

# **Health Informatics Research Institute\***

## **A proposal to catalyze and expand health informatics at UWM**

### **Mission**

The Health Informatics Research Institute (HIRI) will be a campus-wide organizational entity providing common health informatics infrastructure and space designed to enhance and complement campus-wide health and biomedical informatics research resources, provide researchers pre- and post-award support, establish and maintain interdisciplinary informatics research collaborations both within UWM and with outside entities, and disseminate and promote UWM accomplishments throughout the academic, commercial, and governmental sectors. HIRI will also strengthen the links between the university research charge and its' educational mission in these targeted areas. In short, the HIRI will catalyze existing activity and strengths in nursing, health, biomedical, public health and clinical informatics thus expanding the scope, reach and extent of UWM's impact on biomedical science, translational medicine, healthcare and public health at the local, state, regional, national and international domains.

### **HIRI Founding Affiliates**

Six UWM Schools and Colleges have expressed support for a centralized health informatics research entity. In fact, this proposal emerged from a careful review and incorporation of three associated proposals developed by faculty representing some of these schools. These HIRI "founding" Affiliates are: College of Engineering & Applied Science, College of Health Sciences, College of Nursing, School of Business, School of Information Studies, and the new School of Public Health. HIRI is charged with explicitly supporting the faculty and graduate education programs of the founding affiliates. In particular, HIRI will create and maintain state-of-the art infrastructure and robust pre- and post-award support to accelerate the founding affiliate junior faculty research and productivity, strengthen senior faculty external collaborations, and enhance the value of UWM's education, training and collaborative research with external health care, biotech and health informatics industries.

### **Goals**

In concert and collaborative with HIRI Affiliates, the institute is charged with three primary goals:

- Provide infrastructure to facilitate the research needs of faculty (especially junior faculty) and students, including pre and post doctoral training, grant proposal support services, informatics computational, software development and software application assistance, and data collection, integration and warehousing services.
- Catalyze collaborative multi-disciplinary research between Affiliate faculty and external academic, health care and biotech and health informatics industry sectors.
- Support and enhance the various academic programs that currently offer informatics-related coursework and degrees.

### **Need**

Health-related organizations, payers, and the federal government have accelerated the commitment to technology, strategy and human resources that bring the best research to bear quickly on the delivery of safe, secure, effective, culturally appropriate, and cost-effective health care. The recent reframing of the National Institutes for Health (NIH) Research Road Map identified the need to implement a new vision of medical research:

At the core of this vision is the need to develop new partnerships of research with organized patient communities, community-based health care providers, and academic researchers. This also includes the need to build better integrated networks of academic centers linked to a qualified body of community-based health care

\*"The Health Informatics Research Institute" naming rights will be offered as a development opportunity for a private, foundation or corporate donor.

providers who care for sufficiently large groups of patients interested in working with researchers to quickly develop, test, and deliver new interventions. This vision will require new paradigms in how clinical research information is recorded, new standards for clinical research protocols, modern information technology platforms for research, new models of cooperation between NIH and patient advocates, and new strategies to re-energize our clinical research workforce. (nihroadmap.nih.gov, retrieved 8/31/2010)

More recently, HHS launched a \$30 billion initiative (part of the 2009 HITECH Act) covering a broad selection of health, clinical, and nursing informatics programs designed to establish electronic health records, implement EHR data “meaningful use” programs to improve health care outcomes, and create the new health informatics processes, analysis and methods to revolutionize the American health system to dramatically improve healthcare delivery at substantively lower cost. (healthit.hhs.gov, retrieved 9/6/2010). These programs have already generated the need for new skills, knowledge and training in health informatics and have led to increased demand for advanced degree management, research and academic employees. In addition, these initiatives have opened new opportunities for health informatics research and have led to a dramatic increase in the multi-disciplinary academic-industrial research activity that the HIRI will support.

Through its emphasis on interdisciplinary collaborations and partnerships with external entities, the institute will enable UWM faculty and students to work toward and help define these new clinical research paradigms in local, national, and international contexts. In addition, research that will improve the health of the workforce while reducing the costs of care can have a significant positive impact on southeast Wisconsin; healthcare is a key economic driver in the region (e.g., Aurora HealthCare is the largest employer in the state). The current and future investment in health information research and product development in the health informatics arena has significant potential for commercial success in the coming decade. Research in health and biomedical informatics at UWM has expanded rapidly. This expansion includes faculty hired recently to support growth in the Master’s program in Health Care Informatics and the Doctoral program in Medical Informatics, new faculty and initiatives in public health informatics and senior faculty whose research has expanded into health informatics areas.

