

**University of New Mexico Health Sciences Library and Informatics Center
Biomedical Informatics Fellowship Curriculum Specification**

Key to Competency Level

Each of the competencies listed is designed to be taught to a particular level of expertise as defined in this table. For the BioMIT Program, the competency levels are defined for the fellows' level of expertise upon successful completion of the fellowship.

Level:	Competency:
0	Not Applicable
1	Informal Awareness – minimal working knowledge only
2	Informal User – the user has some functional knowledge but usually requires guidance or input from more experienced users
3	Knowledgeable User – the user has enough knowledge to understand key concepts and appreciate complexities well enough to have intelligent conversations and interact efficiently with acknowledged experts in this area
4	Expert User – the user has enough knowledge in this area to function autonomously the vast majority of the time
5	Local Expert User – a known expert in the this area in the local community that other researchers seek out occasionally for advice on this topic
6	Nationally recognized leader in this area

Key to Assessment Level

Each of the competencies is assessed at one of the following levels:

Level:	Assessment:
0	Not Assessed
1	Tracked for completion only
2	Tracked for successful completion by external department or organization's criteria. (Example: receiving a certificate of completion from the UNM Center for Ethics Training Program or participating in the SOM EBM Curriculum for one year.)
3	Tracked for successful completion by HSLIC criteria. (Example: Completion of a HSLIC class.)
4	Tracked for successful completion by BioMIT Program Criteria (Example: completing a paper that is accepted for publication in a peer reviewed scientific journal.)



Key to Abbreviations of Resources:

Each of the following resources can be used to teach the BMI competencies to the fellow as outlined in the subsequent tables.

Abbreviation:	Meaning:
AMIA	Tutorial at an AMIA Meeting
BioMISS	UNM HSLIC Medical Biomedical Informatics Seminar Series. This small group discussion led by topic experts is sponsored by HSLIC and occurs during the academic year approximately twice per month. The goal of this series is to 1) to provide a forum for discussion on current topics in biomedical informatics and 2) to provide a networking opportunity for those working or interested in biomedical informatics at UNM.
EBM	UNM School of Medicine Evidenced-Based Instructor Mentorship Program. This occurs in the SOM Transitions Block of the medical school curriculum. This class is a series of six two-hour lectures and small group discussions on EBM. Each fellow is expected to participate in teaching this class for a minimum of two years to refine his/her knowledge and skills in evidenced-based searching of the medical literature and the practice of evidenced-based medicine.
CI	Clinical Experience in a UNM Hospitals clinic with our Cerner EMR system
CTSC	CTSC Clinical Investigators Program. The fellow’s mandatory participation in this program is designed to teach him/her basic clinical research skills (e.g., protocol development, IRB application and issues, data analysis and basic biostatistics, scientific presentation skills).
CTSCMSCR	CTSC Biomedical Informatics Course
HL-7	Attend tutorial at an HL-7 National Conference. HL-7 is the internationally recognized electronic health information data exchange standard.
HRRC	UNM Human Research Review Committee
HSLIC Course	Class taught at the UNM Health Sciences Library and Informatics Center.
IM	Individual Mentoring
NIH	Attendance at the NIH Regional Grant Writing Conference
OHSU	<p>Oregon Health & Science University Graduate Certificate Program in Biomedical Informatics. This certificate program is a web-based, distance learning program that provides a basic broad overview of the science of biomedical informatics. OHSU is a national leader in providing this type of training in a web-based format. To earn the certificate, the student must a total of 8 on-line courses.</p> <p><u>Required Courses:</u> BMI 510 - Introduction to Medical Informatics BMI 512 - Clinical Systems BMI 514 - Information Retrieval & Digital Libraries BMI 517 - Organizational Behavior & Management</p> <p><u>Elective Courses Required by the UNM BioMIT Program:</u> BMI 570 - Scientific Writing and Communication for Informatics Students BMI 560 - Design and Evaluation in Health Informatics</p> <p><u>Elective Courses Chosen by the fellow:</u> Electives should be chosen in consultation with the fellow’s informatics mentor and should complement the fellow’s existing skills and research project needs. See the following link for a complete list of options: http://www.ohsu.edu/ohsuedu/academic/som/dmice/academics/certificate.cfm</p>
UNMIE	UNM HSC Institute for Ethics: Health Care Ethics Certificate Program http://hsc.unm.edu/ethics/cert_prog.shtml . This program “...is designed for faculty and other professionals interested in the interdisciplinary study of health care ethics with an emphasis on applied clinical ethics, cultural competency, and legal issues.” BMI fellows are required to complete both modules of this certificate program to obtain training in medical ethics as well as in research ethics in particular.

