Faculty Senate Meeting
Monday, December 11, 2017
3:30p.m. – 5:30p.m., Toepfer Room, Adelbert Hall,

3:30 p.m.	Approval of Minutes from the November 28, 2017, Faculty Senate Meeting, *attachment*	Juscelino Colares
3:35 p.m.	President and Provost's Announcements	Barbara Snyder Bud Baeslack
3:40 p.m.	Chair's Announcements	Juscelino Colares
3:45 p.m.	Report from the Executive Committee	Cynthia Beall
3:50 p.m.	Graduate Studies Committee: MS/PhD in Biomedical and Health Informatics, *attachment*	Mendel Singer
4:00 p.m.	Information on Upcoming University Compliance Training, *attachment*	Lisa Palazzo
4:10 p.m.	Graduate Student Council "Charlottesville" Resolution, *attachment*	Sahil Gulati
4:15 p.m.	Proposed Faculty Senate Resolution, *attachment*	Kimberly Emmons Ken Ledford
4:25 p.m.	CUE Status Update and Discussion	Kimberly Emmons
4:35 p.m.	Report from University Health and Counseling Services	Jennifer McCarthy Sara Lee

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Faculty Senate

Faculty Senate Meeting
Monday, December 11, 2017
3:30 pm to 5:30 pm
Adelbert Hall, Toepfer Room

Members Present

Rohan Akolkar
Bud Baeslack
Cynthia Beall
Leon Blazey
Matthias Buck
Christine Cano
Gary Chottiner
Juscelino Colares
Christopher Cullis
Simone Dekker
Kimberly Emmons
Steven Eppell
Steve Feldman
Archishman (Prince) Ghosh
Sahil Gulati
Peter Harte
Susan Hinze
Paul Iversen
Sudha Iyengar
Kathleen Kash
Thomas J. Kelley
Ruth A. Keri
Ahmad M. Khalil
Kenneth Ledford
Paul MacDonald
Gerald Mahoney
Anne Matthews
David Miller
Thomas Montagnese
Susan Painter
Andres Pinto
Dana Prince
Renato Roperto
R. Mohan Sankaran
William P. Schilling
Barbara Snyder
Usha Stiefel
Ali Syed
Valerie Boebel Toly
Dustin Tyler
Rebecca Weiss
Chris Winkleman
Jo Ann Wise

Members Absent

Amy Backus
Harihara Baskaran
Karen Beckwith
Bo Carlsson
Lisa Damato
Evelyn Duffy
Steven Hauck
Maureen McEnery
William Merrick
Leena Palomo
Aaron Perzanowksi
Andrew Pollis
Roger Quinn
Vasu Ramanujan
Beverly Saylor
Peter Shulman
Glenn Starkman
Robert Strassfeld
Ibrahim Tulunoglu
Joachim Voss

Others Present

Dan Anker
Kathleen Blazar
Bob Brown
Jonathan Carlson
Donna Davis Reddix
Don Feke
Arnold Hirshon
Maril Sanders Mobley
Dean Patterson
Suzanne Rivera
Jennifer Scharf-Deering
John Sideras
Jeff Wolcowitz
Sue Workman
Victoria Wright

Faculty Senate

Call to Order
Professor Juscelino Colares, chair, Faculty Senate, called the meeting to order at 3:30 p.m.

Approval of Minutes
The Senate approved the minutes from the November 28th, 2017 Faculty Senate meeting. *Attachment*

President's Announcements
The President reported on the US Senate and House tax bills and the negative implications for higher education. It is likely that there will be a vote on the final bill next week. The President said she is cautiously optimistic that the proposal to increase the tax burden on graduate students will be removed. She is less optimistic that the proposed excise tax and provision that eliminates tax-exempt private activity bonds will be removed.

Provost's Announcements
The Provost said that feedback on the CUE recommendations should be forwarded to Professor Kimberly Emmons, chair of the CUE.

Chair's Announcements
Prof. Colares reported that attendance at Senate standing committee meetings has been strong. Next semester the Executive Committee will hear reports from standing committee chairs. Prof. Colares encouraged senators who haven't participated in Diversity 360 to sign up through the OIDEO office.

Three faculty have been nominated to serve on the university committee charged with reviewing and possibly refining the Sexual Misconduct Policy. The three faculty members are Lou Katz (LAW), Helen Saltz (SOM), and Shannon French (CAS).

Prof. Colares also reminded senators about the Library Content and Resources Review Process required for new degree and certificate programs. The Committee on Graduate Studies will expect the proponents of new programs to include a library report in the materials submitted to the Committee for approval. Faculty senators should remind their constituents about this requirement. A member of the Senate said the intent was for the library review requirement to apply to new undergraduate majors and minors, but it appears that there may be some confusion about this. Another member asked what would happen if a report from the appropriate librarian finds insufficient library resources for a new program. Prof. Colares said that this will need to be considered by the relevant Senate committee but it won't automatically invalidate the program.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Faculty Senate

Report from the Executive Committee

Professor Cynthia Beall, vice chair of the Senate, reported on items from the December 5th Executive Committee meeting:

1. Proposed revisions to MSASS and SOM By-Laws were referred to the Senate By-Laws Committee for review and recommendation.

2. SON Report- The Faculty Senate By-Laws provide that each Executive Committee member shall report to the Executive Committee at least once a year about issues affecting his or her constituent faculty. Professor Evelyn Duffy, SON, made a report which included a question to the President and Provost about the confidential nature of the SON dean search. The Provost said that the trend is to retain applicant confidentiality in order to attract the strongest pool of candidates.

3. Report from Committee on Women Faculty – The Senate By-Laws also provide that the Executive Committee should hear reports from the standing committees at least once a year. Professor Leena Palomo, chair of the Senate Committee on Women Faculty, reported on the activities of the committee which include collaborations with various groups across campus. She also reported on child-care related advances for families with young children and the committee's plan to publish a white paper to help inform the campus community about the advances.