Typically, health informatics research involves collaborations of large interdisciplinary groups, large data sets, substantial computational resources and sophisticated software tools for managing and analyzing data and for developing new applications using this data. At UWM, however, research in health and biomedical informatics is limited due to the following factors:

- Lack of common research infrastructure;
- No mechanisms for secure sharing of resources such as data and tools;
- No common support staff to identify funding opportunities, prepare proposals, design and maintain databases, recruit subjects, and provide a web-based portal to help UWM researchers find potential local collaborators and to disseminate resources and publications; and
- No common entity for promoting UWM accomplishments in health and biomedical informatics or for establishing partnerships between UWM and other institutions at a level greater than that of individual faculty members.

### **Research Programs**

The institute will house and facilitate the health informatics research programs defined by the founding affiliates and their faculty. Formulated around research themes identified by the interests of the faculty, defined by the scientific advisory board, prioritized by the director and approved by the Provost and Vice Chancellor for Research, research programs will bring together investigators and students from multiple academic units with related areas of science and facilitate innovative, interdisciplinary solutions. Previous discussions have identified a selection of candidate research program areas (below). However, the HIRI is charged with the objective to maintain a stable set of research programs meeting the current needs of faculty while also applying periodic judicious review of emerging research themes and programs to explore and when approved, launch and support new programs taking advantage of new faculty interests, new research collaboration opportunities and new

funding programs. Each research program will include discovery, method and application development and translation to healthcare application components such as:

- Knowledge Based Systems (including evidence translation from research to practice)
- Public Health Information Systems and Electronic Health Records
- Nursing Informatics and Secondary and “Meaningful” Use Methodology
- Medical Imaging and Biomedical Applications
- Bioinformatics, Translational and Personalized Medicine Informatics

### Academic Programs

HIRI will not host entire MS or PhD programs. However, HIRI will support all existing health related informatics academic programs offered by participating units, as well as future informatics-related programs by arranging for and coordinating a common seminar series, a "readings and research" course, and other 'common' courses and seminars to be defined by the affiliated schools and colleges and executive committee. It will also support the informatics academic programs by providing more informal, but perhaps even more valuable, channels of communication through which MS thesis and PhD dissertation students may be introduced to and learn from abroad collection of like-minded and experienced researchers. Supported educational and training programs will include:

- Undergraduate Certificate in Health Care Informatics (College of Health Sciences)
- MS in Health Care Informatics (College of Health Sciences)
- PhD in Medical Informatics (Department of Electrical Engineering and Computer Science in the College of Engineering and Applied Science)

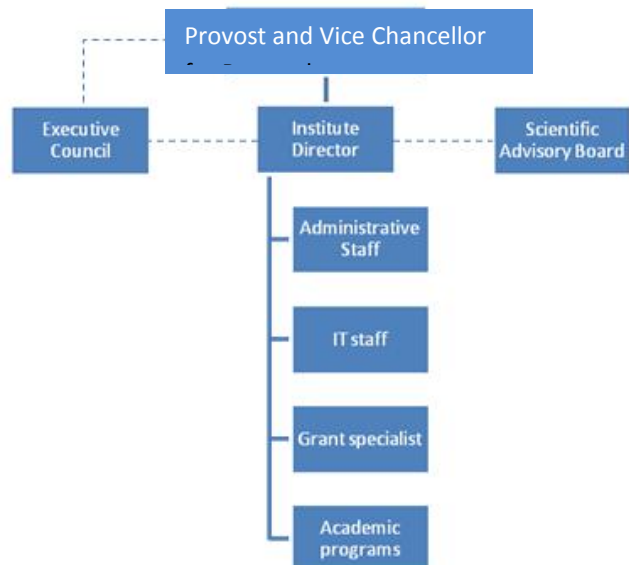
### Institute Governance and Structure

HIRI will be an independent institute (existing outside UWM schools and colleges) whose director will report to The Provost and the Vice Chancellor for Research. The institute is charged to support and will include representatives from the following Colleges and Schools:

- College of Engineering & Applied Science
- College of Health Sciences
- College of Nursing
- School of Business
- School of Information Studies
- School of Public Health

The institute will be overseen by an 8-member executive council, composed of representatives from each of the six Founding Affiliates (Schools or Colleges): the dean or dean designate from each unit and two faculty appointed by the Provost and Vice Chancellor for Research upon recommendation by the Director. The executive council will:

- Review, approve and present the Director’s budget to the Provost and Vice Chancellor for Research;
- Present an annual HIRI report to the Provost and Vice Chancellor for Research;
- Work with the Director to set research and educational support program priorities; and
- Review and approve the Director’s proposed institute policies and procedures.



