

University of Nebraska Biomedical Informatics Graduate Program

Annual report

2016-2017



UNIVERSITY OF
Nebraska
Biomedical Informatics

www.unmc.edu/bmi

Contact information

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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. Recent national initiatives to address weaknesses in the health of our population such as the NIH Precision Medicine All of Us Program (<https://allofus.nih.gov/>) and AHRQ Learning Health System Training Program (Forest 2017) create a growing demand for BMI education. BMI graduates not only need to know how to organize, analyze and interpret biomedical data but how to translate that knowledge into practice.

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. This past year, the Great Plains Clinical and Translational Research Network, funded by a NIGMS IDeA CTR grant established a Biomedical Informatics and Cyberinfrastructure Enhancement Core to support regional expansion of BMI education and support (<http://gpctr.unmc.edu>). The University of Nebraska BMI program is central to the development of a workforce capable of leading research and development in informatics as well as supporting our CTR scholars.

The Biomedical Informatics affiliated faculty are actively involved in national and international research and development in informatics disciplines. 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 within the national Patient-Centered Research Network (<http://pcornet.org>). Dr. W. Scott Campbell's team is standardizing the encoding of anatomic pathology findings within SNOMED in conjunction with an international consortium. Dr. James McClay leads participation in the Greater Plains Collaborative Clinical Data Research Network (<http://gpcnetwork.org>), and Dr. John Windle is working with the American College of Cardiology to improve outcomes in cardiovascular medicine.

The UNMC informatics team in collaboration with the Research Information Technology Office at UNMC created the Clinical Research Analysis System (CRANE) 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. Babu Guda directs the Bioinformatics and Systems Biology Core at UNMC. His lab nurtures a wide variety of research areas related to bioinformatics. His lab researches novel methods for data mining and knowledge discovery. Through the application of machine learning tools, the core supports researchers across the region.

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

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. The Joint program between UNMC and the UNO School of Interdisciplinary Informatics brought together existing informatics efforts distributed across both campuses into a single program.

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 University of Nebraska 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:

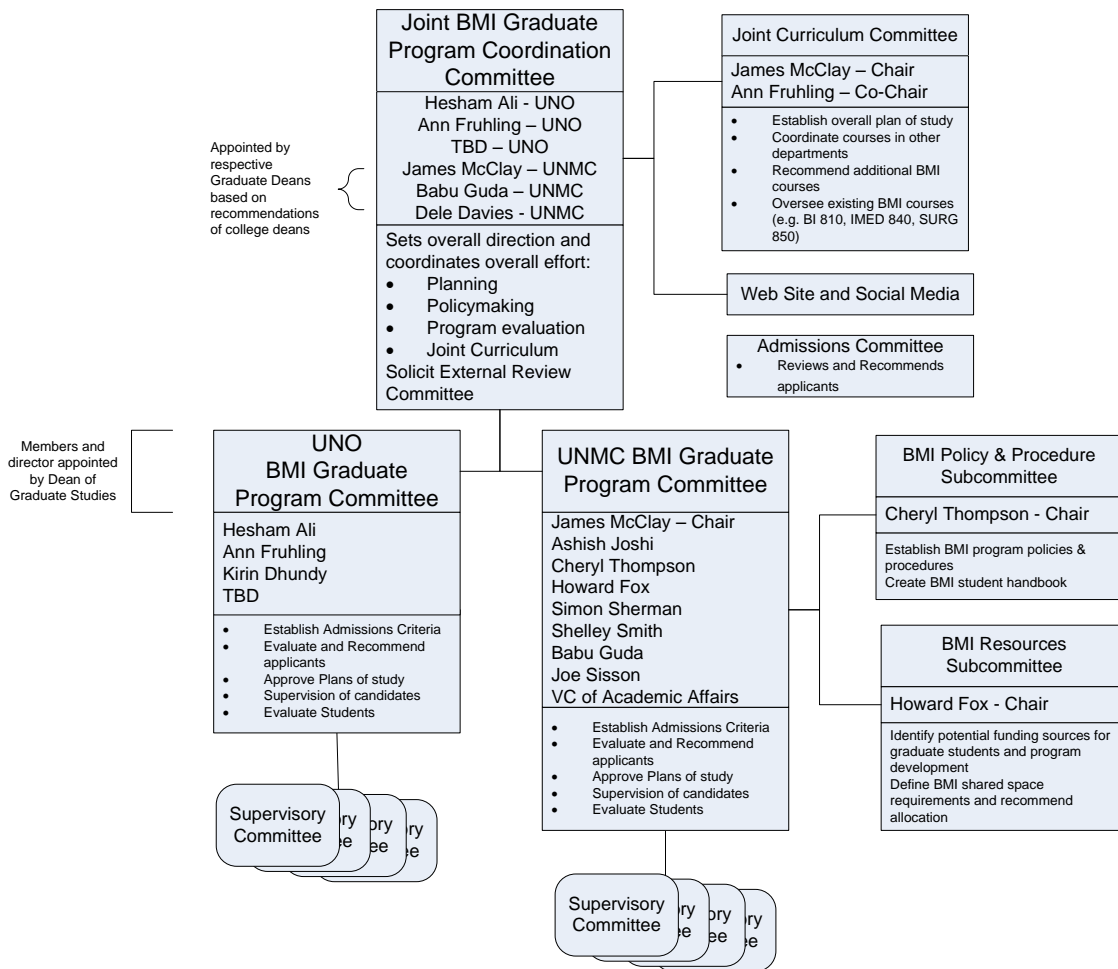
- To lead innovative interdisciplinary research and development in biomedical informatics
- To prepare graduate students to conduct advanced basic and applied research, to address local, national, and international needs in health information and communications technology.
- To prepare students to be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