4. Academic Calendar – Professor Gary Chottiner, chair of FSCUE, reported that last year, the committee had been charged with considering whether the university should expand the Thanksgiving holiday to include the Wednesday before since so many more undergraduate students come from out of state and need time to travel home. During FSCUE's discussion, questions were raised about other days on the academic calendar, and FSCUE sought advice from the Senate Executive Committee whether to expand its review to encompass more than just the Thanksgiving holiday or whether the Executive Committee would prefer to establish an ad hoc Committee instead. Prof. Chottiner also queried whether any further discussion of these issues should be postponed until after January 30th when feedback on the CUE recommendations is due. The CUE has made recommendations that if approved, would have an impact on the academic calendar. The Senate Executive Committee did not formally charge FSCUE with consideration of academic calendar issues, but suggested that it would be most efficient if FSCUE was ready to discuss any and all calendar issues with the CUE after the January 30th deadline.

5. Student Record Retention – Professor Chottiner also asked the Executive Committee whether FSCUE should consider developing a policy for retention of faculty and student course records such as syllabi, assignments, exams, readings, student submissions, etc… This question

arose because of the need to transition all academic materials from Blackboard to Canvas by June 2018 when the university will lose access to Blackboard. Representatives from UTech attended the meeting and discussed current steps being taken to complete the transition. They are meeting with academic leadership in the schools to determine what data should be retained. There are records in Blackboard dating back to 2003. The Executive Committee advised that FSCUE should work with UTech on these issues and report back to the Executive Committee as early as possible in the spring semester.

Graduate Studies Committee: MS/PhD in Biomedical and Health Informatics

Professor Mendel Singer, SOM, presented the proposed MS and PhD in Biomedical and Health Informatics. There is an increased use of computing and informatics in the field of biomedical and population health, and a growing need for those to work in this field. The program is sponsored by the Center for Computational Biology and will have administrative support from the department of Population and Quantitative Health Sciences. The programs have three main areas of focus: Biomedical and Heath, Computation and System Design, and Data Analytics. Students are expected to come from various backgrounds including medical residents/staff, clinical staff, engineering management, biostatistics, biomedical engineering, and others. Prof. Singer said he thought that approximately four masters' degree students would enroll in the PhD program.

Prof. Singer also thanked Kathleen Blazar, director of the Health Sciences library, for her quick turnaround on the new program library review report. The Senate Executive Committee had requested that this report be completed in accordance with the Library Content and Resources Review Process approved by the Senate last year, prior to Faculty Senate consideration. Prof. Singer noted that it would be best if proponents of new programs provide the librarian with a recommended list of library resources prior to requesting the library assessment. The Senate voted to approve the program (24 in favor, 4 against, and 4 abstentions). *Attachment*

Information on Upcoming University Compliance Training

Lisa Palazzo, University Chief Compliance and Privacy Officer, reported on upcoming compliance training for faculty and staff. This will be the third year of compliance training and each year there is new content. This year's training will address CWRU's alcohol and tobacco free campus policies as well as university policies regarding youth on campus. Results from a 2017 survey informed the development of the upcoming module. The most common suggestion was to make training more interesting and interactive, perhaps by including video/visual content. Faculty and staff will have until the end of March to complete the training. Live sessions will supplement the online training for those working with youth, and for staff who don't regularly use computers. The module should take approximately 30-40 minutes to complete. A senator said that he would like to read the policies before completing the

training module and requested that links to the policies be included in the email from the Compliance Office. *Attachment*

Graduate Student Council "Charlottesville": Resolution

Sahil Gulati, VP of Academic Affairs GSC, presented the Graduate Student Council's "Charlottesville" Resolution which had been amended after feedback from the Faculty Senate in November. The resolution was amended to include the words "race" and "nationality" in the first "Resolved" clause. The Faculty Senate voted unanimously to endorse the resolution. *Attachment*

Proposed Faculty Senate Resolution

Professor Kim Emmons and Professor Ken Ledford (CAS) presented a proposed Senate resolution denouncing the government's proposal to tax graduate student tuition waivers. The goal is to show solidarity with graduate students and with the administration who have worked to defeat this measure. The Faculty Senate voted to endorse the resolution. *Attachment*

CUE Status Update and Discussion

Professor Kim Emmons, chair of the Commission on the Undergraduate Experience (CUE) reminded the Senate that the deadline for feedback on the CUE recommendations is January 30th, and that after that date she will have more information to share.

Report from University Health and Counseling Services

Jennifer McCarthy, Executive Director of University Health and Counseling Services, and Sara Lee, Director of Health Services reported on the activities of the University's Health and Counseling Services. Ms. McCarthy said they have received positive feedback on the decision to combine the health and counseling functions. There have been a number of changes in services also, notably, they will now accept students without appointments who seek counseling services. There has been a 16% increase in number of visits since last fall. While the offices are still located in separate locations, they may be combined in the future.

The university is in the final year of a three-year $300,000 SAMHSA (Substance Abuse and Mental Health Services Administration) grant to institute suicide prevention programming on campus. Training sessions are available for those who work with students to understand and recognize suicide warning signs. Postvention services (after an attempted suicide) are also being developed.

President Snyder said that faculty play an integral role in the prevention of suicide and should be aware of the warning signs. It is critical to act right away if warning signs are detected and not to delay in referring students to appropriate resources.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Faculty Senate

The meeting was adjourned at 5:00pm.

Mendel Singer, PhD MPH

MS/PhD Degree Program in Biomedical and Health Informatics

Why?

