skills (subject to committee approval).

Finally, for those students pursuing a part-time M.S. degree (i.e., working at a 50% effort level or higher), they will be required to meet coursework requirements during the first two years of their studies and the research requirements within 1 to 2 more years.

The complete proposal gives several examples of curricula templates, tailored to various student backgrounds and concentration areas. Here one such template is presented.

Curriculum Sample: M.D. pursuing Ph.D. – Clinical Systems Focus

Prerequisites

- *Epidemiology*
- *Basic Biostatistics*
- *Computer Literacy*
- *Intermediate-level Computer Programming skills in a standard structured or object-oriented high-level language*
- *Networks*

Year 1 – Fall

- Foundations of Biomedical Informatics and Evidence-Based Practice (with Lab)
- Design and Analysis of Algorithms
- Systems Evaluation
- Research Seminar/Colloquium

Year 1 – Spring

- Mathematical Statistics
- Medical Artificial Intelligence I: DSS & ML (with Lab)
- Clinical Information Systems & Databases (with Lab)
- Research Seminar/Colloquium

Year 1 - Summer

- MS Research

Year 2 - Fall

- Bioinformatics for Molecular Biology (with Lab)
- Health Care Organization, Management & Policy
- MS Research
- Research Seminar/Colloquium

Year 2 - Spring

- Multivariate Statistics
- MS Research
- Research Seminar/Colloquium

Year 2 - Summer

- MS Research
- Prepare Reading List for Comprehensive Examination & have it approved

Total M.S. credits: 31 (31 formal coursework)

Year 3 - Fall

- Elective 1 (Advanced Medical Informatics)
- Prepare For Comprehensive Examination
- Research Seminar/Colloquium

Year 3 - Spring

- Take Comprehensive Examination
- Elective 2 (e.g., Software Engineering)
- Research Seminar/Colloquium

Year 3- Summer

- PhD Research

Year 4 - Fall

- PhD Research
- Research Seminar/Colloquium

Year 4 - Spring

- PhD Research
- Research Seminar/Colloquium

Year 4 - Summer

- PhD Research
- Write Dissertation

Year 5 - Fall

- Write Dissertation

Year 5 - Spring

- Submit Dissertation to Ph.D. Committee
- Schedule Final Examination
- Register Copies of Dissertation
- Final Examination
- Additionally: TA one course in any semester during Years 3 and 4 or substitute with business-related elective; Special Skills Seminars during Years 3 to 5.

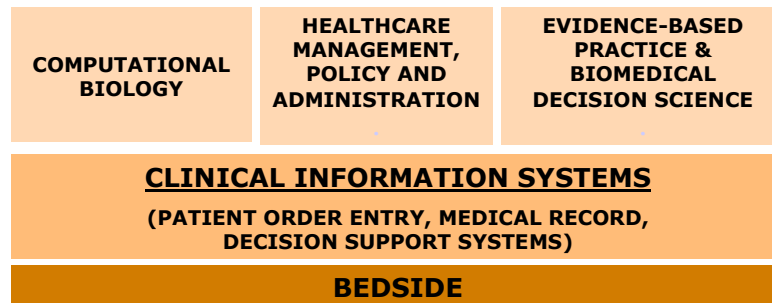
Total Ph.D. credits: 72 (37 formal coursework)

The Major Strength of the VU-BMIP

The major strength of Biomedical Informatics at Vanderbilt University Medical Center is the functional integration of informatics within the institution, aligned with institutional research, education, and clinical practice objectives. Nationally, no other institution offers such a balance and range of rigorous academic studies coupled with applied informatics in clinical practice and biomedical research. Some programs offer exceptionally strong theoretical education, but no extensive clinical information systems to apply the theory. This is analogous to learning a basic science without a laboratory. Other programs emphasize comprehensive clinical systems over theoretical rigor.

The Vanderbilt Biomedical Informatics Graduate Program is in the unique position to simultaneously provide strong theoretical training and an advanced informatics environment in which new scientific hypotheses can be tested and new technologies can be deployed.

Another strength is the nationally and internationally prominent faculty experienced in research, education, and administration. The faculty members are engaged in a wide variety of ongoing, leading-edge projects. The faculty has clearly focused, long-term service and research agendas. A strategic priority of Vanderbilt University and the BMIP is the integration of the new and exciting areas of Computational Biology and Evidence-Based Medicine with proven Clinical Information Systems technologies.



Student Backgrounds and Entrance Requirements

We will encourage applications from candidates with backgrounds in the Health Care Professions, Biomedical Sciences and/or Computer Science - related disciplines, who possess strong technical skills (computer programming, mathematics, engineering), an understanding of the field and a strong commitment to advancing health through rigorous scientific research. In addition, successful candidates will have excellent oral and written communication skills (including command of the English language for non-native speakers) the necessary time and funding to devote themselves to their studies, standardized test scores as required by university rules, strong record of past academic achievement in required fields, prior research experience in same or related fields, enthusiasm and ability to work collaboratively as well as to undertake responsibilities assigned to them, good working habits, persistence, patience, and good time management skills.

Expected student backgrounds and career foci include:

- M.D.s pursuing a clinical research career, or pursuing a basic research career.
- R.N.s pursuing an academic, consulting, or management career.
- Computer science graduates with a special interest in biomedical research.
- Biostatisticians with an interest in Bioinformatics or clinical research.
- Biologists with an interest in computation/Bioinformatics, and health care

Contact Information

Constantin F. Aliferis M.D., Ph.D., Director of DMBI Graduate Degree Programs:

Constantin.Aliferis@mcmail.vanderbilt.edu

Randolph A. Miller M.D., Professor & Chairman, DBMI: Randolph.A.Miller@vanderbilt.edu