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

Program Structure

As a University of Nebraska Joint program, the administration and 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 BMI 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 seven doctoral students and two Master of Science students in the UNMC BMI degree program. Two doctoral students were admitted in the fall 2016 and one in the spring 2017. Two doctoral students graduated in the fall 2016.

UNO

There are currently 17 Master of Science and five doctoral students in the UNO BMI degree program. UNO admitted seven Master of Science students in the fall 2016 and one Master of Science and two doctoral students in the spring 2017.

Student projects:

Nagavardhini Avuthu

Supervisor: Babu Guda

Identification of biomarkers for stomach cancer through metabolic network modeling on metagenomics data: The aim of this project is development of an in-house database with microbial genome and pathway information and biomarker prediction tool. Whole genome metagenomics datasets from gut cancer samples will analyzed for prediction of stomach cancer biomarkers using developed tool. The established in-house database provide options to access information from database, metabolic network prediction and visualization.

Sanjit Pandey

Supervisor: Babu Guda

Metagenomics is a growing field of study of microbial genomes in an environment, such as human microbiome. The composition of microbes in different regions of the human body is very distinct and they help drive different biological processes that are required for human health. Alterations in these microbial compositions could perturb biological processes leading to an array of human diseases. Hence, identification and quantification of the microbes present in an environment allows us to better understand the host-pathogen interrelationships and consequent effects on human health. Traditional approaches require culture of bacteria in labs. Unfortunately, most microbes cannot be cultured in lab due to our inability to replicate the ideal culture conditions for each species. Metagenomic techniques allow for sequencing of the entire environmental sample in bulk followed by data analysis to identify and quantify species present in the samples. At times, variation at a strain level determines a bacteria's ability to cause diseases; hence, identifying microbes at the strain level is very important. While a number of bioinformatics tools exist for analyzing metagenomic datasets, accurate and efficient tools for strain-level identification are lacking. I am developing a novel n-gram based method to efficiently identify and quantify bacterial species at the strain-level using the whole-genome sequencing data from metagenomic samples.

Siddesh Southekal

Supervisor: Babu Guda

Drug discovery & Identification of protein targets in cancer: The identification of protein targets and understanding their mechanism of action are important steps in the process of drug discovery. We aim to use the data obtained from high-throughput sequencing to enable comprehensive prediction of target sites thereby providing insights on binding of small-molecules to their protein targets. We further aim to experimentally validate the predicted phenotypes in cancer cell lines.