I. Competencies in Clinical Research

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>I.1 Evidenced-Based Searching of the Medical Literature: Given a clinical or research question, the fellow will be able to efficiently search the medical literature and find articles or resources at the highest level of evidence available to answer his/her clinical or research question. The fellow will then be able to critically appraise the quality of the literature in an evidenced-based manner and discuss the appropriateness of applying such evidence to his/her clinical practice or research project. The fellow will be able to demonstrate proficiency of use of the major medical knowledge databases including Cochrane, DARE, and PubMed by completing EBM class instructor training and participate as an instructor in the EBM class for a period of at least one year.</p>	EBM, IM	5	<ul style="list-style-type: none"> • The EBM Process • Constructing clinical questions • Randomized controlled trials • Meta-analysis • Systematic Reviews • Analyzing articles about therapy • Analyzing articles about screening tests 	2, participation as a faculty/mentor in SOM EBM curriculum for two years
<p>I.2 Citation Management Tools: Given a paper or other scholarly work a fellow is writing, the fellow will demonstrate successful use of a citation management tool such as RefWorks when including references in his/her paper or scholarly work.</p>	HSLIC Course	5	<ul style="list-style-type: none"> • End Note or Ref Works 	3, completion of HSLIC class
<p>I.3 Research Study Design: Each fellow will be able to list a minimum of six different clinical study designs. Given a research question and appropriate research venue, a fellow will be able to select an appropriate study design and describe the strengths and weaknesses of the design he/she selects.</p>	OHSU, EBM, CTSC, IM	4	<ul style="list-style-type: none"> • Case reports • Open trials • Randomized, controlled trials • Cohort analysis • Crossover trial • Meta-analysis • Systematic Reviews 	2, CTSC certificate, OHSU Certificate

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>I.4 Protocol Development: Each fellow will author a protocol document that describes the research protocol for his/her research project and addresses at least the following areas: study design, privacy and confidentiality protections, sample size calculations, outcomes measurement, subject informed consent or waiver thereof, subject recruitment plans, and contingencies for anticipated problems.</p>	EBM, GCRC, IM	4	<ul style="list-style-type: none"> • Human subject research protections • HIPAA regulations • IRB review process 	2, HRRC approval for fellowship research project, CTSC Certificate 2, Participation as a faculty reviewer on the Medical School Research Committee for X 2 years
<p>I.5 Operationalize a Research Protocol: Given a well-written research protocol, a fellow will be able to demonstrate how to administer and operationalize the study.</p>	OHSU, EBM, GCRC, IM	4	<ul style="list-style-type: none"> • Research data collection and management • Database basics 	2, CTSC certificate 2, OHSU certificate
<p>I.6 Data Aggregation for Research: Given a well written research protocol and study design, the fellow will be able to construct a methodology for data gathering and storage, using the appropriate information system tools, and defend his/her choices and methods to the satisfaction of seasoned faculty researchers.</p>	OHSU, EBM, GCRC, IM	4	<ul style="list-style-type: none"> • Research data collection and management • Database basics 	2, OHSU certificate 2, CTSC certificate
<p>I.7 Data Analysis for Research: Given a well written study protocol, study design, and data collection system, the fellow will be able to choose appropriate data analysis methodologies and operationalize them. The fellow will be able to defend his/her choices of specific methodologies and analyses to seasoned faculty researchers.</p>	OHSU, EBM, GCRC, IM	4	<ul style="list-style-type: none"> • Basic biostatistics 	2, OHSU certificate 2, CTSC certificate
<p>I.8 Critical Question Development: Given a specific area of potential research, the fellow will be able to generate well constructed research questions that have the potential to be operationalized into a clinical research project.</p>	OHSU, EBM, GCRC, IM	4	<ul style="list-style-type: none"> • “PICO” research question format 	2, CTSC certificate 2, participation as a faculty/mentor in SOM EBM curriculum for two years

