

University of Nebraska Biomedical Informatics Graduate Program

Annual report

2013-2014



UNIVERSITY OF
Nebraska
Biomedical Informatics

www.unmc.edu/bmi

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Welcome Letter

I am excited to share the progress of the University of Nebraska Biomedical Informatics (BMI) Graduate Program with you. The rapid pace of change in the science of biomedicine and the delivery of healthcare are creating an unending need for specialists who understand how to organize, analyze and interpret biomedical data. Our program is prepared to ride the expanding wave of data generated by the increasing number of automated systems analyzing genomes, patients and populations.

Our students have an increasing number of opportunities to excel in the field with the combination of two premier research institutions, UNMC and UNO, offering diverse and exciting opportunities. Our researchers are instrumenting patients in the community to analyze data on activity, the installation of a next generation gene sequencer is adding to the data available, and our recently accredited College of Public Health provides experience in global informatics.

The Biomedical Informatics affiliated faculty is actively involved in many facets of study in the field. Drs. Thompson (UNMC CON) and Fruhling (UNO) teamed up with educators in the Netherlands to offer multidisciplinary informatics teaching across cultures. Dr. James Campbell is leading the effort to standardize data shared across the GPC and within PCORI. Dr. James Campbell and Dr. W. Scott Campbell are IHSTDO fellows working to standardize healthcare terminology internationally. Dr. Windle is working with the American College of Cardiology to improve outcomes in cardiovascular medicine.

Dr. McClay is the site PI for the PCORI funded Greater Plains Collaborative (GPC) creating a clinical data research network linking academic health centers to perform comparative effectiveness research. In collaboration with the Research Information Technology Office at UNMC he created the Enterprise Data Warehouse and Analysis System to support clinical research projects across the campus. As an HL7 Co-chair, Dr. McClay is also leading the creation of information standards for emergency care across the nation

Dr. Guda directs the Bioinformatics and Systems Biology Core at UNMC. His lab nurtures a wide variety of research areas related to bioinformatics. His lab conducts research into novel method development, data mining and knowledge discovery, and the application of machine learning tools to solve biological problems.

Our students are gaining a new perspective beyond their focused studies on the spectrum of informatics activities. The students are presenting their work at regional and national conferences. With increasing opportunities for education and collaboration we see many opportunities for growth and look forward to an exciting year.

James, McClay, M.S., M.D.

Mission, Purpose and brief history

Biomedical Informatics

The American Medical Informatics Association (AMIA) is the Academic Home for specialists in Biomedical and Health Informatics. AMIA defines biomedical informatics as “the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving and decision making, motivated by efforts to improve human health.”¹

Background

Based on over more than five years of collaborative work, the University of Nebraska Biomedical Informatics (BMI) program brought together existing informatics education programs at both UNMC and UNO campuses to create a comprehensive interdisciplinary education program. The University of Nebraska Biomedical Informatics Program consolidates prior informatics curriculum in the UNMC MSIA program in Health Informatics Program, the UNMC Path-Micro bioinformatics program, the UNMC College of Public Health, and the UNO bioinformatics and public health informatics efforts.

The Biomedical Informatics Graduate Program (BMI) was formally approved by the Regents of the University and the State of Nebraska in the spring of 2013 as a Joint program between UNMC and the UNO School of Interdisciplinary Informatics.

The Joint UNMC/UNO Biomedical Informatics Graduate Program represents a multidisciplinary, interprofessional effort integrating the theory and practice of information technology management, computer science, decision support systems, and applied computing with clinical science, biological science, bio-imaging, and public health.

The vision of the BMI program is to be a premier center for training and research in biomedical informatics by developing the next generation of biomedical informaticists who will advance research and practice in contemporary information and knowledge management using innovative evidence based approaches to improve human health.

