A Startup Proposal for a New Faculty Establishment of a Medical Informatics Laboratory (MI-Lab) at Southern Illinois University

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Abstract

We propose establishing a Medical Informatics Laboratory (MI-Lab) under the school of health sciences at Southern Illinois University. The primary goal of establishing a Biomedical Informatics Lab is to provide a collaborative research environment for SIU students and scholars, as well as foster inter-disciplinary research and collaborations. SIU's MI-Lab will operate as an independent research center. MI-Lab will collect a wide range of biomedical data, including natural language, biomedical, histological, and radiological images, proteomic data, and gene expression data from various tissues and cell lines. Under the direction of the investigator, research scholars will produce a tremendous research output for Southern Illinois University. The establishment of MI-Lab will be able to attract extramural funding from both medical facilities and federal funding agencies as well as industrial firms. The establishment of a medical informatics laboratory will become one of the achievements of the Imagine 2030 strategic plan, with the Chancellor Dr. Austin A. Lane's support, and improve SIU's research capabilities.

1. Background: Why Does the School of health Sciences Need a New Lab?

Medical informatics is a relatively new, interdisciplinary field in the healthcare industry that uses information technology to organize and analyze health records to improve healthcare outcomes. The advent of medical informatics within healthcare practice has created many job opportunities. Health informatics combines analytics skills, technology, and leadership. Health informatics has been proven to be a great career choice for students. According to the U.S. Bureau of Labor Statistics, health informatics remains relatively young, with job prospects likely to grow in the coming decade. It is estimated that job growth will reach approximately 32% in medical and health services. The rise of the job market provides a promising career path for future students. Upon bachelor's degree graduation, a health informatics specialist earns $90,708 per year (data: Coursera). The average salary for a health informatics analyst is $100,934, and similar figures exist for medical data analysts ($92,984) and health care systems analysts ($87,177). All these positions will pay 50% more than the U.S. average household income of $67,521 in 2020. (Data: Census.gov). Expanding job opportunities allow professionals with health informatics backgrounds to work in various settings, such as hospitals, medical laboratories, pharmaceutical manufacturing, physician offices, and outpatient clinics. Therefore, expanding the medical informatics program is beneficial to increase the job reputation of "SIU" in career choices and improve research outcomes.

To succeed in the health informatics field, students need to develop skills in analytics, communication, and leadership in SIU's health informatics program. Students also require

extensive training in technology and must stay abreast of technological changes to succeed in medical informatics positions. Expanding the health care management program would increase the quality and capacity of enrolled students, which would allow more students to get trained in health informatics and get ready for career choices. To ensure the quality of teaching and learning experiences, research support plays an essential role in the students' success in the health professions program.

In order to attract students to enter the bachelor and master of health care management programs at SIU, we suggest expanding the research outcomes in biomedical informatics from the diverse faculty group, research-oriented graduate students, and potential external research collaborators. An establishment of a biomedical informatics laboratory under the school of health sciences can serve as a research center and increase research outputs in multiple aspects. The major envisioned strength of MI-Lab as an entity would be its ability to attract extramural funding from both medical facilities and federal funding agencies as well as industrial companies. With the support of chancellor Austin A. Lane, the establishment of a medical informatics laboratory and the fruitful research outcomes will become part of the achievements of the Imagine 2030 strategic plan.

Southern Illinois University has administered a New Faculty Start Program by the Office of the Vice Chancellor for Research for the highest quality faculty that have the best research potential. A start-up funding program can help a new faculty member establish and enhance their research career. The SIU website has listed all benefits as well as the application process for the startup program. As Health Care Management of the School of Health Sciences is recruiting new faculty who are specialized in medical informatics. It is an excellent opportunity to establish a medical informatics lab with the support of the New Faculty Start Program and use the startup fund to hire a new domain expert to lead the lab.

2. Research topic: What Research Topics this Lab can do?

Here we listed three cutting-edge research topics that have great potential to turn the school of health sciences into a national-leading research center.