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>I.9 HIPAA Privacy and Security Regulations for Research: Given a potential research protocol involving the collection, storage, and analysis of protected health information, the fellow will be able to apply the general components of the HIPAA regulations appropriate to the particular protocol and design the necessary accommodations and processes that would be needed to insure that operationalization of the research protocol would be in compliance with these regulations. In addition, the fellow will have to be able to defend his/her recommendations to a seasoned faculty researcher.</p>	CTSC	5	<ul style="list-style-type: none"> • What is Protected Health Information • HIPPA Regulations • Technological tools for securing data • Protections for storage of Protected Health Information 	2, CTSC certificate 2, CTSC MSCR Biomedical Informatics Course
<p>I.10 Grant Writing Skills: The fellow will demonstrate basic grant writing skills by successfully completing the NIH Regional Grant Writing Workshop</p>	NIH, IM	4	<ul style="list-style-type: none"> • NIH grant writing skills 	2, Attendance at the NIH Regional Grant Writing Conference
<p>I.11 IRB Review Process: All fellows will demonstrate basic knowledge of basic human subjects' protection regulations and associate responsibilities by successfully completing the UNM Human Research Review Committee's web-based training course. In addition and with the help of his or her mentors, all fellows will demonstrate practical knowledge of the HRRC application process by successfully constructing all the required application documents and receiving HRRC approval for his/her fellowship research project.</p>	NIH, HRRC, CTSC, IM	4	<ul style="list-style-type: none"> • Beneficence • Federal regulations regarding protection of human subjects • Protocol review process at UNM 	2, CTSC certificate 2, HRRC approval for fellowship research project
<p>I.12 Study Subject Recruitment: Given a well written research protocol, the fellow will be able to design and defend a study-subject recruitment process sufficient to meet the requirements of the research protocol.</p>	NIH, HRRC, CTSC, IM	4	<ul style="list-style-type: none"> • Sample size calculation • Informed consent 	2, CTSC certificate 2, HRRC approval for fellowship research project,
<p>I.13 Biostatistics: Given a well designed research protocol, the fellow will be able to recommend the basic statistical tests that will validate the kind of data collected by the study at a level that a professionally trained biostatistician will be able to easily understand.</p>	CTSC	2	<ul style="list-style-type: none"> • Power analysis • Sample size calculation • Statistical testing 	2, CTSC Certificate

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>I.14 Scientific Presentation Development: Given the results of a well-conducted research project, the fellow will be able to construct and deliver a professional scientific presentation in variety of venues including a poster session and talk at a national scientific meeting.</p>	CTSC, IM	4	<ul style="list-style-type: none"> • PowerPoint presentation skills • Presenting scientific data at a scientific meeting 	2, CTSC certificate & four completed presentations at CTSC Clinical Investigators' Dinner Meetings
<p>I.15 Scientific Manuscript Development: Given the results of a well designed research project, the fellow will be able to construct a well written manuscript suitable for submission to a scientific journal for publication.</p>	EBM, CTSC, IM	4	<ul style="list-style-type: none"> • Scientific communications skills 	2, CTSC certificate 4, completion of manuscript accepted for publication in a peer reviewed journal
<p>I.16 Scholarly Communications Issues: The fellow will be able to describe the current crisis in scholarly communication and suggest at least two actions individual researchers can take to help to be a part of the solution to mitigate the crisis.</p>	CTSC, IM	4	<ul style="list-style-type: none"> • Crisis in scholarly communication • NIH Public Access Policy • PubMed Central 	2, CTSC MSCR Biomedical Informatics Course
<p>I.17 Ethics: Each fellow will demonstrate his or her understanding of basic ethical principles regarding medical care and research by successful completion of the UNM Institute for Ethics Health Care Ethics Certificate Program.</p>	UNMIE	4	<ul style="list-style-type: none"> • Beneficence • Values-based decision making • Professional responsibility • Patients' rights • Privacy and confidentiality • Truth telling • Reproductive ethics • Health care reform and delivery • Research ethics 	2, UNMIE Health Care Ethics Certificate Program (Two modules)