The goals of the program are:

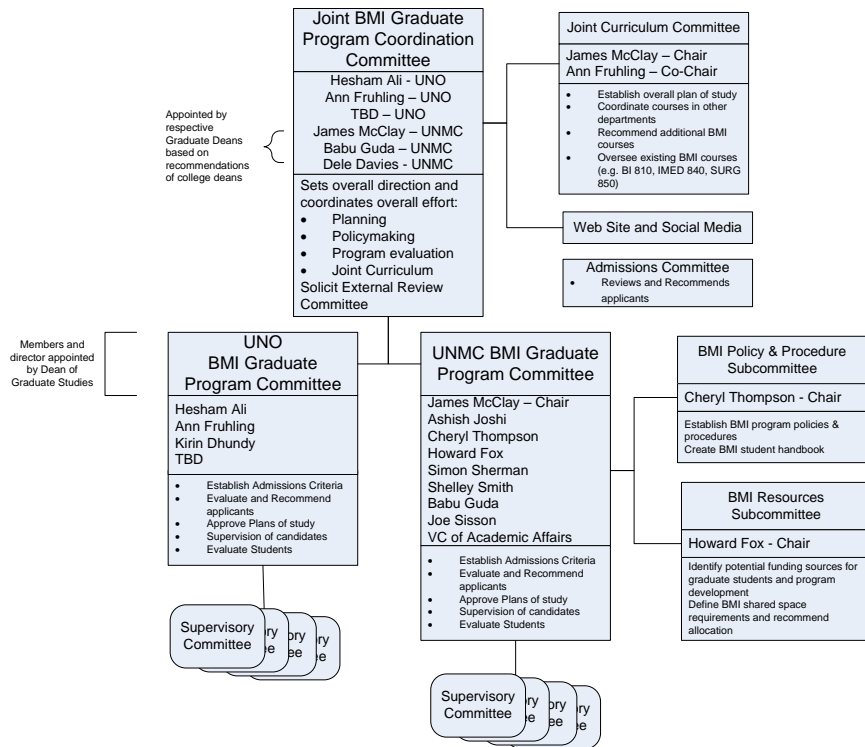
- To lead innovative interdisciplinary research and development in biomedical informatics
- To prepare graduate students to conduct advanced basic and applied research, to address local, national, and international needs in health information and communications technology.
- To prepare students to be leaders in academic research and health care

¹ <http://www.amia.org/biomedical-informatics-core-competencies>

Program Structure

As a State of Nebraska Designated Joint program the curriculum is shared between UNMC and UNO. Students apply to either or both programs and are accepted to one of the two campuses.

Draft Biomedical Informatics Graduate Committee Structure Thursday, August 13, 2013



The Joint coordinating committee meets quarterly to monitor the program. A joint curriculum committee meets MONTHLY to continue to refine the curriculum, monitor course availability and propose course development.

Each campus maintains its own admissions committee and local implementation of policies and procedures. Student supervisory committees are designed to include at least one member from the opposite campus and many projects are shared across campuses.

Students

UNMC

There are currently 7 doctoral students in the BMI degree program and 1 Masters Student

One doctoral student and 2 Masters Students were admitted for Fall 2014

UNO

UNO admitted 2 Masters and 1 doctoral student in the Spring of 2014 and will matriculate 5 masters students and 1 doctoral student in the Fall of 2014.

Student projects:

Akram Mohammed (supervisor, Dr. Guda):

A computational method for enzyme classification and its application to analyzing human gut metabolism. We use machine learning algorithms such as SVMs (support vector machines), Bayesian networks, Random forests, etc. to develop models that could predict if a given protein is an enzyme, and if so, the specific enzymatic reaction it carries out. This method is being applied to analyze the enzymes for human gut microbiome to study the microbe-dependent human metabolism.

Suleyman Vural (supervisor, Dr. Guda):

Molecular subtyping of breast cancer genomes using exome sequencing data and machine learning methods. We use hundreds of tumor-normal paired exome sequencing data from breast cancer patients to develop a computational method for predicting breast cancer subtypes. A prediction model is developed using genome structure variation such as SNVs (single nucleotide variations), CNVs (copy number variations), Indels (Insertions/deletions), fusion genes, etc.

You Li (supervisor, Dr. Guda): :

Developing a novel method to detect fusion gene products in cancer transcriptomes. Cancer genomes are highly perturbed resulting in abnormal genomic rearrangements and translocations. Occasionally, some of the rearrangements in the coding regions could result in fusion genes, which generate fused transcripts and proteins. These fusion gene products impart loss or gain of function in cancer cells. We propose to develop a computational method to detect such fusion gene products to study their impact on cancer growth and development.