Ahmad Tanwir

Supervisors: Dr. Babu Guda and Dr. Balasrinivasa R Sajja

Neuroanatomic database development: The goal of the project is to develop a database that will allow authorized members from multiple laboratories to insert and extract Magnetic Resonance - Diffusion Tensor Imaging (MR-DTI) data without having to go through complicated manual mapping process. DTI is a relatively advanced MR technology that helps measuring the diffusivity of the water molecules in biological systems. During the project work, data acquired from brain will be preprocessed, quantified for DTI metrics, extracted from various regions of brain and formatted to insert into the database, and then exported the results from database for statistical analysis. In the end, a comparison will be made to demonstrate the advantage of the developed database over conventional analysis of brain DTI data.

Bret Gardner

Supervisor: Dr. James McClay

Enhancing Reproducibility of clinical research. The translation of clinical trials to clinical application is challenged by cost and complexity of clinical research. Due in part to these challenges, few studies are replicated for validation or extension of published results. In addition, some studies have not been replicated or have demonstrated conflicting results. Also, the publication environment and research culture do not favor or reward replication studies or negative results. For these reasons, demonstrating a method for reliably replicating research quickly and inexpensively remains paramount. The increasing creation of distributed research networks (DRNs) coupled with the widespread use of electronic health records (EHRs) promises to mitigate some of the challenges and costs associated with comparative effective research and may enable replication of studies.

Jay Pedersen

Supervisor: Dr. W. Scott Campbell

Novel non-relational database systems applied to clinical data warehousing. Demonstration of specialized data management systems for clinical research.

Sample of Core faculty and student publications 2016-2017

Clarke MA, Moore JL, Steege LM, Koopman RJ, Belden JL, Canfield SM, Kim MS. Toward a patient-centered ambulatory after-visit summary: Identifying primary care patients' information needs. *Inform Health Soc Care*. 2017 Apr 11:1-16. doi: 10.1080/17538157.2017.1297305. [Epub ahead of print] PubMed PMID: 28398094.

Clarke MA, Belden JL, Kim MS. How Does Learnability of Primary Care Resident Physicians Increase After Seven Months of Using an Electronic Health Record? A Longitudinal Study. **JMIR Human Factors**. 2016;3:e9.

Clarke M, Belden J. and Kim M. (2016). Comparing Electronic Health Record Usability of Primary Care Physicians by Clinical Year. In *Proceedings of the 9th International Joint Conference on Biomedical Engineering Systems and Technologies - Volume 5: HEALTHINF, (BIOSTEC 2016)* ISBN 978-989-758-170-0, pages 68-75. DOI: 10.5220/0005692900680075

Preferences and Actual Chemotherapy Decision-Making in the Greater Plains Collaborative Breast Cancer Study; Berger, Ann, Buzalko, Russell, Kupzyk, Kevin, **Gardner, Bret**, Djalilova, Dilorom, Otte, Julie (April 2017). *Acta Oncologica* – **submitted**, under review.

Mechanism of Action of Selective Laser Trabeculoplasty and Predictors of Response; Gulati, V., Fan, S., **Gardner, B. J.**, Havens, S. J., Schaaf, M. T., Neely, D. G., & Toris, C. B. (2017). *Investigative Ophthalmology & Visual Science*, 58(3), 1462-1468. doi:10.1167/iovs.16-20710 [doi]. PMID: 28264102

Talbott H, Hou X, Qiu F, Zhang P, **Guda C**, Yu F, Cushman RA, Wood JR, Wang C, Cupp AS, Davis JS. (2017) Early transcriptome responses of the bovine midcycle corpus luteum to prostaglandin F2 α includes cytokine signaling. **Molecular and Cellular Endocrinology**, doi: 10.1016/j.mce.2017.05.018 [[PubMed](#)]

Toh S, Rasmussen-Torvik LJ, Harmata EE, Pardee R, Saizan R, Malanga E, Sturtevant JL, Horgan CE, Anau J, Janning CD, Wellman RD, Coley RY, Cook AJ, Courcoulas AP, Coleman KJ, Williams NA, McTigue KM, Arterburn D, **McClay J**; The National Patient-Centered Clinical Research Network (PCORnet) Bariatric Study Cohort. *JMIR Res Protoc* (forthcoming) doi:10.2196/resprot.8323. (Senior Author)

Kettelhut VV, Vanshooneveld TC, **McClay JC**, Mercer DF, **Fruhling A**, Meza J; Empirical Study on the Impact of a Tactical Biosurveillance Information Visualization on Users' Situational Awareness. *Military Medicine*, 2017;182(S1):322-9. PubMed PMID: 28291493