The director of the institute will report directly to the Provost and the Vice Chancellor for Research and will act as the *ex officio* member of the executive council. The founding director will be appointed by the Provost for a fixed period of time at 100% appointment. Thereafter, directors will be recommended by the EC for a renewable, three-year term at 100% appointment. As needed, the Director will be allowed to split time between Institute and Department responsibilities based on Department faculty affiliation and contingent on Department/School % effort commitment. At the end of the appointment term, the director will be subject to review by the executive council which will provide its' recommendation to the Provost and Vice Chancellor for Research. The director will be responsible for the day-to-day operation of the institute, including supervision of the administrative and other staff. The director will also coordinate and manage HIRI resources to support the prioritized research and academic programs approved by the executive council. The appointment will also allow adequate time and resources for the development of the director's own research program coincident with HIRI's research themes and programs.

The institute will include a scientific advisory board, composed of four UWM faculty members and six representatives external to the university (including healthcare system representatives, corporate leaders, health policy experts, and academic researchers with national and international standing). The scientific advisory board will be appointed by the executive council based on recommendations from the director in coordination with and under advice of HIRI members.

### **Institute Membership**

The institute will support faculty, student and external memberships:

- Faculty Associate (for UWM faculty.)
- Faculty Affiliate (for non-UWM faculty)
- Research Affiliate (for industry and other non-academic entities)
- Academic (including post-doc researchers and visiting UWM faculty)
- Student Associate (for UWM students) and Student Affiliates (for non-UWM students)

Faculty Associate candidates include those listed in Appendix B. Departments and individuals external to the founding affiliates represented on the executive council, but with applicable research interests, may also become members of the institute. All candidates for institute membership must submit a membership application to the institute director and be recommended to and approved by the executive committee.

### **Facilities and Infrastructure Resources**

Facilities for the institute will be located on campus and will include offices for fellows and medical informatics PhD students, an area for administrative staff, and two meeting rooms, one large and one small. The institute will house 20 members (including post-doc researchers and visiting faculty) by the third year of operation, and space should be allocated with this in mind. With all offices, administrative space, and meeting rooms in mind, the institute will require 4,000 square feet total (estimate).

The institute will offer the following infrastructure and support resources for Associate faculty members and their collaborators (provided by support staff and student workers):

- Access to primary research, de-identified medical and public health data
- IRB, HIPAA, privacy, security and resource information and processes
- Terminology and ontology repositories and other infrastructure tools and applications
- Software, software systems, and software development platforms
- Assistance with research dissemination
- Grant development support
- Healthcare IT support

## Resources

### **Initial Three Year Budget**

The institute budget is approximately \$300,000 in its first year with a 3% increase in the second and third years (see Appendix A). This amount covers salary and benefits for the director, an administrative assistant, a grant specialist, as well as supplies and other expenses, such as travel and marketing. First-year support is requested from the Office of the Provost (director's faculty position); general funds (\$125,000); the Graduate School (funding for the grant specialist), and the Founding Affiliates (\$10,000 each).

In the second and third year, postdoctoral researchers and research assistants will be added as affiliate interdisciplinary collaboration's develop and funding allows. Research assistants and postdoctoral researchers will be funded by the faculty PI who mentor those fellows. UWM Schools and Colleges may also contribute to HIRI PA, RA and Post Doc support and thus contribute to the Institute multi-disciplinary collaborative activity while at the same time explicitly supporting their own HIRI Associate faculty. HIRI will increasingly self-support PAs, RAs and Post Docs as infrastructure, training and research grants and foundational funding is secured (see Development and Future Funding sections).

### **Cluster Hire in Health Informatics**

The director of the institute in coordination with the founding affiliates and by direction from the executive council, Provost and Vice Chancellor for Research will explore the UW system cluster hire mechanism to establish new faculty with primary affiliation in the institute or by arrangement with the affiliate colleges and schools.

### **Development Funding**

The Director, Executive Council, Provost and Vice Chancellor for Research will work collectively to identify and secure significant development funding from sources outside the UW system. Candidates for development funding will include individuals, foundations and industry with particular interests in healthcare, biotechnology and health informatics business sector, or general public health improvement. A contributor will be identified to offer Naming Rights to the Institute and affiliated laboratories and resources of the HIRI. In addition, the director will identify and pursue infrastructure, research, institute, and educational startup funding from the national and international funding agencies supporting biomedical and health informatics research and training. Obvious candidates include the National Institutes of Health (NIH), the Department of Health and Human Services (HHS), and the National Library of Medicine (NLM). Existing funding programs include:

Three Grant Proposals will be submitted in 2011:

- NSF MRI Shared Instrument grant to increase high throughput biomedical science computing infrastructure
- NIH/NCRR S10 Shared instrument program to increase cluster computing and health informatics computing infrastructure
- NIH/NLM Biomedical and health informatics training program for ten pre- and post- doctoral trainees (T32)

In addition, founding faculty will submit proposals to additional NIH programs in 2011 including:

- NIH/NLM Express Research Grants in Biomedical Informatics (R01)
- NIH/NCI Academic Research Enhancement Award (R15)
- NIH/NIMH Research Education Grants (R25)
- NIH/NLM Independent Career Development Award for Biomedical Informatics (K22)
- NIH/NLM K99 Career Development Program in biomedical and health informatics

The HIRI director will also work with Associate Faculty and others to apply for National Science Foundation (NSF) awards, such as the Faculty Early Career Development Program, and will reach out to state and national education- and health-oriented foundations, such as The Helen Bader Foundation and the Aegis Foundation.

All successful grant proposals supported and administered at the HIRI will provide long-term direct cost HIRI funding. In addition, for Principle Investigators who are HIRI Associate Members, the current “return rates” to the PI’s School or College will remain untouched. The remaining percentage of indirect funds will be returned to HIRI. This arrangement will be re-negotiated after four years between the Executive Council, the Director, the Provost and Vice Chancellor for Research.

### **Future Funding**

A 2007 RAND analysis found the following:

- Properly implemented and widely adopted, health information technology (HIT) saves money and significantly improves healthcare quality;
- Annual savings from HIT-related efficiency alone could be \$77 billion or more;
- Implementation would cost around \$8 billion per year, assuming adoption by 90 percent of hospitals and doctors’ offices over 15 years.

Just two years later, the American Stimulus package (ARRA, 2009) allocated a \$19 billion investment in health informatics. In the past 3 years, over \$9 million of extramural funding to support institute-related activities has been awarded to individuals who represent the initial class of HIRI fellows, post-graduates and faculty members.

These and related analysis demonstrate that the modest startup funding and support from founding Affiliates will result in \$2-3 million of direct extramural funding annually within the first five years of operation. Besides the potential funding sources (see below), we anticipate leveraging UWM’s recent successes in biotech and pharmaceutical collaborations to identify and pursue HIRI-related high commercialization potential. In addition, Wisconsin has a strong and growing industrial base in biotech, healthcare, and healthcare technology. HIRI will enhance the state’s workforce training and broaden opportunities to establish revenue streams from local, regional and state-wide industries requiring highly skilled and advanced degreed workforce.

### **Existing Funding without HIRI infrastructure resource support:**

A few UWM faculty demonstrate sustained and strong extramural funding in the areas of health and biomedical informatics (Appendix C). Recent and current funding sources include: Cerner Corporation, National Science Foundation, GE Healthcare, National Institutes of Health, and the Agency of Health Research and Quality. Total extramural funding for the past three years in the College of Health Sciences, Engineering, and Nursing exceeds \$10M.

The existing funding demonstrates the tremendous potential to expand and catalyze existing strengths and faculty and to work with external collaborators to leverage current research interests with external funding opportunities.

### **Existing and Potential Funding Corporate, Government, and Academic Sponsors and Partners**

Aurora Health Care	Center for Urban Population Health	WI based Foundations
GE Healthcare	Medical College of Wisconsin	National Library of Medicine
RW Johnson Foundation	US Department of Education	US Department of Labor
National Institutes of Health	State of Wisconsin	Biotechnology companies
National Science Foundation	US Agency for Healthcare Research and Quality	
Wisconsin Center of Excellence in Genomics Science		WI Dept of Human Services

**Space and Location**

The institute will be assigned adequate space to house the director and administrative staff, up to six faculty affiliates (in shared offices), six fulltime faculty research fellows appointed from the participating schools and colleges, twelve fulltime pre- and post-doc fellows and other graduate and undergraduate students. The proposal for HIRI coincides with the Columbia St Mary (CSM) site acquisition plan. The 4000 ASF estimated space requirements for the institute coincide with the Sept 7, 2010 CSM Planning Committee Final Report's prioritized allocation of space for an interdisciplinary Academic and Education entity titled at the time of analysis as the, "Biomedical and Health Informatics Research Institute". HIRI is the Institute.

**Review of Comparable Institutes**

Six comparable institutes were reviewed (Appendix D.) were reviewed to prepare this proposal. In addition, all Wisconsin health-related academic and research centers, departments and programs were reviewed. A summary of educational offerings and courses offered in Milwaukee demonstrate the large number of health informatics programs and courses (Appendix E.) are available. In some cases, UWM students can take MCW or MU courses for graduate credit and HIRI will help coordinate and support this cross-institute pollination.