II. Competencies in General Biomedical Informatics:

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>II.1 Data Warehouses & Database Research: The fellow will be able to describe in detail a minimum of six common benefits and problems or difficulties in performing this type of research. In addition, the fellow will be able to describe in detail strategies to incorporate into the design of a clinical data warehouse or database to help mitigate the problems to the satisfaction of a seasoned informatics researcher.</p>	OHSU, CTSCMSCR	5	<ul style="list-style-type: none"> • Basic database architecture and functionality • Data mining 	2, OHSU certificate program 2, CTSCMSCR Biomedical Informatics Course
<p>II.2 Ontologies: The fellow will be able to describe in detail the complexities with knowledge representation and how terminology standards are used to help solve this complex problem. In addition, he/she will be able to construct a proposed solution to common ontological problems.</p>	CTSC, AMIA	4	<ul style="list-style-type: none"> • Semantic triangle • Polysynonymy 	2, AMIA Tutorial on Ontology's 2, CTSC certificate
<p>II.3 Standardized Terminologies: Given a suitable domain space, the fellow will be able recommend the choice of appropriate NLM standardized terminologies. In addition, the fellow will be able to construct an argument in support of his/her choice that takes into account the advantages and limitations of the recommended choice of terminology to the satisfaction of a seasoned informatics researcher.</p>	CTSCMSCR	5	<ul style="list-style-type: none"> • Need for standardized terminologies in medical databases • UMLS • LOINC • RxNorm • ICD-9 	2, AMIA Tutorial on Terminology 2, CTSCMSCR Biomedical Informatics Course
<p>II.4 Quality Improvement: The fellow will be able to describe the concept of continuous quality improvement and list several examples of how this was practically implemented for an organizational process or business unit.</p>	IM, OHSU, CTSCMSCR	4	<ul style="list-style-type: none"> • Different project design methodologies • Continuous quality improvement 	2, CTSCMSCR Biomedical Informatics Course 2, OHSU course Organizational Behavior & Management (BMI 517)

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>II.5 Electronic Medical Records: The fellow will be able to demonstrate the use of an electronic medical record in an appropriate clinical or research setting. In addition, the fellow will be able to describe the benefits and limitations of the common features of most electronic medical records' designs to the satisfaction of a seasoned informatics researcher.</p>	<p>BioMISS, CE, OHSU, CTSCMSCR, Committee Observation</p>	<p>5</p>	<ul style="list-style-type: none"> • Difficulties in creating an electronic medical record • Coding versus free text information • Database complexities • Political, cultural and financial complexities 	<p>1, BioMISS lectures on electronic medical records and electronic decision support 1, Clinical experience with UNMH's electronic medical record system 2, CTSCMSCR</p>
<p>II.6 Computerized Decision Support Systems: Given a particular design of a clinical decision support system, the fellow will be able to analyze the particular design and point out its strengths and weaknesses to the satisfaction of a seasoned BI researcher. In addition, the fellow will be able to explain the importance and difficulty of setting the sensitivity and specificity in the design of decision-support interventions commonly used in clinical practice.</p>	<p>BioMISS, CE, OHSU, CTSCMSCR</p>	<p>5</p>	<ul style="list-style-type: none"> • What is decision support • Why can it work • Advantages of computerized decision support • Limitations 	<p>1, BioMISS lectures on electronic medical records and electronic decision support 1, Clinical experience with UNMH's electronic medical record system 2, CTSC MSCR course</p>
<p>II.7 HL7 and Communication Standards: Given a typical intersystem HL-7 interface, the fellow will be able to construct an analysis of the design of the given interface, highlighting its strengths, weaknesses, and possible alternative design strategies to accomplish the goals of the particular interface.</p>	<p>IM, HL-7/AMIA</p>	<p>4</p>	<ul style="list-style-type: none"> • HL-7 Standard • Multiple methods to accomplish the same task in HL-7 	<p>2, Complete HL-7 tutorial at HL-7 or AMIA conference.</p>

