

## **Proposal for Graduate Certificate in Biomedical Informatics**

### **Need**

National initiatives such as the National Health Information Infrastructure and President Bush's 2004 mandate for every American to have an electronic medical record within the next 10 years have dramatically increased awareness of the need for informatics practitioners. There is an urgent need for professionals trained in biomedical informatics. The American Medical Informatics Association (AMIA) recently launched a "10 x 10 program" that is intended to train 10,000 new professionals by the year 2010. The increasing demand for informatics practitioners on the national level is echoed by local employers including Intermountain Health Care (IHC), the University of Utah Health Sciences Center, the Veterans Administration, and vendors such as TheraDoc, 3M Health Information Systems, Associated Regional and University Pathologists (ARUP), General Electric Medical, and Myriad Genetics. These companies have expressed support of a graduate certificate in addition to the academic degrees currently offered. The new certificate program will be a key part of our plans toward implementing national initiatives for increasing the number of trained informatics professionals.

The need for a certificate program is also apparent from interactions with potential and existing students. The department typically receives 3 to 4 times as many highly qualified applications for the masters and doctoral degree programs than can be accommodated in those programs. Many of the requests are from students who are looking for a career in applied informatics rather than a research career. These students already have a degree in a related field such as computer science, business, public health, or a clinical area (e.g., medicine, nursing, pharmacy) and desire formal training as a supplement to their primary degree to enhance their capabilities and productivity. The Graduate Certificate in Biomedical Informatics is designed to provide students with a set of competencies in the aspects of informatics that will enable them to be successful in their careers. The program is flexible so that students can participate in the courses that would be most valuable for their career paths. The design enables students to take advantage of their existing academic background and to fill gaps in areas where they have less experience. The certificate program would allow the department to increase the number of students who are trained generally in Biomedical Informatics.

The need for a certificate program is also illustrated by the number of previous students who have completed their course work and then received job offers before finishing their research dissertation or thesis. Many of these individuals are now employed and productive in the field, indicating that a graduate certificate could lead to a cadre of skilled and productive professionals who have the necessary competencies for meeting the interdisciplinary challenges of Biomedical Informatics.

Multiple requests are received each week for distance education in informatics. The Graduate Certificate in Biomedical Informatics is designed to offer coursework in a distance learning format, supplemented with in-person sessions. This will open access to informatics coursework to people in rural areas and areas outside of Salt Lake City.

Similar programs at the University of Utah in disciplines such as Business and Public Administration have demonstrated that a graduate certificate in these high-demand areas is desired by working professionals. Similar programs in Biomedical informatics at other universities include programs at Oregon Health and Science University, Ohio State University, Stanford, and Pittsburgh. The success of these programs indicates that a graduate certificate in Biomedical Informatics at the University of Utah would be in demand.

### **Educational objectives**

The graduate certificate program in medical informatics is an opportunity for students (most of whom bring expertise from related disciplines) to develop a basic understanding of how health information systems are developed, implemented, studied and modified. The certificate program allows students to gain a broad background in the core issues, as well as more specialized knowledge in the sub-domains, such as bioinformatics, public health informatics, clinical information systems and medical imaging. Individual programs of study allow for further specialization and development of knowledge in related fields. The table below illustrates some possible courses of study for a range of students:

<b>Informatics emphasis area</b>	<b>Major areas of concern</b>	<b>Student background</b>	<b>Additional areas of study for individual</b>
Clinical information systems	Standards and terminologies; evidence-based medicine; patient data representation, storage and retrieval, decision support technologies; order entry systems; implementation, integration, testing and training.	Health care professional (MD, RN, PharmD, etc.)	Application design; databases; research methods
		Hospital administration	Research methods; operations and quality management
		Computer science	Human factors engineering; principles of health care including terminology and delivery; statistics
Public health informatics	Standards and terminologies; syndromic surveillance; patient registries; immunization records	Public health (MPH, etc.)	Computer science, database technology and data mining
		Computer science	Epidemiology
Bioinformatics	Analysis of genetic and protein sequences, genetic epidemiology,	Molecular biology	Statistics; computer science and database technology
		Clinical genetics	
		Computer science or mathematics	Fundamental genetics and molecular biology; computational biology; statistics; database technology;
Medical imaging	Image interpretation;	Radiology	
		Computer science	Human anatomy

### **Impact on Existing Programs**

The Certificate Program will become an integral part of the Department's teaching and research program. Our goal is to have the certificate program students attend the existing courses within the department whenever possible. We may need to add additional courses over time based on assessments of the unique needs of the certificate students. With the recent move of the Department to the new Health Sciences Education Building on the medical campus of the University, we have ample classrooms with size and facilities to teach larger classes and to use new teaching technologies to help in distance learning and interactive remote teaching. Our Department Chairperson has recently allocated Graduate Teaching Assistants to assist with the major courses taught by the faculty. As a result, the faculty load of grading additional papers and exams resulting from the new Certificate Students will be minimized.