**APPENDIX A: Three-Year Budget Estimates**

The Director’s salary and startup package is provided by the Provost’s office\*.

The Graduate School support the grant specialist\*\*.

The Founding Affiliate Schools and Colleges contribute \$10,000 each for the first three years.

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
<b><u>Personnel</u></b>			
<b>Director*</b>			
Salary	120,000	124,800	129,792
Benefits	47,400	49,296	51,268
<b>Grant Specialist**</b>			
Salary	50,000	52,000	54,080
Benefits	19,750	20,540	21,362
<b>Administrative Assistant</b>			
Salary	35,000	36,400	37,856
Benefits	13,825	14,378	14,953
<b>Personnel Totals</b>	<b>285,975</b>	<b>297,414</b>	<b>309,311</b>
<b>Supplies and Expenses</b>	<b>10,000</b>	<b>15,000</b>	<b>20,000</b>
<b>Overall Annual Totals</b>	<b>295,975</b>	<b>312,414</b>	<b>329,311</b>



## **APPENDIX B: List of UWM faculty indicating health Informatics research interests**

Faculty members who are already participating in informatics-related projects or have been identified as potential participants are listed below by school or college affiliation:

### **Lubar School of Business**

Hermant Jains  
Huimin Zhao  
Fatemah (Mariam) Zahedi

### **College of Engineering and Applied Science**

Susan McRoy  
Joe Bockhorst  
Zeyun Yu

### **School of Information Studies**

Xiangming Mu  
Hope Olson  
Jin Zhang  
Jacques du Plessis  
Alex Dimitroff  
Wooseob Jeong  
Karen Davies

### **College of Health Sciences**

Timothy B. Patrick  
Hong Yu  
Min Wu  
Mark Johnston  
Rohit Kate

### **College of Nursing**

Norma Lang  
Amy Coenen  
Sally Lundeen  
Tae Youn Kim  
Mary Jo Baisch  
Suzanne Feetham

### **School of Public Health**

Peter Tonellato  
Nancy A Mathiowetz  
Helen Wang (new faculty starting in 2011)  
(Four additional health informatics, biostatistics, epidemiology faculty will be hired in 2011)

### **APPENDIX C: Current Funded Informatics Projects**

This list includes recent research grants and contracts, according to the University of Wisconsin System Wisconsin Data Mart for PeopleSoft Financials (WISDM) and **WIS**consin Proposal Electronic Routing (WISPER). It does not include grants and contracts that ended prior to August 2009.

#### **College of Engineering and Applied Science (\$1,986,471 total)**

“A Novel High-Electron-Mobility Transistor for DNA Detection”, David Klemer, PI, UWM Research Foundation, \$80,000, 2008-2009.

“Automatic Patient Search for Breast Cancer Clinical Trials”, Jun Zhang, PI; Xiangming Mu- (SOIS), Hong Yu (CHS), Tian Zhao, Co-PIs; UWM Research Foundation, \$70,000, 2009-2010.

“CAREER: Compressed Sensing Magnetic Resonance Imaging”, Lei Ying, PI, \$239,671, 2009-2012.

“Earlier Diagnosis of Retinal Disease”, Hao Zhang, PI; Shaw Scientist Award, \$200,000, 2009-2014.

“Goals: Parallel Mri Using Phased Array Coils”, Lei Ying, PI, \$154,137, National Science Foundation, 2007-2010.

“Microelectronic DNA Sensor for NATP”, David Klemer, PI, Medical College of Wisconsin, \$20,000, 2009-2010.

“Multifunctional Unimolecular Micelles for Tareted Cancer Therapy”, Shaoqin Gong, PI; UWM Research Foundation, \$105,000, 2008-2009.

"Multiscale and Multiphysics Simulation Tools with Applications to Biomedical Systems", Zeyun Yu, PI; NIH, sub-award with the National Biomedical Computational Resources (NBCR) at University of California-San Diego, \$191,663, 2009 – 2014.

“Random Encoding MRI”, Lei Ying, PI, UWM Research Foundation, \$85,000, 2009-2010.

#### **College of Health Sciences (\$2,838,165 total)**

“BioIMAGE: Intelligent seMantic Analysis of Biomedical imaGEs in literature”, Hong Yu PI; subcontract with University of Michigan , National Institute on Drug Abuse, \$86,372, 2008-2009.

“Early Childhood Integrated Database System (ECIDS): Implementation and Evaluation”, Healthier Wisconsin Partnership Program, \$449,691 (award amount), Patrick TB and Rhyner PM, Co-PIs; 07/01/2007-06/30/2010.