Clinical Text-Based Natural Language Processing

There are an enormous number of biomedical documents available, which are generated daily by researchers as published articles and by clinicians as clinical reports, discharge summaries, and so on. The rate at which such documents have been produced has accelerated in recent years, as evidenced by the contents of PubMed and electronic healthcare records. It is impossible for any human to keep track of all the research developments reported in these research articles, let alone mine useful patterns from a large number of clinical reports. The use of computers to automatically process the knowledge contained in these documents holds the promise of improving future healthcare quality while also speeding up biomedical research. Because the vast majority of biomedical documents are written in natural languages such as English and are intended for human readers rather than computers, the medical natural language processing center (MI-Lab) is

able to use computers to process these documents. Building useful databases of biomedical discoveries from published articles, summarizing research articles, inferring the clinical state of patients from clinical reports, assisting in clinical decision support systems by finding answers to clinical questions from biomedical documents, doing bio-surveillance from clinical reports, and building and enriching ontologies and metadata schemas that can support further research are some applications of biomedical natural language processing.

Analysis And Optimization of Biomedicals Image Search Engine

In addition to natural language (both text and speech), biomedical researchers include a large number of figures and images in their publications to report experimental results, present research models, and provide examples of biomedical objects (e.g., cells, tissue, and organs). Automatically and effectively mining information from those images can greatly benefit physicians for clinical education or disease diagnosis, and biologists for seeking specific biologic information. Developing a figure search engine by classifying figures into different types (e.g., gel image, image-of-thing, graph, model, and mixed), improving biomedical named entity recognition and normalization by extracting figure text, and performing figure ranking using both textual and image features are examples of such applications.

Detection And Discovery of Adverse Drug Effects

With the rapid advancement of high throughput biological experiments, massive amounts of omics data, such as the genome, proteome, interactome, and localizome, are proliferating. The automatic analysis of these data is critical to improving our understanding of biological systems. Such increased understanding can be extremely beneficial to translational research, ultimately leading to better patient care. For example, by analyzing gene expression data, connections between drugs, biological processes, diseases, and other adverse effects can be detected, which could benefit several real-life applications of patient care safety, such as detecting drug adverse effects prior to clinical trials for drug development and discovering new adverse effects for in-market drugs.

3. Feasibility Analysis: What This Lab Can Bring?

The goal of MI-Lab research is to systematically integrate MI-Lab, biomedical image processing, ontology and metadata development, and bioinformatics on omics data to meet the information needs of the biomedical, clinical, and biological communities. Given the high demand for biomedical research as evidenced by funding trends and collaborations, there are massive benefits to establishing a research center to advance SIU's research mission. The need for research will quickly become a hub of interdisciplinary medical research for SIU faculty and students and is likely to expand to the affiliated hospitals and external collaboration opportunities from the Department of Computer Science. It will significantly increase the visibility of SIU's research, attracting more external funding, collaborators, postdocs, and students. All of this will allow current faculty to be more productive while also potentially attracting new faculty to strengthen the university's research outcomes. It will

also aid in the formation of professional relationships with other leading researchers in MI-Lab as well as the acquisition of knowledge from them through seminar series and invited talks. The funded seminar talks will improve communication between SIU students and faculty and world-class recognized scholars, thereby increasing SIU's research excellence.