A major faculty and student activity for achieving a Master of Science (MS) or a Doctor of Philosophy degree (PhD) is carrying out an innovative research project. These original research projects are intensive and complex. However, execution of such research projects is not part of the Certificate need. As a consequence, we should be able to accommodate these new Certificate students rapidly and easily .

### **Certificate Program Acceptance Criteria**

Applicants must satisfy University of Utah requirements for admission to graduate school. Those requirements include a Bachelor's Degree and 3.0 grade point average or better in their undergraduate work. They must also have completed a programming class or have equivalent experience. The applicants will be assessed and approved by the Department of Medical Informatics admissions committee.

### **Courses**

Fifteen hours of course credits is the minimum needed for a certificate. The curriculum for the Graduate Certificate in Biomedical Informatics consists of a required core course "Introduction to Medical Informatics" (6 Credits), required seminars (Spring and Fall semesters of either "Graduate Seminar" or "Bioinformatics Seminar" (total of 2 Credits)), and the remainder of the 15 credit hours as electives. Students may select courses to meet their learning objectives. Depending on the student's prior background (e.g. clinical vs. computer science), the elective courses can be chosen from any of the standard courses offered by the Medical Informatics department, or selected from courses in the Computer Science department or other university departments. A faculty advisor will be assigned to each student to guide them in selecting courses that best meet their needs.

Although all of the existing courses offered in the department will be available to certificate students, the research courses are likely to be less appropriate. Standard course prerequisite requirements will be followed as with degree seeking students. Over the next 2-3 years we expect to adapt many of the departmental courses to accommodate distance-learning opportunities, which will improve access to these classes. It is expected that at least 12 of the 15 required hours will be from the Medical Informatics Department course list.

### **Course Offerings:**

#### **6000 Introduction to Medical Informatics** (6 Credits, Fall Semester)

Provides an overview of the basic concepts of medical informatics. The course includes systems development, databases, data representation, data acquisition and presentation, man-machine interfaces, communication and networking, statistics, experimental design, decision support, knowledge engineering, genetic epidemiology, introduction to health information systems, quality improvement, signal processing, physiologic models, and medical imaging. (Required for all graduate students.)

#### **6105 Statistics for Biomedical Informatics** (3 Credits, Fall Semester)

Basic course in the use of statistical methods.

#### **6110 Research Design** (2 Credits, Spring Semester, Prerequisite: 6100)

Practical course in basic research design, outcomes, literature review, presentation skills, and technical writing.

#### **6220 MI Vocabulary & Standards** (3 Credits, Spring Semester, Prerequisite: 6000)

Principles of database management systems as applied to medical care. Tools for representation of information in the electronic medical record. Standards applicable to medical information systems for communication, development, and validation of systems.

#### **6300 Medical Decision-Making** (3 Credits, Fall Semester, Prerequisite: 6000)

Quantitative and symbolic approaches to medical decision-making. Statistical methods (discriminate functions, Bayes theorem), decision analysis, utility theory, artificial intelligence and expert systems. Survey of operational decision-making systems; strengths and weaknesses of a group of approaches. Expert system techniques used in medical decision-making. Conceptual framework for computer-based medical decision-making. Student works with an expert in a medical discipline to conceive and develop an operational expert system.

#### **6400 Quality and Quality Measures** (3 Credits, Spring Semester)

Basic principles and accomplishments in the field of quality improvement and medical informatics. Practical training using tools and resources in the field.

#### **6460 Website Design** (2 Credits, Spring Semester)

The role of the Internet in relation to healthcare. Basic instruction in the use of web

authoring tools (e.g., HomeSite, FrontPage, Visual students.) and technologies (e.g., DHTML, Java Script, Cold Fusion, ASP, and PHP).

**6500 Genetic Epidemiology** (3 Credits, Fall Semester, taught on odd years, or when there are sufficient students)

Genetic Epidemiology is taught in the Fall Semester provided sufficient demand and at the discretion of the instructor. MDINF 6500 is a first level course and introduction to the field of genetic epidemiology. Basic knowledge of statistics and genetics are prerequisites.