- Increasing use of computing and informatics in biomedical and population health
- Fast growing demand for people who do it, and people who understand it (forecast 22% growth 2012-2022)
- Major shortage of properly trained people to do it
  - People with complementary knowledge doing it anyway
- Directive from Dean Davis to develop MS/PhD in Health Informatics

Run by

- Sponsored by the Institute for Computational Biology (ICB)
  - Center for Education and Training in Health Informatics (CETHI)
  - Collaborative across schools and affiliated institutions
- Administrative support from Population and Quant. Health Sciences
  - Vice Chair for Education, Mendel Singer PhD MPH
  - Administrative Director for Non-Clinical Education, Nickalaus Koziura MEd
- Leadership
  - Program Director: David Kaelber, MD (Metro) and Satya Sahoo, PhD
  - Mendel Singer, PhD MPH

Concentration Areas and Training

- Biomedical and Health
  - Focus on Clinical Research Informatics
  - Example course: Medical Imaging Fundamentals
- Computation and System Design
  - Focus on Computational Informatics
  - Example course: Machine Learning and Data Mining
- Data Analytics
  - Focus on Data Modeling and Analysis
  - Example course: Applied Probability and Stochastic Processes for Biology
- Experiential Learning and Career Guidance
  - Multiple courses with project-based learning
  - Thesis or mentored project for M.S. / Dissertation for Ph.D.
  - Career guidance provided by faculty trainers through seminars, professional development presentations, and career talks by invited speakers and panels from industry

What?

- Based on core competencies from the American Medical Informatics Association (AMIA), US National Library of Medicine (National Institutes of Health). Content divided into 3 areas:
  - Biomedical and Health
  - Computation and System Design
  - Data Analytics
- MS – 30 credits
  - 9 credits of required courses
    - HSMC 432 Introduction to Health Informatics
    - PQHS 431 Statistical Science I
    - PQHS 416 Foundations of Computing in Biomedical and Health Informatics
  - Distributional requirements: 3 credits from each of three content areas
  - Concentration: 6-9 additional credits in one of the three areas (6 for Plan A; 9 for Plan B)
  - Plan A: 24 credits of coursework, 6 credits of thesis.
  - Plan B: 27 credits of coursework, 6 credits of mentored M.S. project (track edits from Grad Studies Committee)
    - Missed: p. 7 of proposal: says 30 cr. courses and choice of exam or project. Should be 27 cr. courses + project
- PhD in Biomedical and Health Informatics (36 credits courses + 18 credits of 701)
  - 3 required M.S. courses and Statistical Science II (PQHS 432) for a total of 12 credits
  - 3 credits in each of three content areas for a total of 9 credits
  - 12 credits of electives determined by mentoring committee according to student's desired specialization
  - Ethics (1 credit) and Communication (2 credits)

Students From Many Backgrounds

- Medical Residents/Fellows
- Clinicians of all types
- Engineering Management
- Health Care Management
- Population and Public Health
- Biostatistics
- Computer/Data Science
- Biomedical Engineering
- Biological Sciences

Tuition

- Tuition follows the program
- Special arrangement with Weatherhead to use HSMC 432 as a required core course. $750/credit hour.
  - Only required course from outside PQHS
- Other courses from outside SOM done collegially
  - Mutual benefit: Courses in program will also strengthen Medical Informatics concentration in M.S. Computer Science and Future Data Science MS/PhD
- University policy on tuition across schools coming soon?
  - If so, it will supersede this arrangement.

Pamela B. Davis, MD, PhD
Dean
Senior Vice President for Medical Affairs
Office of the Dean

10900 Euclid Avenue
Cleveland, Ohio 44106-4915

Visitors and Deliveries
Biomedical Research Bldg., Room 113

phone 216.368.2825
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casemed.case.edu

November 16, 2017

Juscelino Colares
Chair, Faculty Senate
c/o Rebecca Weiss
Secretary of the University Faculty
Adelbert Hall

Dear Professor Colares:

On behalf of the Faculty of Medicine, I forward a proposal to establish an MS and PhD degrees granting program in biomedical and health informatics. I understand that the process for further review includes review and approval by the Faculty Senate's Graduate Studies Committee and the Faculty Senate as a whole.

This unique program will address the growing need for professionals in health information technology, especially the use of computing and information technology in biomedical and health research to advance knowledge, contribute to scholarship, and to improve patient care.

The proposed program has been recommended for approval by the School of Medicine's Faculty Council, as described in the accompanying memo from Dr. Phoebe Stewart, Faculty Council Chair, after prior review according to established School of Medicine procedures.

I strongly support approval of the program.

Please let me know if I can provide additional information. Thank you.

Sincerely,

Pamela B. Davis, MD, PhD

cc: Paul MacDonald, Chair Faculty Senate Graduate Studies Committee
Phoebe Stewart, Chair, Faculty Council
Mendel Singer, Vice Chair for Education, Department of Population and Quantitative Health Sciences
Nicole Deming, Assistant Dean for Faculty Affairs and Human Resources

Memorandum

To: Pamela B. Davis, MD, PhD
Dean, School of Medicine
Case Western Reserve University

From: Phoebe Stewart, PhD
Chair, Faculty Council

Re: Biomedical Health Informatics MS/PhD Proposal

Date: October 27, 2017

At its October 16, 2017 meeting, the Faculty Council voted to recommend approval of a new MS/PhD program in Biomedical and Health Informatics. Dr. Mendel Singer, Associate Professor and Vice Chair for Education in the Department of Population and Quantitative Health Sciences, presented the proposal to the Faculty Council.

As Dr. Singer noted, there is a major shortage of people with MS and PhD degrees in this field. Administrative support will be provided by the Department of Population and Quantitative Health Sciences (Vice Chair for Education, Mendel Singer, PhD, MPH; Administrative Director for Non-Clinical Education, Nickalaus Koziura, MEd). Leadership will be provided by David Kaelber, MD, PhD and Satya Sahoo, PhD (program directors) with Mendel Singer assisting.

A motion was made and seconded to approve the new graduate certificate. A vote was taken, 28 members were in favor, 2 were opposed, and 2 abstained. The motion passed.

After your review, I hope you will join me in recommending approval of the new MS/PhD program in Biomedical and Health Informatics.