4. Organizational Structure

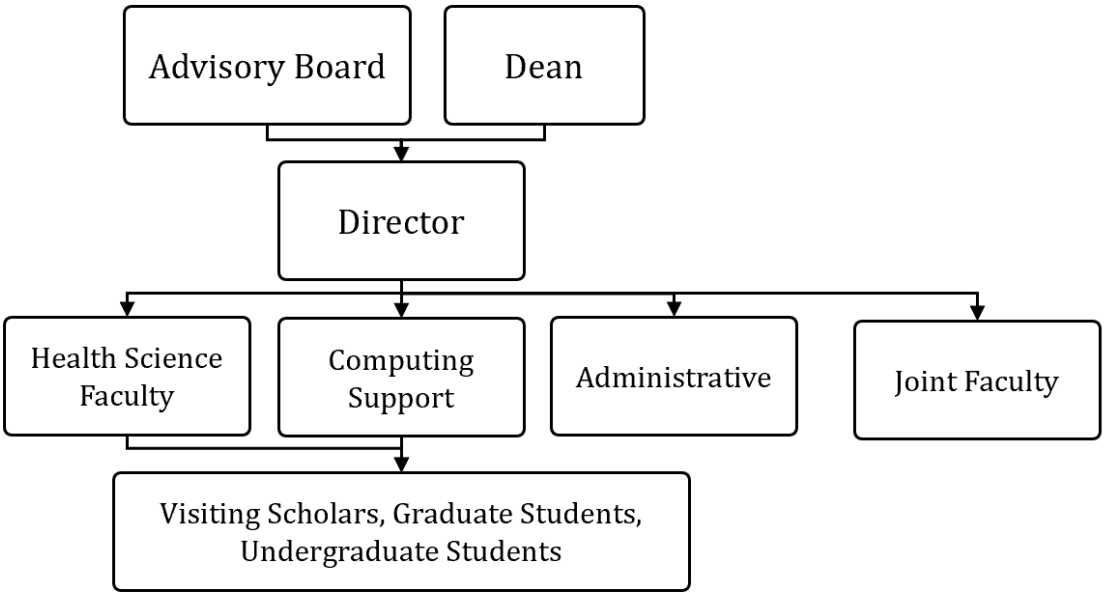

Figure 1: MI-Lab Organization Structure

Figure 1 shows the structure of the medical informatics lab. The school of health science will consult external advisory board members to complete the feasibility verification. The external consulting ensures the lab will be on the right track. The dean of the school of health sciences will lead the lab. The director (principal investigator) of MI-Lab will annually report to the chair and dean of the school of health sciences on the lab's completion, maintenance, and outcomes. The newly recruited or hired health science faculty, computational support, and administrative support will be established and will serve as the lab's main engine. We will also seek joint faculty members who can contribute to the lab through research and collaborations. MI-Lab can attract visiting scholars, graduate undergraduate students, and provide paid assistantships to serve as a research hub in the school of health sciences.

5. Who Will Direct the Lab?

We nominate Ling Tong as a prospective principal investigator of the new lab. Ling Tong will be a newly hired faculty member of SIU in the school of health sciences as the principal investigator of the lab. He will keep track of the establishment, recruit new lab members and research assistants, and maintain productive research outputs. Ling will also host a regular academic seminar for students and scholars as part of a long-term research commitment in the school of health sciences.

Principle Investigator's Biography

Ling Tong is a specialist in health informatics and artificial intelligence. He graduated from the University of Wisconsin—Madison as a doctor of biomedical and health informatics. He co-authored over 20 high-quality publications in biomedical informatics. He also has extensive experience working on research projects funded by the National Institutes of Health (NIH), the National Natural Science Foundation of China (NSFC), and the Advancing a Healthier Wisconsin Endowment. He is an active member of the American Medical Informatics Association. Since 2019, he has served as a reviewer for top medical informatics journals, including the Journal of Medical Internet Research (impact factor: 7.08), IEEE Journal of Biomedical and Health Informatics (IF: 5.77), Computers in Biology and Medicine (IF: 6.69), and Biomedical Signal Processing and Control (IF: 5.08). Please read Ling Tong's curriculum vitae here.

6. Who Will Join in And Collaborate? Incoming Collaborations

MI-Lab research is collaborative by nature due to the nature of biomedical informatics. To be successful, research in this area requires strong collaborations that include not only computer scientists, informaticians, and linguists but also biomedical domain experts, like bio-curators, annotators, practicing clinicians, etc. In fact, being an applied area, its goals and measures of success are often set by biomedical experts. The proposed center will also be inter-disciplinary and will bring together and involve researchers with different expertise. As seen in the principal investigator's profile, he has established a strong partnership with medical doctors of the Medical College of Wisconsin and professors of the University of Wisconsin-Madison. His recognition by the American Medical Informatics Association will also lead to endless collaboration opportunities. During the annual conference, MI-Lab will be able to find collaborations and build solid partnerships with more prestigious universities. MI-Lab will not only strengthen the existing collaborations but also attract more collaborations within SIU as well as from outside.

The following is a list of the organizations and scholars that are expected to collaborate with MI-Lab. However, this is not meant to be an exclusive list, and MI-Lab will welcome collaborations with any other interested groups. We compiled a list of all inter- and intra-departmental collaborations with research interests. Furthermore, the principal investigator will bring his extensive network of biomedical informatics academic contacts to facilitate the collaboration. The external collaboration table listed researchers who had previously collaborated with the principal investigator and had produced a number of works.