**6550 Advanced Genetic Epidemiology** (5 Credits, Spring Semester, taught even years, Prerequisite: MDINF 6500)

Advanced Genetic Epidemiology is an advanced, applied course for graduate students on the Genetic Epidemiology track that includes a 2 hour computer lab. Provided sufficient demand, it is taught in the Spring Semester following MDINF 6500 in the Fall.

**6600 Introduction to Bioinformatics** (3 Credits, Spring Semester)

Introduction to Bioinformatics is taught in the Spring Semester. It is an introductory course to Bioinformatics covering computational biology, DNA sequence analysis, genomics, proteomics, molecular databases, and phylogenies.

**6700 Public Health Informatics** (3 Credits)

The Public Health Informatics introductory course will provide background material for those interested in applying Medical Informatics techniques to the field of Public Health. The new (2002) 34 chapter textbook, "Public Health Informatics and Information Systems" will be the basis of the course. The State of Utah and many of its health authorities have already been broadly involved in establishing databases of hospital discharge summaries, immunization records, tracking adverse drug events and Bioterrorism surveillance. Thus there is a need and an opportunity to better apply Medical Informatics techniques to this field. In cooperation with the Utah Department of Health, this course will be offered to give students an opportunity to learn about and discover the real needs of Public Health Informatics.

**6804 Primer IT Operations** (3 Credits, Fall Semester, Cross listed as NURS 6804)

Introduces models and approaches for implementation, management, and evaluation of a clinical information system. Concepts and theories related to change, organization and group process examined. Approaches evaluating impacts of clinical information systems examined. Project management method, including human and financial resource allocation, applied through assignments.

**6950 Special Topics** (1-4 Credits, by arrangement)

Special projects and clinical internships announced or arranged by the Department.

**7000 Graduate Seminar** (1 Credit, Fall and Spring Semesters)

Weekly research presentations by University faculty, visiting faculty, and graduate students.

**7005 Bioinformatics Seminar (1 Credit)**

Weekly presentations in Bioinformatics

**7010 Current Topics/Journal Club (1 Credit, Fall and Spring Semesters)**

Weekly discussions of current medical informatics topics and/or in-depth discussions of papers published in the refereed literature.

**6801 Clinical Systems Analysis (3 Credits)**

Focuses on clinical systems analysis and design for development of health information systems that support practice in complex health care settings. The organizational context of complex health care settings and informatics roles are examined as they relate to clinical systems analysis. Methods for clinical systems analysis and requirements determination are emphasized.

**6803 Clinical Database Design (3 Credits)**

Development and maintenance of clinical databases or application in solving clinical problems. Design methods, database structures, indexing, data dictionaries, retrieval languages, and data security are presented.

**6817 Knowledge Discovery in Databases (2 Credits)**

This course emphasizes health care applications and issues of Knowledge Discovery in Databases (KDD) at an introductory level. The entire KDD process is explored, including creation of target data sets, pre-processing, data mining, pattern interpretation and evaluation, corresponding with the Fayyad model of the KDD process. Lecture and practical exercises survey data mining methods for classification, prediction, rule induction, clustering, and attribute sub-set selection.

Later in the course, emphasis shifts to critical analysis of KDD applications in health care.

**Assessment**

The value of the certificate program will be assessed by:

- Student course evaluations
- Exit interviews
- Contact/survey of alumni one or more years following graduation
- Survey of employers of former students to assess whether the educational program is meeting the needs of the employer

A committee will be formed that will be responsible for assessing the program. The committee will consist of four members: the faculty coordinator, two other faculty members appointed by the department chair, and a current student. Course evaluations will be performed for each course, and at least half of the students will be interviewed as they exit the program. Surveys of employers and former students will be conducted every two years after the program start date. The assessment committee has the responsibility for conducting the assessments, receiving evaluations from the advisory

committee (describe below), and recommending improvements to the department's curriculum committee. The curriculum committee will consider the recommendations of the assessment committee and advise the department chair on needed changes in faculty assignments, course content, course timing, and in any other areas as appropriate.

### **Faculty**

Current and future faculty members in the Departments of Medical Informatics and Nursing Informatics will teach the certificate program courses. The faculty members most likely to be involved are: Bruce E. Bray, Brad R. Farr, Reed M. Gardner, Joseph W. Hales, Peter J. Haug, John F. Hurdle, Stanley M. Huff, Joyce A. Mitchell, Mollie Poynton, Roberto A. Rocha, Kathy Sward, Dean K. Sorenson, Alun W. Thomas, Adam B. Wilcox, and Charlene R. Weir.