Please let me know if I can provide any additional information.

Thank you for your consideration.

Sincerely,

Phoebe L. Stewart

Phoebe L. Stewart, Ph.D.
Faculty Council Chair
Professor of Pharmacology
Case Western Reserve University School of Medicine

cc: Nicole Deming, JD, MA
Dan Anker, PhD, JD

CWRU Action Form for Majors/Minors/Programs/Sequences/Degrees **Docket # _____**
(instructions on back)

College/School: _____**School of Medicine**_____
Department: _____**Population and Quantitative Health Sciences**_____

PROPOSED: _____ **major**
_____ **minor**
____ **program**
_____ **sequence**
___ **X** __ **degree**

TITLE: ___ **PhD and MS Program in Biomedical and Health Informatics**_____
_____

EFFECTIVE: ___**Fall**___ **(semester)** __**2018**____ **(year)**

DESCRIPTION: The MS/PhD program in Biomedical and Health Informatics (BHI) will provide students from different backgrounds a common set of educational experience and skills to meet their career objectives in BHI.

1. Health Informatics is a fast growing area and there has been great interest on the part of Dean Davis (SOM) to create graduate programs in BHI. This MS/PhD degree program will enable CWRU to establish and lead the development methodologies in the fast growing field of BHI by leveraging several unique advantages, including biomedical research.
2. The program is a project of the Institute for Computational Biology, a collaborative venture. This MS/PhD program is in collaboration with SOM, Engineering and Weatherhead. The department of Population and Quantitative Health Sciences (formerly Epidemiology and Biostatistics) is assisting with administration of the program.
3. The program will be open to clinical residents and fellows, clinical staff and students in computer science, statistics, mathematics, biological sciences, physics among other programs.
4. All faculty/staff resources required are currently in place and available with new planned course to be offered by existing faculty members.

Is this major/minor/program/sequence/degree: __**X**___ **new**
_____ **modification**
_____ **replacement**

If modification or replacement please elaborate: _____

Does this change in major/minor/program/sequence/degree involve other departments? ____**Yes**_ __**X**__**No**

If yes, which departments? _____

Contact person/committee: _**Mendel Singer, mendel@case.edu 368-1951**_____

SIGNATURES: **DATE**

Department Curriculum Chair(s)/Program Directors: ___ Mendel E. Singer _____**August 29 2017**
Department Chair: _____
College/School Curriculum Committee Chair: _____
College/School Dean(s): _____
FSCUE Curriculum Subcommittee Chair: _____

File copy sent to: _____**Registrar** _____**Office of Undergraduate Studies/Graduate Studies**
_____**Other:** _____

Case Western Reserve University
MS and PhD Program in Biomedical and Health Informatics

Proposal

Contents

1. **Introduction**
2. **Academic Quality**
   - Environment
   - Program Emphasis and Design
   - Faculty Resources
3. **Program Description**
   - Program Summary
   - PhD Program Summary
   - MS Program Summary
4. **Program Administration**
   - Program Admission
   - Tuition Transfer
   - Program Support
5. **Need for Biomedical and Health Informatics Training**
   - Access and Retention of Underrepresented Groups
   - Statewide Alternatives

Department of Population and Quantitative Health Sciences

School of Medicine

1. Introduction

The increasing use of computing and information technology in biomedical and population health research for managing and leveraging data to provide novel insights and improve patient care requires critical investments in creating an appropriately trained workforce. The US Bureau of Labor Statistics projects that employment related to health informatics to grow 22% from 2012 to 2022, however there is a growing shortage of trained workers. The National Institutes of Health (NIH) and in particular the US National Library of Medicine (NLM) have made significant investments in training of investigators in computer science and mathematical statistics with applications in biomedical, clinical and translational research, and public health.

To address the growing need for health information technology (IT), the Office of the National Coordinator (ONC) for health information technology within the Department of Health and Human Services has initiated the "Health IT Workforce Development" program. The program has funded 82 community colleges across the 50 states to create or upgrade existing training programs in health informatics. Similarly, the US NLM supports 16 educational institutions to train investigators in biomedical informatics and data science. In 2011, the American Medical Informatics Association (AMIA) announced the approval of a new subspecialty certification called "Clinical Informatics" by the American Board of Medical Specialty. Given these national initiatives and growing recognition of the need for biomedical and health informatics training, it has become important to develop a degree program at Case Western Reserve University (CWRU) to keep pace with peer educational institutions and also contribute to the development of biomedical and health informatics education.

Therefore, the new MS/Ph.D. program in **Biomedical and Health Informatics (BHI)** at CWRU brings together a diverse group of multi-disciplinary and interdisciplinary faculty members from across the university campus to educate and train students. Biomedical and health informatics is key to the success several initiatives in precision medicine, accountable healthcare, and reproducible science. The growing volume of multi-modal and heterogeneous data in biomedical and health domain needs to be effectively leveraged to realize the objectives of these initiatives through translational research enabled by informatics platforms. The US NLM recommends biomedical and health informatics training to focus on "principles and concepts" of informatics and data science, mathematical and statistical methods, computer science, and domain specific training in biomedicine and health. This interdisciplinary training will allow researchers to advance biomedical and health informatics research. In addition, it will also help administrators and managers using or supervising the use of computing systems in health care, biomedical, and translational research to advance their career objectives.

CWRU is uniquely positioned to establish a MS/PhD program in biomedical and health informatics by building on its pioneering work in medical and graduate education, which has been adopted nationally. In addition, it has leading programs in the School of Engineering and the Weatherhead School of Business that have close relation with the School of Medicine, which are essential for developing a truly interdisciplinary biomedical and health informatics graduate program. **This proposal describes a clearly defined plan to create a graduate program in biomedical and health informatics that brings together faculty from multiple departments and schools across the university campus**. This multi-disciplinary synergistic approach will enable students and program participants to be taught the principles of sound and rigorous methodology for research as well as operational applications (e.g., for MS students).