“Early Childhood Integrated Database System (ECIDS) Phase 2: Standardizing the Data for Birth to 3 Programs in Milwaukee County”, Helen Bader Foundation, Patrick TB and Rhyner PM, Co-PIs, \$100,000, 07/01/2007 – 06/30/2010.

“HERMES - Help physicians to Extract and aRticulate Multimedia information from literature to answer their ad-hoc medical questions.” Hong Yu, PI. 1R01LM009836-01A1 NIH, \$ 1,453,182; 2007-2010

“Info Retrieval in Biology”, Hong Yu, PI; UWM RGI 101X089, \$339,318, 2007-2010.

“Towards the Building of a Comprehensive Biological Experiment Database”, Hong Yu PI, 1R211RR024933-01A1, NIH, \$409,602, 2007-2009.

"Preventing the Incidentalome" Hong Yu, (Kohane PI) NIH, \$127,184, 2009-2011

**College of Nursing (\$2,540,827 total)**

"The Knowledge-Based Nursing Initiative (KBNI): Developing embedded clinical decision support for nurses at the point of care, (ACW Phase III & IV) , Lundeen , SP and Lang, NM, Co-PIs, Contract with Aurora Health Care, Inc. and Cerner Corporation. \$1,202,525; 2007-2010.

"Collaborative Intelligent Health Information Systems Initiative (CIHISI)," Lundeen, S, PI, National Science Foundation, Partnerships for Innovation-PFI , \$598,549; 2007-2009.

"Using Evidence-based Nursing Practices and EHR Decision Support to Reduce Fall-related Patient Injuries in Acute Care", Lang, NM, PI , Agency for Health Care Research & Quality (AHRQ ACTION;) subcontract with Aurora Healthcare, \$62,334; 2009-2010.

"Expanding and testing the International Classification for Nursing Practice (ICNP®) for documentation of nursing practice," Coenen, A, PI, Contract with International Council for Nursing (ICN); \$677,419; 2007-2010.

## **APPENDIX D: Comparable Organizations**

Duke Center for Health Informatics  
[www.dchi.duke.edu](http://www.dchi.duke.edu)

University of Cincinnati Center for Clinical and Translational Science and Training; A CTSA site (with collaborating Medical Schools (Children's Hospital and VA)  
[www.cctst.uc.edu](http://www.cctst.uc.edu)

University of Louisiana-Lafayette Health Informatics Center of Acadiana (HICA)  
[www.louisiana.edu/AboutUs/Excellence/HICA.shtml](http://www.louisiana.edu/AboutUs/Excellence/HICA.shtml)

University of Minnesota Institute for Health Informatics  
[www.ihl.umn.edu/aboutihl/faq/home.html](http://www.ihl.umn.edu/aboutihl/faq/home.html)

University of Missouri Informatics Institute  
[mii.missouri.edu/index.php?pid=0](http://mii.missouri.edu/index.php?pid=0)

Center for Biomedical Informatics, Harvard Medical School  
[cbmi.hms.harvard.edu](http://cbmi.hms.harvard.edu)

## **APPENDIX E: Courses at UWM and Surrounding Institutes**

### Joint Offerings of Health Related Informatics Courses

The following health informatics related courses are available at UWM, MU and MCW. UWM students interested in public health informatics and more broadly in biomedical health informatics (nursing, health sciences, medical, clinical, information science) will likely benefit from considering these courses when planning and executing their program of study.

### Graduate Courses Cross Offerings

UW-Milwaukee has entered into a partnership with the Marquette University (MU) and the Medical College of Wisconsin (MCW) to allow graduate students to take advantage of academic resources available in the Milwaukee area. To learn more about the program contact your advisor. The primary contact for the exchange

program at UWM is:

Patricia Hayes

[hayes@uwm.edu](mailto:hayes@uwm.edu)

(414) 229-6263

MCW:

Julie Piorkowski

[jpiorkowski@mcw.edu](mailto:jpiorkowski@mcw.edu)

(414) 955-8218

MU:

The Basic process is to participate in this collaboration is:

- Identify courses offered at the collaborative institute and NOT offered at the home institute.
- Write justification for course and receive approval from graduate advisor or school.
- Submit to P. Hayes.

The course must be germane to the student's graduate program and NOT offered at the home institute. It is preferred that approval from UWM be received before contacting either MU or MCW.