Kettelhut V, Van Shooneveld T, **McClay J**, Fruhling A, Dempsey K; "The Utility of Electronic Health Record-Based Hygiene Notes for Chlorhexidine Bathing Practice Evaluation." *J Infect Prevent*, (August 2016) DOI: 10.1177/1757177416667288

Campbell JR, Campbell WS, Hickman H, Pedersen J, McClay JC; "Employing Complex Polyhierarchical Ontologies and Promoting Interoperability of i2b2 Data Systems" *J Am Med Inform Assoc* Vol. 2015, p. 35

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Negi SK, Guda C. (2017) Global gene expression profiling of healthy human brain and its application in studying neurological disorders, *Scientific Reports*, 7:897 [[PubMed](#)]

Li Y, Heavican TB, Vellichirammal NN, Iqbad J, **Guda C.** (2017) ChimeRScope: a novel alignment-free algorithm for fusion gene prediction using paired-end RNA-Seq data, *Nucleic Acids Research*, doi: 10.1093/nar/gkx315. [[PubMed](#)]

Mishra NK, **Guda C.** (2017) Integrative analysis of genome-wide methylation and expression in pancreatic adenocarcinoma. *Oncotarget*, 8:28990-29012. [[PubMed](#)]

Massilamany C, Nandakumar R, Madayiputhiya, **Pandey S, Guda C, Reddy J.** (2017) Gender-differences in the expression of proteins in autoreactive T cells specific to central nervous system myelin proteolipid protein. *Journal of Autoimmune Disorders*. (In press)

Windle, JR, Katz, AS, Dow, JP, Edward TA, et al. 2016 ACC/ASE/ASNC/HRS/SCAI Health Policy Statement on Integrating the Healthcare Enterprise. *J Am Coll Cardiol*.2016;68(12):1348-1364. Doi:10.1016/j.jacc.2016.04.017.

Sample of Core Faculty and Student Presentations 2016-2017

A. Tarrell, **M. A. Clarke,** T. A. Windle, **J. R. Windle** "Computer Skills Drive User Decision for Personal Health Record." Academy Health Annual Research Meeting 2017

M. A. Clarke, J. L. Moore, J. L. Belden, L. M. Steege, M. S. Kim S. M. Canfield, R. J. Koopman, "Impact of Age on the Likelihood of Patients' Accessing their Health Information Online." 8th International Conference on Applied Human Factors and Ergonomics (AHFE 2017)

M. A. Clarke, M. Sitorius, T. A. Windle, **A. L. Fruhling,** T. L. Bernard, **J. R. Windle** "Impact of Age on User-Desired Personal Health Record Functionality: A Qualitative Study" 2016 American Medical Informatics Association

M. A. Clarke, L. M. Steege, J. L. Moore, J. L. Belden, R. J. Koopman, S. M. Canfield, M. S. Kim. "Improving information design of end of visit summary for primary care patients" 7th International Conference on Applied Human Factors and Ergonomics (AHFE 2016)

Bahado-Singh RO, Zafra R, Albayrak S, Alish B, Avinash M, Saiyed NM, Mishra NK, **Guda C,** Rouba A, Radhakrishna U. Placental Epigenetic Biomarkers accurately detect isolated non-syndromic Ventricular Septal Defect: A new Frontier in CHD Detection? 16th World Congress in Fetal Medicine 2017. Ljubljana, Slovenia. 25-29th June 2017

Chandel DS, **Pandey S, Guda C,** Panigrahi P, Kharbanda KK. Role of Betaine in Preventing Alcohol-Induced Gut Dysbiosis Conference: The 2017 Gordon Research Conference (GRC) on Alcohol-Induced End Organ Diseases "Metabolic Reprogramming and Molecular Mechanisms of Tissue Injury by Alcohol". March 26-31, 2017

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Chandel DS, **Pandey S, Guda C**, Panigrahi P, Kharbanda KK. ISCHS – International Symposium on Cells of the Hepatic Sinusoid National University of Ireland Galway. 14th to 17th June 2017

Simarjeet Negi and **Guda C** (2016) Functional characterization of the healthy adult human brain and its application to study neurological disorders, **RECOMB/ISCB**, Phoenix, AZ, November 6-9 2016 (Poster presentation)