A graduate program in biomedical and health informatics requires faculty members with expertise and experience in basic biological sciences, medicine, public health, computer science, mathematics, and statistics. CWRU has an outstanding record of innovation and accomplishments in these domains with a strong culture of collaborations and interdisciplinary research both at individual and institutional leadership levels. The recently established Institute for Computational Biology (ICB) has enabled academic collaboration between CWRU, University Hospitals, and the Cleveland Clinic Foundation. ICB aims to use computational methods for analyzing large and diverse biomedical data to expand our fundamental knowledge of human biology to improve our ability to diagnose, treat, prevent, and deliver healthcare.

In addition to ICB, the participating departments and CWRU schools have built significant research presence in medicine, genetics, genomics, epidemiology, biostatistics, computer science, engineering, and business management, which can enable effective use of biomedical and health data for advancing research as well as patient care delivery. The biomedical and health informatics MS/PhD program is designed to build on these existing strengths and develop into a highly successful graduate program to serve local, national, and international researchers and students.

We anticipate enrollment increasing over 5 years up to a cap of 30 per year. Below is a table that projects the expected enrollment targets in the BHI program, which also includes projected international student enrollment. The PhD students admitted to the program are expected to be full-time students.

Table 1: Projected enrollment of students in the BHI program

Program	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
MS/PhD BHI Program - **New Enrollees**	10-20	20-30	20-30	30	30

2. Academic Quality

The biomedical and health informatics (BHI) program leverages the experience and expertise of faculty members from across the campus. Several faculty members from the School of Medicine, School of Engineering, and the Weatherhead School of Business are committed to the BHI program. These faculty members have the demonstrated experience and accomplishments in genetic and quantitative biology, medicine, clinical research, computer science, and mathematical statistics to establish a high-quality graduate program that provides unique multi-disciplinary training in BHI. The BHI program will use a combination of existing courses across the three participating CWRU schools and also develop customized programs of study for participating students based on their area of focus, prior background, and future career objectives. The students graduating from the BHI program are expected to have minimum competencies in three fundamental areas of: **Data Analytics**; **Biomedical and Health**; and **Computation and System Design**. The initial program trainers have experience of teaching many students in the past five years.

Environment

CWRU has systematically created and expanded infrastructure as well as research program that is necessary to create a nationally competitive BHI graduate program.

- The Department of Population and Quantitative Health Sciences (PQHS), which is the academic home of the BHI program have invested significant resources in faculty recruitment and acquiring computing as well as data infrastructure for computational biology and clinical research using quantitative approaches.
- The ICB is leading two initiatives for integrative biomedical and health research using Big Data technologies. The Safely Held Electronic Data (SHED) project is creating an integrated database to support investigator initiated studies in biomedicine. In addition, a data warehouse for Electronic Health Record (EHR) data called CLEARPATH will hold de-identified EHR data.
- In addition, there has been continuing investments in genetic epidemiology and biostatistics research in the PQHS department for integrative research in personalized medicine using advances in genetics.
- CWRU supports and maintains Kelvin Smith Library. The library maintains a rich and diverse catalog of 2.75 million volumes that can be access through a variety of formats. Additionally, the library houses the University Technology (UTech) Services new renovated data center.
- The CWRU High Performance Computing Cluster (HPCC) is a facility provided by UTech to support Big Data projects in multiple domains, including biomedical and health research. The HPCC consists of "GPU nodes for higher end graphics processing, Xeon Phi node for massive parallelization, SMP nodes for intensive memory needs, and compute nodes for general purpose tasks."
- Each trainer in the BHI program has access to office and laboratory/research space to allow students to perform activities required in this program.
- Case Western Reserve holds membership in the Association of American Universities, and is fully accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools and by several nationally recognized professional accrediting associations.

Program Emphasis and Design

The BHI program will train students in (1) quantitative methods including statistical techniques; (2) computational methods including computer and information sciences; and (3) basic biology, medical, and/or public health application domains with appropriate cross-training that provides an integrative approach to tie them together. The program aims to provide students with both training and experience in interdisciplinary research and also training in innovative methods as well as approaches. This training may also include research rotations and project-based experience (specifically for Ph.D. students). The program will have a particular focus on biomedical and health Big Data (e.g., Electronic Health Records (ER), imaging, pathologic, electrophysiological, genomics, and other 'omics' data), which has significant potential to transform research and practice of biomedicine and health (see Appendix A for course descriptions). Therefore, the BHI program is distinct from the SYBB Bioinformatics MS/PhD program as it aims to address the needs to clinicians, biomedical researchers, and students interested in informatics research beyond basic biological sciences.

Through appropriate course work, the students will gain a broad understanding of biomedical and health informatics field. These courses are divided into a set of core courses that will be required for all students in the BHI program. The three core courses are designed to cover primary topics in biomedical and health informatics, computing technologies, and applied

statistics. In addition to the core courses, the students will be required to take three courses (from a number of selected courses as described in the Appendix A) spread across the three focus areas of this program and elective courses based on their area of interest, which will be decided in consultation with the student's mentorship/advisory committee. The broader objective of the BHI program coursework is interdisciplinary training that equips the students to leverage informatics as an integral component of biomedical and health research as well as practice.

Faculty Resources

The faculty trainers for the BHI graduate program have received significant funding from the NIH and the National Science Foundation (NSF) in the last five years. They also have a strong record of training students. The initial group of trainers will be selected based on a review of their NIH funding, previous training record, and publications that are relevant to the broader domain of informatics in biomedical and health research. We note that although junior faculty members may not have a history of funding or training, they are likely to have strong publication track record in biomedical and health informatics. Therefore, all faculty members with primary or adjunct appointment at CWRU are eligible for consideration to be a training faculty in the BHI program.