Simarjeet Negi (supervisor, Dr. Guda):

Functional characterization of healthy adult human brain and its application to studying neurodevelopmental disorders. The hypothesis of this project is that gene expression profiles from healthy human brains can be used as a baseline to infer abnormal gene expression patterns in persons affected by neurodevelopmental disorders. In this project, we analyze the gene expression profiles of six human brains (healthy at the time of death) obtained from the Allen Brain Atlas project. We will build a model that represents the transcription profile of a

healthy brain and use this model to identify abnormal transcriptional patterns and their consequences in the diseased individuals.

Sanjit Pandey (supervisor, Dr. Guda):

Develop a novel computational method for analyzing metagenomic samples in the human microbiome. Trillions of pathogenic and non-pathogenic microbes inhabit human body in several locations such as mouth, gastrointestinal track, etc. Characterization of the phylogenetic composition of individual species in these microflora will help understand their role in human disease and/or human metabolism. In this project, we propose to develop a new tool and data analysis pipeline to analyze metagenomic data from next generation sequencing studies. Our goal is to identify different species at the strain level and also to quantify the relative abundance of each species.

Lisa Grabenbauer (supervisor, Dr. Windle):

Evaluating EHR Usability for Cardiac Patient Care. Information systems provide access to information through the system's user interface. In EHR systems, providers create and use patient information by typing, clicking, or other interactions using the display on their device or workstation. It is hypothesized that usability requirements will differ among providers based on their years of clinical experience. In this project, we will identify usability gaps for cardiologists using Epic, a widely used, commercial integrated EHR software platform, to care for patients with cardio-vascular diseases in a hospital setting.

Valeriya Kettelhut (supervisor, Dr. McClay):

Developing a Theory for an Infection Safety Situational Awareness Oriented System Design. Improved decision-making in efforts to prevent hospital acquired infections will lead to a better quality of care and further decrease in the healthcare-associated infection rates. In this project, we will provide health care workers with real-time information on *the infection safety critical cues* that will allow them to assess the risk of infection transmission to a patient. We hypothesize that this will improve compliance with the infection prevention and control interventions, determining "*high hazard situations*", and planning the proportionate to this risk infection prevention activities.

Sample of Core faculty Publications 2013-2014

Guda, Chittibabu. "Bioinformatic Methods and Resources for Neuroscience Research." Current Laboratory Methods in Neuroscience Research. Springer New York, 2014. 453-463.

Shen, Ru, and **Chittibabu Guda.** "Applied Graph-Mining Algorithms to Study Biomolecular Interaction Networks." BioMed research international 2014 (2014).

Wang, Xiaosheng, and **Chittibabu Guda**. "Computational Analysis of Transcriptional Circuitries in Human Embryonic Stem Cells Reveals Multiple and Independent Networks." *BioMed Research International* 2014 (2014).

Srinivasan, S. M., Vural, S., King, B. R., & **Guda, C.** (2013). Mining for class-specific motifs in protein sequence classification. *BMC bioinformatics*, 14(1), 96.

Ozturk, F., Li, Y., Zhu, X., **Guda, C.**, & Nawshad, A. (2013). Systematic analysis of palatal transcriptome to identify cleft palate genes within TGFβ3-knockout mice alleles: RNA-Seq analysis of TGFβ3 Mice. *BMC genomics*, 14(1), 113..

Goonesekere, N. C., Wang, X., Ludwig, L., & **Guda, C.** (2014). A Meta Analysis of Pancreatic Microarray Datasets Yields New Targets as Cancer Genes and Biomarkers. *PloS one*, 9(4), e93046..

Srinivasan, Satish M., and **Chittibabu Guda**. "MetaID: A novel method for identification and quantification of metagenomic samples." *BMC Genomics* 14.8 (2013): 1-12.

Shukla, A., Chaturvedi, N. K., Joshi, S. S., Bierman, P., Cornish, A., Pandey, S., & **Guda, C.** (2013). The Role Of PRDM1 and Its Interacting Proteins In The Pathogenesis Of Chronic Lymphocytic Leukemia. *Blood*, 122(21), 2865-2865.

Campbell, W. S., Campbell, J. R., West, W. W., **McClay, J. C.,** & Hinrichs, S. H. (2014). Semantic analysis of SNOMED CT for a post-coordinated database of histopathology findings. *Journal of the American Medical Informatics Association*, amiajnl-2013.

Waitman, L. R., Aaronson, L. S., Nadkarni, P. M., Connolly, D. W., & **Campbell, J. R.** (2014). The Greater Plains Collaborative: a PCORnet Clinical Research Data Network. *Journal of the American Medical Informatics Association*, amiajnl-2014.