### **Coordinator**

Stanley M. Huff, M.D. will be the initial coordinator of the program. The coordinator responsibility will be rotated among interested faculty as appropriate.

### **Advisory Committee**

We will form an advisory committee with two representatives from each of four areas: industry, government, departmental faculty, and external faculty. The advisory committee will be convened by the department chair and will meet at least annually to assess the needs and value of the program. The advisory committee provides its input to the assessment committee described above.

### **Budget**

The Department of Medical Informatics is primed to expand the program with the addition of the certificate option. A contributing strength is that the Department is now housed in the new Health Sciences Education Building, which is equipped with distance learning technology and adequate space to accommodate larger classes. It will not be difficult to absorb the initial students into the existing classes. Faculty will be assigned TAs to help handle the additional work of larger classes. The cost of providing TAs to our instructors will be kept at a minimum by using degree seeking students supported on our National Library of Medicine (NLM) training grant. The Department plans to accept five certificate-seeking students in Fall 2006, 10 in Fall 2007 and 15 in Fall 2008. The number will be capped at 15-20 in Fall 2009.

The Department is in a healthy fiscal position to launch this new program. Increased dollars for student credit hours can be estimated at \$45,290 during 2006-07, with the admission of five certificate students as our target. In the next year, 2007-08, we would hope to admit 10 new certificate students and expect an income of \$90,580. Under the Mission Based Management in the School of Medicine, the Department received \$577 per student credit hour for the FY06 budget. Under this model, however, there is a two year lag time before funds would actually be realized for the increase in student credit

hours. The number of student credit hours for 2004 were used to calculate the dollars received for the FY 2006 budget. An increase in the amount paid per credit hour has not been included in the calculation because there is not enough history in the evolving Mission Based Management model to do so.

Calculations of increased profits from student credit hours are modest. It is a very real possibility that these profits could be significantly higher with the addition of distance learning courses. The informatics program at Oregon State University is funded solely by its distance learning program.

The Department is currently aggressively recruiting new faculty. These new faculty will assist in certificate program direction, course leadership, and student advising. As the department grows over the next few years, a faculty member will be appointed as the Director of Graduate Studies, and will be assisted by the addition of an Academic Coordinator. This change will be required by all programs within the Department; not solely for the certification portion.

Financial Model for Proposed Certificate Program

Year 1 -- 2006-07 Admissions		
# of students targeted		5
	Cr. Hrs.	
Fall Semester 2006		
Credit Hour Increase		
Core Course	6	30
Seminar	1	5
		35
Spring Semester 2007		
Elective 1	3	15
Elective 2	3	15
Seminar	1	5
		35
		70
		x \$577 per credit (based on MBM budget allowance for FY06)
<b>Credit Hour Increase</b>		<b>\$40,390</b>
		Extra funds realized in FY 2008



Year 2 -- 2007-08		
# of students targeted		10
	Cr. Hrs.	
Fall Semester 2007		
Core Course	6	60
Seminar	1	10
		70
Spring Semester 2008		
Elective 1	3	30

Elective 2	3	30	
Seminar	1	10	
		70	
		140	x \$577 per credit (based on MBM budget allowance for FY06)

**Credit Hour Increase**                      **\$80,780**    Extra funds realized in FY 2009

Year 3 -- 2008-09			
# of students targeted		15	
	Cr.		
	Hrs.		
Fall Semester 2008			
Core Course	6	90	
Seminar	1	15	
		105	
Spring Semester 2009			
Elective 1	3	45	
Elective 2	3	45	
Seminar	1	15	
		105	
		210	x \$577 per credit (based on MBM budget allowance for FY06)

**Credit Hour Increase**                      **\$121,170**    Extra funds realized in FY 2010

Year 4 -- 2009-10			
# of students targeted		20	
	Cr.		
	Hrs.		
Fall Semester 2009			
Core Course	6	120	
Seminar	1	20	
		140	
Spring Semester 2010			
Elective 1	3	60	
Elective 2	3	60	
Seminar	1	20	
		140	
		280	x \$577 per credit (based on MBM budget allowance for FY06)

**Credit Hour Increase**                      **\$161,560**    Extra funds realized in FY 2011

Please see the attached spreadsheet projecting income and expenses. Several assumptions are made as we project the income and costs for a seven year period. For budgetary purposes, we have used the tuition costs from the 2005-06 tuition schedule. We also assume that all students will pay tuition as residents and no students will be eligible for half-price tuition.