The Steering Committee for the program is co-chaired by Drs. David Kaelber and Satya Sahoo and includes Steering Committee members Mendel Singer, Associate Professor of Population and Quantitative Health Sciences, Alan Dowling, Professor in the Weatherhead School of Business, Rong Xu, Associate Professor of Population and Quantitative Health Sciences, Colin Drummond, Professor of Biomedical Engineering, Dana Crawford, Associate Professor Population and Quantitative Health Sciences, William Bush, Assistant Professor of Population and Quantitative Health Sciences, and Jill-Barnholtz-Sloan, Professor of Cancer Center (Primary) and Population and Quantitative Health Sciences (Secondary).

In addition to the listed faculty members, other faculty members from additional departments and schools across the University have committed to make significant contributions to the BHI program and will serve as founding trainers in the program. The initial group of trainers have significant achievements in biomedical, health, and informatics research.

3. Program Description

The BHI program aims to provide students from different backgrounds a common set of skills and educational experience that are essential for meeting their career goals in biomedical and health informatics. This BHI program consists of a set of core courses covering foundational topics of biomedical informatics research and elective courses that enables students to focus on specialized areas of bioinformatics, medical/clinical informatics, and population health informatics. In addition, participation in research seminar courses and practical research experience allows students in this program to have the necessary skills to lead biomedical and health informatics research projects to generate, process, and analyze data. This distinguishes the BHI program from other graduate programs that are exclusively focused on computational or basic sciences or clinical research.

The academic requirements of the BHI program are designed to enable students to have common foundation in biomedical informatics with minimum competencies in three focus domains of: (1) Biomedical and Health, (2) Computation and System Design, and (3) Data Analytics. These required competency and core courses are aimed to train students through a new interdisciplinary program that enables students to develop and apply novel computing and quantitative methodologies and techniques in biomedical application domains. This will be reflected in their

Thesis work (for PhD or MS Plan A students) or in their curriculum (MS, Plan B). Each student will have a mentoring or advisory committee (similar to the graduate student requirements in the PQHS department) who will guide the students in completing the appropriate coursework to gain required competencies during training and meet the requirements of different focus areas of biomedical and health, computation and system design, and data analytics with applications in public health, clinical research, or basic biology.

The general framework for fulfilling these competencies for the PhD is included in three example courses of study in the Appendix. An example course of study for the MS curriculum is also included in the Appendix also.

Ph.D. Program Summary

The BHI program differs from current CWRU programs in terms of its requirements for systematic understanding of three core focus areas of biomedical and health, computation and system design, and data analytics. The program includes a core set of courses, including Introduction to Health Informatics (MPHP 532/HSMC 432), Foundations of Computing in Biomedical and Health Informatics, and Statistics I (PQHS 431), and a set of three required distribution of courses in the three core focus areas together with Statistics II (PQHS 432) course for a total of 12 credits. In addition, the student is required to take 4 courses from a set of courses categorized into the three focus areas for a total of 12 credits based on the recommendations of the mentorship/advisory committee members and the area of interest for the student. The PhD student also has to take a course on Research Seminar, Research Ethics in Population Health Sciences, and Communicating in Population Health Science Research for a total of 3 credits. Finally, the student will have a qualifier exam, a PhD thesis, and oral defense that conforms to the requirements and guidelines of CWRU. A PhD student is required to take at least 54 credits (including 18 credits of dissertation research) that conforms to the CWRU graduate program requirements.

The PhD students in the BHI program will follow the same guidelines for dissertation proposal as other PhD students in the PQHS department. This involves the creation of a dissertation committee in consultation with their research mentor consisting of at least 4 university faculty members. The research advisor will be part of this committee, however a faculty member other than research advisor will be the committee chair. The third member of the committee should be a member of the PQHS department and the fourth member should be from another department of the university. A student will write a dissertation proposal based on their dissertation topic and defend the proposal in a public presentation (as described in the PQHS PhD student handbook). The student's written dissertation needs to conform to the guidelines described in the PhD student handbook and the final oral examination should be public with appropriate approval obtained from the School of Graduate Studies. The complete details of the PhD program dissertation committee and dissertation proposal defense are provided in the PQHS department PhD student handbook attached with this proposal as **Appendix B**.

Master's Degree Plan A Summary

The minimum requirements for the MS degree under Plan A are 24 semester hours of coursework (with at least 18 semester hours of course work at 400 level or higher) and 6 semester hours of thesis course with the thesis evaluated by the mentoring/advisory committee for a total of 30 hours. The courses must include Introduction to Health Informatics (MPHP 532/HSMC 432), Foundations of Computing in Biomedical and Health Informatics, and Statistics I (PQHS 431). The

student's course plan must be approved by the program steering committee and include appropriate set of course distribution covering the three focus areas of biomedical and health, computation and system design, and data analytics. The Appendix includes sample course schedules.

Each student must prepare an individual thesis that must conform to regulations concerning format, quality, and time of submission as established by the dean of graduate studies. For completion of master's degrees under Plan A, an oral examination (defense) of the master's thesis is required, where the examination is conducted by a committee of at least three members of the university faculty and the research advisor is a primary faculty appointment in the PQHS department. The students in the BHI MS program will conform to the degree requirements of the PQHS MS program requirements as described in details in the MS student handbook (attached with this proposal as **Appendix C**).

Potentials Dissertation or Theses Topics

- Natural Language Processing toolkit for EHR data.
- Ontology-driven integration of heterogeneous data.
- Drug-reposition using network analysis of drug-drug interactions.
- Social media data analysis for tracking depression in undergraduate student population.

Master's Degree Plan B Summary

The minimum requirements for the MS degree under Plan B are 27 semester hours of course work (with at least 18 semester hours of course work at the 400 level or higher) and a major project (3 credits) with report that is evaluated by the student's mentorship/advisory committee). The coursework must include Introduction to Health Informatics (MPHP 532/HSMC 432), Foundations of Computing in Biomedical and Health Informatics, and Statistics I (PQHS 431). The student's course plan must be approved by the program steering committee and include appropriate set of course distribution covering the three focus areas of biomedical and health, computation and system design, and data analytics.