Table 1: Internal potential collaboration, department and research interests

SIU Researcher	Department	Research interests
Erin R. Hascup	School of Medicine	Neurobiology, Alzheimer's Disease
Bishal Bhandari	School of Medicine	Internal Medicine, Cardiology
Sowmyanarayanan Thuppal	School of Medicine	Clinical Research, Global Health, Public Health, Surgery, Infectious Disease
Heeyoung Han	School of Medicine	Online learning, Medical Education

Wasantha Jayawardene	Public Health	Obesity, Substance, Translational Research
khaled R. Ahmed	Computer Science	Big Data, Deep Learning
Mejdl Safran	Computer Science	Data Mining, Big Data, Machine Learning
Purvag Patel	Computer Science	Artificial Intelligence, Fuzzy logic

Table 2: External Collaboration, with PI's previous collaboration records, researchers. Affiliation and research interests

Researcher's Name	**Affiliation**	**Research interests**
Jake Luo	University of Wisconsin-Milwaukee	biomedical informatics, Health Data Science
Susan Mcroy	University of Wisconsin-Milwaukee	artificial intelligence, natural language processing, health informatics
D M Anisuzzaman	Mayo Clinic	Image Processing, Deep Learning
David R Friedland	Medical College of Wisconsin	Otology and Neurotology, Hearing Loss
Melek Somai	Medical College of Wisconsin	Clinical Informatics, Predictive Analysis, Machine Learning
Ben George	Medical College of Wisconsin	Oncology, Hematology
Rong Xu	Case Western Reserve University	Artificial Intelligence, Machine Learning, Nature Language Processing
Lingyun Luo	University of South China	Medical Informatics, Ontology
Ron Cisler	University of Michigan	public health, health services
Bradley Crotty	Medical college of Wisconsin	Clinical informatics

7. A Five-Year Projection of Success

The proposed center will bring together the above researchers and collaborators and will help channel their interests and efforts towards doing productive research, which will also lead to strong extramural grant proposals. MI-Lab will also play an important role in supporting students doing research in a collaborative environment. Conducting world-class research being its primary goal, the proposed center will help SIU improve its standing as a R2 institution, increase its visibility and reputation in the medical and research communities in the nation as well as abroad, and help it advance to a R1 goal: very high research activity.

Subject to appropriate financial support, the following are six ambitious but achievable goals of the proposed center within five years.

1. Collaborate with internal and external researchers to publish over 20 journal papers in medical informatics, affiliated with the SIU School of Health Sciences.
2. Bring in more than $500,000 in direct costs in extramural funding from the National Institutes of Health (NIH) or other similar agencies over the next five years so that more studies can be done.
3. Invite over 50 well-respected biomedical informatics researchers and host over 50 academic seminars in the school of health sciences. By doing this, SIU will become a respected, well-known center for doing medical informatics research that has an impact on both the national and international levels.
4. Supervise at least 10 master's students' research studies and graduate from health science programs.
5. Attract at least two visiting scholars who can bring their own research grants and conduct research at SIU for a minimum of one year.
6. Complete all of the requirements for a PhD in biomedical informatics or similar doctoral program for potential students. The years after year 5 will be spent developing a PhD program or programs in the school of health sciences in order to become an R1: very high research university.

8. Budget: How Much Funds Are Needed?

The following funding is being requested as a one-time, 5-year startup fund, including as part of the recruitment of the new faculty Ling Tong's startup package, and will be supported as part of the New Faculty Start Program by the Office of the Vice Chancellor. The budget will help establish the research lab at SIU to the point where it will be able to attract sufficient extramural funding to be self-sustaining and meet the goals mentioned earlier.

Year 1, estimated cost:

Description	Budget	Remark
PI's summer salary	$18,000	Based on a $72,000 annual, 3-month salary
External Advisory Board	$2,000	Consulting fee
1 Research Assistant Student	$40,000	Including fringe, stipend and tuition
Computers	$20,000	Including a total of 2 laptops valued $2,000 for PI and Student And a $15,000 Computational Server, available for departmental research use
Research Lab Space	$0	Provided by school of health Sciences
Research Data Purchase	$20,000	$5,000, AHRQ: Healthcare Cost and Utilization Project Database $5,000, Utilization of data at Clinical Translational Research Institute in Medical college of Wisconsin Journal subscriptions; Software purchase (SAS, research writing tool, Matlab); Research publication and processing fees.
Academic Seminar Series	$18,000	Monthly seminar, $1,000 travel funds, $500 payment to the speaker
Administrator (35K)	$26,250	50% load for the first 6 months, and extend to 100% for the next 6 months
Conference Travel Expense (National Only)	$6,000	Includes PI and research assistant, $1,500 each person, 2 person each time, twice each year. ($1,500 x 2 x 2 = $6,000)
Printing, fax, office supplies	$1,000	
Total	$151,250	