Insights from Breast Cancer Patients Regarding the Decision-Making Process Regarding Adjuvant Chemotherapy; Ann M. Berger, Russell Buzalko, Kevin Kupzyk, **Bret Gardner**, Julie Otte
2017 Midwest Regional Nursing Society (MNRS) Annual Research Conference – Poster

Deployment of ONC standard terminologies within an i2b2 data warehouse; Pedersen, Jay G. MA, **Gardner, Bret J., Campbell, James R. MD, Campbell, W. Scott PhD, McClay, James C. MD, MS**
2017 AMIA Joint Summits on Translational Science – Podium Abstract

Replicating Research: An Example using Risk for 30-Day Readmissions in Heart Failure Patients; **Bret J. Gardner, James C. McClay, MD** 2016 PCOR Annual Meeting – Poster

Feasibility of Extending the PCORnet Common Data Model To Encompass Emergency Department Clinical Research; **James C. McClay MD, MS, Bret J. Gardner**
2016 AMIA Annual Symposium – Poster

Evaluating Ability to Apply a Model for 30-Day Readmission in a Clinical Research Data Warehouse; **Bret J. Gardner, James C McClay MD, MS**
2016 APSA Midwest Regional Meeting – Poster

McClay JC, Langford LH; “Developing HL7 Standards to Improve Clinical Research in Emergency Medicine: The Common Model of Emergency Care Information” Society for Academic Emergency Medicine, May 12, 2016, Dallas, TX

McClay JC, Campbell J, Mudgapalli A, Waitman R; “Issues in the Uniform Capture of Patient Reported Outcomes in a Heterogeneous Research Network.” AMIA 216 Joint Summits on Translational Science, March 23, 2016, San Francisco, CA

Campbell WS, McClay JC, Pedersen J, Campbell JR; “Enhancing Epic for Reporting of Anatomic and Genomic Pathology in Cancer” Epic XGM, May 2, 2017, Verona, WI

Core Faculty Funding

John R. Windle, MD:

1R01HS022110001A1 PI: Windle 09/02/2017 – 08/31/2019
“Optimizing the Electronic Health Record for Cardiac Care”

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Chittibabu (Babu) Guda, PhD:

Role: Co-Investigator

2P30MH062261-16A1 (Buch)

05/11/2017 - 03/31/2022

1.20 calendar

\$1,082,466

DHHS/NIH/NIMH

Chronic HIV Infection and Aging in NeuroAIDS (CHAIN) Center

This is a Center grant to provide Administrative and Core Support for scientists investigating NeuroAIDS.

Role: Co-Investigator

1R01MH110636-01A1 (Mirnics)

06/01/2017 - 05/31/2018

0.36 calendar

\$348,915

DHHS/NIH/NIMH

Vulnerability of DHCR7+/- mutation carriers to aripiprazole and trazodone treatment

W. Scott Campbell, PhD:

NIH 1U01HG009455-01 Campbell (PI), \$1,345,830 "Deploying ONC National Standards in Support of Metadata for Big Data Research Warehouse Management of Repurposed Laboratory, Pathology & Patient Findings Data From the EHR" 9/22/2016-6/30/2019

James McClay, MD:

NIH 1U54GM115458-0, Subproject ID 5422. "Great Plains Idea-Ctr-Biomedical Informatics and Cyberinfrastructure Enhancement Core." 9/1/2016-6/30/2021. \$1,855,000

PCORI CDRN-1306-04631 Phase II "The Greater Plains Collaborative; a PCORnet Clinical Data Research Network Phase II"; 9/5/2015-9/4/2018 \$7,900,000 (\$260,000) Role: UNMC PI and Network Co-PI (Russ Waitman)

PCORI OBS-1505-30683; PCORnet Bariatric Study, 2/1/16-1/31/18. \$4,999,000 (\$79,000) Role; GPC PI. (David Arterburn)

Study Sections

Chittibabu (Babu) Guda, PhD

NIH Study Sections Served:

2017 NIH/NCI Panelist, PDXNet Special Emphasis Panel, July 2017

2017 NIH/NCI Informatics Technology for Cancer Research (ITCR) review panel (March)

2016 NIH BDMA Study section