### **University of Wisconsin at Milwaukee**

#### **College of Engineering and Applied Science**

##### **Computer Science**

CS 422 Introduction to Artificial Intelligence. 3 cr

CS 423 Introduction to Natural Language Processing. 3 cr

CS 425 Introduction to Data Mining. 3 cr

CS 444 Introduction to Text Retrieval and Its Applications in Biomedicine. 3 cr

CS 535 Data Structures and Algorithms. 3 cr

CS 557 Introduction to Database Systems. 3 cr

CS 710 Artificial Intelligence. 3 cr

CS 711 Pattern Recognition - Statistical, Neural, and Fuzzy Approaches. 3 cr

CS 712 Image Processing. 3 cr

CS 720 Computational Models of Decision Making. 3 cr

CS 723 Natural Language Processing. 3 cr

CS 743 Intelligent User Interfaces. 3 cr

CS 744 Text Retrieval and Its Applications in Biomedicine. 3 cr

CS 757 DataBase Organization and File Structure. 3 cr

CS 759 Data Security. 3 cr

CS 790 Introduction to Bioinformatics. 3 cr

CS 870 Medical Informatics Seminar. 1 cr

##### **Electrical Engineering**

EE 436 Introduction to Medical Instrumentation. 3 cr

EE 437 Introduction to Biomedical Imaging. 3 cr

EE 438 Bioanalytics and Biomedical Diagnostics. 3 cr

EE 737 Medical Imaging Signals and Systems. 3 cr

### Mechanical Engineering

ME 469 Introduction to Biomechanical Engineering. 3 cr

### Industrial and Manufacturing Engineering

Ind Eng 716 Engineering Statistical Analysis. 3 cr

Ind Eng 767 Statistical Methods for Engineers and Scientists. 3 cr

### **Business Administration, Lubar School of Business**

Bus Adm 714 Multivariate Techniques in Management Research. 3 cr

Bus Adm 741 Web Mining and Analytics. 3 cr

Bus Adm 744 Information Technology Strategy and Management. 3 cr

Bus Adm 747 Systems Analysis and Design

Bus Adm 749 Advanced Data and Information Management. 3 cr

Bus Adm 755 Health Care Administration and Delivery Systems. 3 cr

Bus Adm 756 Health Care Delivery Systems. 3 cr

Bus Adm 757 Managed Care and Integrated Health Networks. 3 cr

Bus Adm 817 Infrastructure for Information Systems. 3 cr

Bus Adm 912: Statistical Methods for Management Research, 3 cr

### **Nursing, College of Nursing**

NURS 710 Patient Care Systems. 3 cr

NURS 720 Biostatistics and Applications for Nursing Practice. 2 cr

NURS 727 Epidemiology. 3 cr

NURS 729 Health Care Systems and Advanced Practice. 3 cr

NURS 773 Information Systems to Support Clinical Decision-Making. 3 cr

NURS 882 Qualitative Approaches to Nursing Research. 3 cr

NURS 883 Quantitative Approaches to Nursing Research. 3 cr

### **Health Care Informatics, College of Health Sciences**

HCA 441: Healthcare Information Systems Analysis & Design, 3 cr

HCA 442: Healthcare Database Design & Management, 3 cr

HCA 537 (HCA 337) Introduction to Healthcare Databases and Technologies. 3 cr

HCA 700: Introduction to HealthCare Informatics, 2 cr

HCA 721 Health Information Technology Procurement. 3 cr

HCA 723 Health Care Systems Applications - Administrative and Clinical. 3 cr

HCA 744 Text Retrieval and Its Applications in Biomedicine. 3 cr

HCA 760 Biomedical and Healthcare Terminology and Ontology. 3 cr

### **Library and Information Science, College of Health Sciences**

L&I SCI 521 (510) Introduction to Reference Services and Resources. 3 cr

L&I SCI 550 Introduction to Information Science. 3 cr

L&I SCI 571 Information Access and Retrieval. 3 cr

L&I SCI 632 Microcomputers for Information Resources Management: 3 cr

L&I SCI 655 (615) Information and Records Management: 3 cr

L&I SCI 656 Electronic Documents and Records Management. 3 cr

L&I SCI 661 (620) Ethics and the Information Society. 3 cr

L&I SCI 714 Metadata. 3 cr

L&I SCI 760 Biomedical and Healthcare Terminology and Ontology. 3 cr

L&I SCI 717 Information Architecture and Knowledge Organization. 3 cr

L&I SCI 774 Online Information Retrieval. 3 cr

L&I SCI 783 (671) Information Storage and Retrieval. 3 cr

L&I SCI 785 (742) Database Management Systems for Information Professionals. 3 cr