Campbell, W. S., Foster, K. W., & Hinrichs, S. H. (2013). Application of whole slide image markup and annotation for pathologist knowledge capture. *Journal of pathology informatics*, 4.

Farley, H. L., Baumlin, K. M., Hamedani, A. G., Cheung, D. S., Edwards, M. R., Fuller, D. C., ...**McClay J.C.**... & Pines, J. M. (2013). Quality and safety implications of emergency department information systems. *Annals of emergency medicine*, 62(4), 399-407.

Windle, T., **McClay, J. C.,** & **Windle, J. R.** (2013). The Impact of Domain Knowledge on Structured Data Collection and Templated Note Design. *Applied clinical informatics*, 4(3), 317-330.

Joshi, A., Magdala, D. A. N., Josiane, M., Sriram, I., Robert, V., Craig, J., ... & Ed Chiehwen, H. (2014). Usability Evaluations of an Interactive, Internet Enabled Human Centered SanaViz Geovisualization Application. In *HCI in Business: First International Conference, HCIB 2014, Held*

as Part of HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014. Proceedings (pp. 723-734). Springer International Publishing.

Joshi, A., Mehta, S., Grover, A., Talati, K., Malhotra, B., & Puricelli Perin, D. M. (2013). Knowledge, Attitude, and Practices of Individuals to Prevent and Manage Metabolic Syndrome in an Indian Setting. *Diabetes technology & therapeutics*, 15(8), 644-653.

Kate, T., Douglas, P. P., Timothy, D., **Joshi, A.**, & Islam, K. M. (2014). Evaluating the Quality of Malaria-Related Health Information in the Nigerian Internet Context. *Advances in Infectious Diseases*, 4(01), 42.

Joshi, A., Amadi, C., Trout, K., & Obaro, S. (2014). Evaluation of an Interactive Surveillance System for Monitoring Acute Bacterial Infections in Nigeria. *Perspectives in Health Information Management*, 11(Spring).

Dempsey, K., Thapa, I., Cortes, C., Eriksen, Z., **Bastola, D. K.**, & **Ali, H.** (2013, December). On Mining Biological Signals Using Correlation Networks. In *Data Mining Workshops (ICDMW), 2013 IEEE 13th International Conference on* (pp. 327-334). IEEE.

West, S., Dempsey, K., Bhowmick, S., & **Ali, H.** (2013, December). Analysis of Incrementally Generated Clusters in Biological Networks Using Graph-Theoretic Filters and Ontology Enrichment. In *Data Mining Workshops (ICDMW), 2013 IEEE 13th International Conference on* (pp. 584-591). IEEE.

Dempsey, K. M., & **Ali, H. H.** (2014). Identifying aging-related genes in mouse hippocampus using gateway nodes. *BMC Systems Biology*, 8(1), 62.

Khazanachi, R., Dempsey, K., Thapa, I., & **Ali, H.** (2013, December). On Identifying and Analyzing Significant Nodes in Protein-Protein Interaction Networks. In *Data Mining Workshops (ICDMW), 2013 IEEE 13th International Conference on* (pp. 343-348). IEEE.

Core Faculty Funding:

1R01GM086533-01A1 (NIH) PI: Guda, C 09/01/09 - 08/31/14
"Cataloging the subcellular and suborganellar proteomes of sequenced genomes"

CGMRP Pilot Grant (UNMC) PI: Guda, C 11/01/13 – 10/31/14
"Genomic profiling of five breast cancer tumors using bioinformatics approaches"

Pancreas SPORE's Pilot Grant (UNMC) PI: Guda, C 08/01/13 – 07/31/14
"Identification and characterization of pancreatic cancer subtypes using exome-sequencing data"

Nebraska Research Initiative (NRI) Core PI: Guda, C 07/01/12 – 06/30/14
"Bioinformatics and Systems Biology Core"

1U24MH100925-01 (NIH) PI: Fox, H 05/01/13 – 04/30/18
"NNTC-DCC: National NeuroAIDS Tissue Consortium - Data Coordinating Center"

PCORnet CDRN (PCORI contract CDRN-1306-04631) Site PI: McClay, J 03/06/14-09/05/15
"Greater Plains Consortium for Comparative Effectiveness Research"