Year 2, estimated cost (assuming a 3% inflation)

Description	Budget	Remark
PI's summer salary	$18,540	
External Advisory Board	$2,060	Consulting fee
Academic Seminar Series	$18,540	Monthly, $1000 travel funds, plus $500 direct payment.
Data maintenance	$5,000	Journal subscriptions, Software purchase, Research publication and processing fees.
1 Research Assistant Student (Fringe, stipend + tuition)	$40,600	
Administrative	0	Share of School's administrative
Conference Travel Expense	$6,180	Twice each year, including PI and research assistant student
Printing, fax, office supplies	$1,030	
Cumulative total	$91, 950	

Year 3, estimated cost (assuming a 3% inflation)

Description	Budget	Remark
PI's summer salary	$19,096	
External Advisory Board	$2,122	Consulting fee
Academic Seminar Series	$19,096	Monthly, $1000 travel funds, plus $500 direct payment.
Data maintenance	$5,000	Journal subscriptions, Software purchase, Research publication and processing fees.
1 Research Assistant Student	$41,218	
Conference Travel Expense	$6,365	Twice each year, including PI and research assistant student travel cost
Printing, fax, office supplies	$1,030	
Cumulative total	$93, 927	

Year 4, estimated cost (assuming a 3% inflation)

Description	Budget	Remark
PI's summer salary	$0	Initial extramural funding will be available to support PI's summer salary for year 3
External Advisory Board	$2,185	Consulting fee
Academic Seminar Series	$19,669	Monthly, $1000 travel funds, plus $500 direct payment.
Computer & Data maintenance	$8,000	Journal subscriptions, Software purchase, Research publication and processing fees. Additional $3,000 reserved for computer parts replacements.
1 Research Assistant Student (Fringe, stipend + tuition)	$41,854	
Conference Travel Expense	$6,365	Twice each year, including PI and research assistant student travel cost
Printing, fax, office supplies	$1,030	
Cumulative total	$79,103	

Year 5, estimated cost (assuming a 3% inflation)

Description	Budget	Remark
PI's summer salary	$0	Initial extramural funding will be available to support PI's summer salary for year 4
External Advisory Board	$2,250	Consulting fee
Academic Seminar Series	$20,259	Monthly, $1000 travel funds, plus $500 direct payment.
Computer & Data maintenance	$8,000	Journal subscriptions, Software purchase, Research publication and processing fees. Additional $3,000 reserved for computer parts replacements.
1 Research Assistant Student (Fringe, stipend + tuition)	$42,509	
Conference Travel Expense	$6,555	Twice each year, including PI and research assistant student travel cost
Printing, fax, office supplies	$1,060	
Cumulative total	$80,633	

9. Conclusion

The principal investigator will be expected to complete six ambitious but achievable goals in five years, subject to a total appropriate financial support of $496,863. Under the direction of the principal investigator, research scholars will produce a tremendous research output for Southern Illinois University. The establishment of MI-Lab will be able to attract extramural funding from both medical facilities and federal funding agencies as well as industrial firms. The establishment of a medical informatics laboratory will become one of the achievements of the Imagine 2030 strategic plan, with the Chancellor Dr. Austin A. Lane's support, and improve SIU's research capabilities, fulfilling the university's long-term goal of becoming an R1 status as a very high research activity university.

1. Collaborate with internal and external researchers to publish over 20 journal papers in medical informatics, affiliated with the SIU School of Health Sciences.
2. Bring in more than $500,000 in direct costs in extramural funding from the National Institutes of Health (NIH) or other similar agencies over the next five years so that more studies can be done.
3. Invite over 50 well-respected biomedical informatics researchers and host over 50 academic seminars in the school of health sciences. By doing this, SIU will become a respected, well-known center for doing medical informatics research that has an impact on both the national and international levels.
4. Supervise at least 10 master's students' research studies and graduate from health science programs.
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