The course of study for each trainee will be customized and approved by the student's mentorship/advisory committee to ensure that the students have appropriate interdisciplinary training with core competencies in the three areas of focus. Students are expected to demonstrate competency in the three areas of focus through performance in courses and also by their participation in the program's research seminar. The overall study plan for each student must be completed and approved by the end of the first semester for MS students and by the end of the first year for PhD students.

The students will participate in research seminar, which will include activities for students to review and present research studies. The research seminar is designed to allow students to learn the essential skills for public presentation of research topics. Students are expected to participate in seminar throughout their graduate program. The students in the BHI MS program will conform to the degree requirements of the PQHS MS program requirements as described in details in the MS student handbook (attached with this proposal as **Appendix C**).

4. Program Administration

The BHI program will reside in the School of Medicine and it will be administered by the ICB. ICB will provide support in terms of a gradate coordinator who will coordinate with the

program faculty members and students to schedule program milestones, maintain admissions and financial records. A list of faculty members affiliated with the program will be reviewed periodically and faculty members will be re-appointed by majority vote of the Steering Committee and will consist of all faculty involved in the instruction of required and elective courses as well as training. The Program Director will serve at the pleasure of the Dean of the School of Medicine and will recommend, on a yearly basis, the composition of the Steering Committee for the Dean's approval. The Steering Committee will typically include four members plus the Program Director, for voting purposes.

The Program Director, Steering Committee and Graduate Coordinator are responsible for oversight of all admissions, academic and curricular issues including the addition of new trainers and shall be empowered to form subcommittees to support these functions. Under the auspices of the Office of Graduate Studies, the affiliated faculty will further develop and regularly review and update program requirements, conduct of qualifying examinations, and administer the final Dissertation Examination as per the rules of the University.

Entering students will be assigned a mentoring committee (by the Steering Committee) of two faculty members to guide them the first year and to recommend a course of study. The mentoring committee will guide the coursework choices of the student such that they have completed training in the three focus areas with additional coursework that meets the requirement for distribution of courses. The recommended course of study for each student will be approved by the mentorship/advisory committee to ensure interdisciplinary focus on computing and quantitative research techniques. After admission to candidacy, a PhD student will form a thesis committee that will include both faculty that have expertise in biomedical work (for example, Clinical Informatics or Bioinformatics) and computational or mathematical analysis to guide the thesis research plan such that includes all the three focus areas.

During the first year, the students will have an opportunity to participate in research projects led by the faculty trainers of this program. These research project participations will also conform to the rotations performed by other PhD students in PQHS (see handbook in Appendix). Students in MS Plan A or PhD program can select to continue working on the research project after approval from the student's advisory and mentorship/advisory committee members. The approval will also allow the advisory committee to review and approve the qualifying exam for the PhD student.

Students, at the end of their second year, will generate and defend an NIH or NSF style proposal based on their proposed thesis research in the qualifier exam; successful oral defense of this proposal and completion of core requirements will result in recommendation for formal Ph.D. candidacy. Candidates not successful at this stage have one more opportunity, which must be within 12 months, to defend successfully. A second failure will result in separation from the program.

Program Admission

Students will enter the Biomedical and Health Informatics program through direct admission to the program or through the "umbrella" admissions program of the medical school: the Medical Sciences Training Program (MSTP) http://mstp.case.edu/. Direct admission is for students who know they would like to earn either MS or PhD in biomedical and health informatics. Direct admission to the BHI program will be through the CWRU online application. Prospective students will complete Part A and Part B of the existing Graduate Application. About one-half of all CWRU SOM graduate students matriculate using direct application to a specific PhD program.

The “umbrella” BSTP program is designed to provide students who are interested in earning a PhD in a biomedical field an opportunity to explore various areas of research interest through laboratory rotations, while participating in a coordinated curriculum in cell and molecular biology. Students select an advisor and specific PhD program because of their research rotations and then become a member of that PhD program. The MSTP program is a highly selective combined MD/PhD program. Students in the MSTP Program take PhD course work in conjunction with MD course work. The MSTP students have 20 different PhD programs available to them including Systems Biology and Bioinformatics. Upon completion of their PhD course work, the students will work full time on their PhD and then upon completion of the PhD return to traditional medical school to complete their MD. Approximately 20% of CWRU SOM graduate students matriculate using this mechanism.

Admission to the Graduate School will follow the guidelines denoted in the General Bulletin of CWRU and the admissions committee will be comprised of the program steering committee or its designate. Candidates will be evaluated based on overall GPA and science GPA, GRE scores and performance on advanced tests (if available). Very important criteria will also include the student essay, 3 letters of reference, prior research experience, and on campus interviews. The TOEFL examination will be required for international students. For direct admit students, we will follow the General Bulletin guidelines regarding the demonstration of the necessary command of English for foreign students. MSTP students apply directly to the MSTP program and seek admission into medical school as well as a specific Ph.D. program. The MSTP steering committee reviews all applications and invites qualified students to campus to participate in the traditional medical school interview as well as an interview with potential MSTP mentors whose research focus matches the interests of the MSTP candidate. After the visit to campus, the MSTP Steering Committee makes admission decisions. Admittance to the MSTP program allows the student to pursue a PhD in one of the 20 affiliated PhD programs including BHI program. The MSTP student chooses a PhD program to complete base upon experience in their research rotations.

All program students will be expected to have an undergraduate or master’s degree in one the component disciplines of the program, for example biomedical and health sciences, mathematics and statistics, or computing and information sciences. The following undergraduate courses are strongly recommended for admission to the BHI program: Introductory Computer Science, Introductory Statistics, Introductory Biology, Calculus, Linear Algebra, and Discrete Mathematics. The admissions process will evaluate the suitability of students before they are admitted and will offer remedial course work prior to graduation. The remedial courses may be added to the student’s study program and additional semester of work may be added with no financial or academic penalty to the student.