### **Marquette University**

#### **Mathematics, Statistics and Computer Science**

MSCS 5600 Fundamentals of Artificial Intelligence  
MSCS 5800 Principles of Database Systems  
MSCS 6010 Probability  
MSCS 6020 Simulation  
MSCS 6030 Applied Mathematical Analysis  
MSCS 6040 Applied Linear Algebra  
MSCS 6050 Elements of Software Development  
MSCS 6060 Parallel and Distributed Systems  
MSCS 6330 Data Mining  
MSCS 6340 Component Architecture  
MSCS 6350 Distributed Computing  
MSCS 6355 Mobile Computing  
MSCS 6360 Enterprise Architecture  
MSCS 6370 Information Representation  
MSCS 6380 Advanced Database Systems

#### **Department of Biomedical Engineering**

BIEN 5220 Embedded Biomedical Instrumentation  
BIEN 5230 Intelligent Biosystems  
BIEN 5320 Biomedical Instrumentation Design  
BIEN 5400 Transport Phenomena  
BIEN 5510 Image Processing for the Biomedical Sciences  
BIEN 5700 Systems Physiology  
BIEN 5931 Topics in Biomedical Engineering: Intellectual Property for Engr  
BIEN 5931 Topics in Biomedical Engineering: Finance Biomed Engin  
BIEN 5931 Topics in Biomedical Engineering: Clinical Iss Biomed Eng Design  
BIEN 5931 Topics in Biomedical Engineering: Large Scale Comput in Biom Eng  
BIEN 6200 Biomedical Signal Processing  
BIEN 6210 Advanced Biomedical Signal Processing  
BIEN 6440 Biomedical Engineering Analysis of Trauma  
BIEN 6451 Musculoskeletal Biomechanics 2  
BIEN 6610 Rehabilitative Biosystems  
BIEN 6931 Topics in Biomedical Engineering: Computational Neuroscience  
BIEN 6947 Medical College of Wisconsin/FUIM-Joint Degree: Advanced Molecular Genetics  
BIEN 6947 Medical College of Wisconsin/FUIM-Joint Degree: Analytical Method Pharm & Tox  
BIEN 6947 Medical College of Wisconsin/Joint Degree-Life Sciences: Advanced Systems Neuroscience  
BIEN 6947 Medical College of Wisconsin/Joint Degree-Life Sciences: Integrated Graduate Neuroscien  
BIEN 6947 Medical College of Wisconsin/Joint Degree-Life Sciences: Fourier Transforms  
BIEN 6947 Medical College of Wisconsin/Joint Degree-Life Sciences: Dsgn. Analysis Clinical Trials

#### **Electrical & Computer Engineering**

EECE 5610 Object-Oriented Software Engineering  
EECE 5620 Modern Programming Practices  
EECE 5630 Software Testing  
EECE 5650 Introduction to Algorithms  
EECE 5690 Developments in Computer Software

EECE 5810 Database Applications  
EECE 5840 Computer Security  
EECE 5850 Introduction to Intelligent Systems  
EECE 5860 Introduction to Neural Networks and Fuzzy Systems  
EECE 6520 Digital Processing of Speech Signals  
EECE 6530 Chaos and Nonlinear Signal Processing  
EECE 6540 Digital Image Processing  
EECE 6560 Information and Coding Theory  
EECE 6810 Algorithm Analysis and Applications  
EECE 6820 Artificial Intelligence  
EECE 6822 Machine Learning  
EECE 6830 Pattern Recognition  
EECE 6840 Neural Networks and Neural Computing

### **Medical College of Wisconsin**

#### **Biostatistics**

BIOST 214 Design and Analysis of Clinical Trials. cr 3  
BIOST 220 Research Seminar. cr 1  
BIOST 221 Theory of Statistical Consulting. cr 2  
BIOST 222 Statistical Consulting. cr 3  
BIOST 224 Biostatistical Computing. cr 3  
BIOST 231 Statistical Models and Methods I. cr 3  
BIOST 232 Statistical Models and Methods II. cr 3  
BIOST 233 Statistical Models and Methods III. cr 3  
BIOST 275 Applied Survival Analysis. cr 3  
BIOST 285 Introduction to Bayesian Analysis. cr 3  
BIOST 313 Advanced Statistical Computing. cr 3  
BIOST 363 Advanced Statistics I. cr 3  
BIOST 365 Linear Models I. cr 3  
BIOST 384 Statistical Genetics. cr 3  
BIOST 385 Advanced Bayesian Analysis. cr 3  
BIOST 386 Theory of Survival Analysis. cr 3  
BIOST 391 Special Topics in Biostatistics. cr 1-3

#### **Graduate School**

PHYS 8284A Computational Methods in Biomedical Research. cr 3  
PHYS 8223A Bioinformatics- Tools & Tactics. cr 1