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>II.8 Educational Technologies: Given a particular educational task and venue, the fellow will be able to construct a recommendation of potential educational technologies that may be used in the given venue that will optimize the learning experience in the given venue. In addition, the fellow will be able to discuss the advantages and disadvantages with regard to the specific technologies he/she has recommended in accomplishing the given educational task in the given venue.</p>	OHSU	3	<ul style="list-style-type: none"> • Web-based educational tools 	2, certificate from OHSU
<p>II.9 Digital Signal Acquisition: The fellow will be able to describe the process of how an analog signal is sampled, encoded, transmitted, and then represented. This will include a description of data compression, signal processing, and storage formats. The fellow will also be able to discuss the basic advantages and disadvantages of storing analog signals in digital format.</p>	CTSCMSCR	3	<ul style="list-style-type: none"> • How are analog signals converted to digital representations • What are the advantages of digital representations over analog Issues recording continuous clinical signals 	2, CTSCMSCR class on biomedical informatics
<p>II.10 Digital Imaging and Associated Standards: The fellow will be able to describe in detail how an image is captured digitally, compressed, and stored. In addition, the fellow will be able to describe the common image storage and compression formats (bitmap, half-toned, JPEG, MPEG, PACS), citing the advantages and disadvantages of each format.</p>	BioMISS, IM	3	<ul style="list-style-type: none"> • How are digital images captured, coded and stored • Common digital image formats and standards 	1, BioMISS lecture on digital imaging

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>II.11 Telehealth: The fellow will be able to describe the benefits of the use of Telehealth systems and describe the advantages and disadvantages of using a Telehealth system in a minimum of three distinct application areas.</p>	BioMISS, IM	2	<ul style="list-style-type: none"> • Regulatory issues • Common uses • Common limitations 	1, BioMISS lectures on TeleHealth
<p>II.12 Bioinformatics: The fellow will be able to list and describe a minimum of three common complex areas in the realm of bioinformatics or computational biology along with the kinds of informatics tools used in these areas. The fellow will be able to perform advanced citation searches using NLM web-based resources for searching the literature by gene or chemical structure.</p>	BioMISS, IM	2	<ul style="list-style-type: none"> • Common problems in informatics when working with DNA, proteins and small molecules • Advantages of using informatics tools in this area 	1, BioMISS lectures on Bioinformatics 2, Attendance at “Biocomputing @ UNM” annual conferences
<p>II.13 Medical Simulation: Given a particular educational goal and venue, the fellow will be able to construct a recommendation and evaluation plan for the use of simulation technology in the given venue. In addition, the fellow will be able to list a minimum of three complexities or difficulties in performing simulation or haptics research.</p>	BioMISS, IM	2	<ul style="list-style-type: none"> • Knowledge transference • Haptics • Definition of low-medium-high fidelity simulation • How simulation can improve medical education 	1, BioMISS lecture on medical simulation

III. Competencies in Basic Information Technology

Competency	Covered in/by:	Competency Level:	Topics:	Assessment:
<p>III.1 Internet history: The fellow will be able to describe the history of the development of the internet, listing at least four features of its design that have led to its success and wide-spread adoption.</p>	BioMISS, IM	2	<ul style="list-style-type: none"> • History of Internet • Review of OSI Layers • Packet Switched Networks 	1, BioMISS 2, CTSCMSCR course on biomedical informatics
<p>III.2 Internet Architectures (web pages, email): The fellow will be able to describe the basic high-level operation of internet in its support of web pages and email applications.</p>	BioMISS, CTSCMSCR	3	<ul style="list-style-type: none"> • WebPages and HTML • Internet and email 	1, BioMISS 2, CTSCMSCR course on biomedical informatics
<p>III.3 Database Design: Given a well written study protocol, the fellow will be able to construct a recommended database design that will adequately support operationalization of the protocol. The fellow will be able to defend his/her design choices to the satisfaction of a seasoned BI researcher.</p>	OHSU, MISS	4	<ul style="list-style-type: none"> • Basic database design and functionality • Complexities when running queries • Normalization 	1, MISS lecture “Clinical Database Research” 2, CTSCMSCR course on biomedical informatics
<p>III.4 Data Representation: Given a list of common clinical data, the fellow will be able to construct at least two different data representation schemes and defend the value of his/her choices to a seasoned informatics researcher.</p>	CTSCMSCR, BioMISS, AMIA	5	<ul style="list-style-type: none"> • Difficulties linking multiple databases 	2, CTSCMSCR course in biomedical informatics 2, AMIA pre-course in terminology and ontology
<p>III.5 Computer Networking: The fellow will be able to list at least three basic network designs and describe the advantages and disadvantages of each type to the satisfaction of a seasoned informatics researcher.</p>	CTSCMSCR	2	<ul style="list-style-type: none"> • Packet switched networks • Contention networks • Token-ring networks 	2, CTSCMSCR course on biomedical informatics

<p>III.6 Wireless Technologies and Protocols: The fellow will be able to name a minimum of three wireless computer communication protocols and standards. In addition, he/she will be able to describe the salient features of each protocol, and describe the relative advantages and disadvantages of each given various usage scenarios to the satisfaction of a seasoned informatics researcher.</p>	<p>CTSCMSCR, BioMISS</p>	<p>2</p>	<ul style="list-style-type: none"> • 802.11a • 802.11b • 802.11g • Bluetooth 	<p>1, BioMISS 2, CTSCMSCR course on biomedical informatics</p>
<p>III.7 User Interfaces & Human Factors: Given a specific data collection task, the fellow will be able to construct a suitable user interface design. In addition, the fellow will be able to defend his/her design in general and specifically his/her choice of a character cell based versus graphic user interface based human-computer interface.</p>	<p>BioMISS, “The Humane Interface” by Jef Raskin, IM</p>	<p>3</p>	<ul style="list-style-type: none"> • Information theory • Characteristics of “Humane” human-computer interfaces 	<p>1, BioMISS lecture on human-computer interfacing 2, Read “The Humane Interface” by Jef Raskin</p>
<p>III.8 Electronic Privacy & Security Technologies: The fellow will be able to describe how data encryption, digital signatures, and digital certificates function. In addition, given a particular situation where electronic privacy and security technologies are required, the fellow will be able to construct a recommendation on what particular technology would best meet the requirements of the given situation.</p>	<p>CTSCMSCR</p>	<p>3</p>	<ul style="list-style-type: none"> • Data encryption • Digital signatures • Digital certificates • Methodologies for protecting networked servers 	<p>1, BioMISS 2, CTSCMSCR course on biomedical informatics</p>
<p>III.9 Project Management and System Design Processes: Given a suitable project, the fellow will be able to make a recommendation from amongst the various types of project development models and defend his/her choice to the satisfaction of a seasoned BI researcher.</p>	<p>IM, OHSU, CTSCMSCR</p>	<p>5</p>	<ul style="list-style-type: none"> • Waterfall model • Rapid prototyping model 	<p>2, OHSU course Organizational Behavior & Management (BMI 517) 2, CTSCMSCR course on biomedical informatics</p>