Tuition Transfer

Tuition return for graduate students enrolled in a degree program, by default, is assigned to the student’s home school. Within the School of Medicine, a tuition sharing arrangement is already in place with a standard rate of $263 per credit hour. There is one course offered by the Weatherhood School of Management (WSOM) that is required of the MS and PhD students, 37.5% of the tuition for MS students taking this course will be transferred to WSOM, after allowing 4 new MS students per year to take it without transfer. There is no transfer of tuition for PhD students since they are generally not income generating (and new SOM rules assess no tuition for PhD students). We note that there has been some movement towards a University policy of tuition sharing for graduate students who take courses in a different school. That has not

happened as of the time of this proposal. If such a policy is accepted, it will be applicable to this program also.

Program Support

At present, first year PhD students are supported by the School of Medicine. In subsequent years, they are supported by individual PIs. Students in the BHI program will be supported in a similar manner. If the student joins a laboratory and support is lost, the mentor's home department will be financially responsible for the student. This support is assured by a required signoff from the mentor's Department Chair. Additional funds to add to these resources are being sought from the strategic plan funding, foundation and philanthropic support. After approval of this program, we plan to apply for NIH training grants to support students in the BHI program.

Classroom Space and Library Support

The BHI program involves teaching of only 1 new course and we have administrative access to 3 classrooms. Therefore, classroom space for the new program is expected to be adequate. We have attached the Library Content and Resource Review documents with the program proposal describing the library content and resource requirements for this program.

5. Need for Biomedical and Health Informatics Training

The US Bureau of Labor Statistics projects that employment related to health informatics to grow 22% from 2012 to 2022. Despite this projected growth, the emergent field of health informatics education remains fragmented. According to the American Medical Informatics Association (AMIA), there are approximately 70 advanced degree programs in the United States offering a variety of programs, including institutions such as the University of Cincinnati and Ohio State University. Admission to these programs tends to not be competitive due to high market demand for graduates. Additionally, these programs typically utilize open enrollment policies as a way to generate revenue. There is not a coordinated professional program involving structured activity that balances health care and information technology. Many existing programs are "reactive" to the Affordable Care Act and are not all that relevant to the needs of the US health care system. Levels of technical instruction vary in these open enrollment programs; some courses center more heavily on strategy, others on statistics and "R" programming, and yet others on medicine.

This new interdisciplinary certificate program is designed to meet the increasing demand for clinical or health informatics professionals in healthcare research and biomedical research, both nationally and locally in the Greater Cleveland area and Northeastern Ohio (NEO). Although NEO is home to three renowned hospital systems (Cleveland Clinic Foundation, University Hospitals, The MetroHealth System), there has been a lack of centralized and structured education in clinical and health informaticists in this region. This new program will provide a centralized, coherently structured system that serves the health informatics domain in NEO and will provide a foundation of knowledge and an opportunity for professionals in fields that are increasingly incorporating health informatics into daily operations.

As described earlier, the ICB is an academic collaboration between Case Western Reserve University (CWRU), University Hospitals, and the Cleveland Clinic Foundation. Founded in November 2013, the ICB seeks to expand our fundamental knowledge of human biology and thus

improve our ability to diagnose, treat, prevent, and deliver healthcare through the application of computational methods to large and diverse datasets.

The Department of Population and Quantitative Health Sciences is a proud member of the CWRU School of Medicine. The School of Medicine is affiliated with some of the nation's best hospitals, such as University Hospitals Cleveland Medical Center, Cleveland Clinic Foundation, Veteran's Administration Medical Center, and The MetroHealth System. The proposed MS/PhD program will be administered by the Department of Population and Quantitative Health Sciences.

Notable graduate programs include:

- Biomedical Informatics program at Columbia University. (https://www.dbmi.columbia.edu/)
- Biomedical Informatics program at University of Pittsburgh (www.dbmi.pitt.edu/)
- Biomedical Informatics program at Stanford University (http://bmi.stanford.edu/)
- Medical Informatics program, University of Edinburgh, UK (http://www.ed.ac.uk/studying/postgraduate/degrees/index.php?r=site/view&id=924)

Access and Retention of Underrepresented Groups

Recruitment efforts for the BHI program are collaborative with those already established and ongoing within the MSTP, BSTP, and other programs at CWRU. Special efforts will be made to enroll minority students as part of the CWRU commitment to bringing more minorities and women into advanced fields of study. Although in the field of Basic and Translational Biomedical Research women are not underrepresented at the student and junior faculty levels, the representation of women in informatics is low. Thus, every effort will be made to foster a supportive environment in order to successfully mentor and retain minority and female Ph.D. candidates and guide these students into leadership roles in this new field.

Institutional History and Achievements. CWRU has well-established efforts to recruit and retain under-represented minority students to our graduate and medical schools. In 1971, the Office of Multicultural Programs was established to help and encourage minority students enter careers in medicine and biomedical research. Graduate programs across the campus have been successful in matriculating minority students. In 2007, of 823 domestic applicants, 192 matriculated and 46 were minorities (24%). To ensure that matriculated minority students are supported and are part of a community a Minority Graduate Student Organization (MGSO) was formed. Participation is voluntary, but strongly encouraged, to foster a student group identity and shared values. MGSO meeting topics are varied and cover many issues, including the experiences of the students in research.

The success of the medical and graduate minority recruitment efforts at CWRU can also be attributed to our institutional presence at various historically African American colleges and universities and at scientific conferences organized by underrepresented minority groups. The BHI Program will be represented at these ongoing recruitment efforts. In addition, we plan to send a representative of the Program to the national meeting of the Society for Advancement of Chicanos/Latinos and Native Americans in Science, the Annual Biomedical Research Conference for Minority Students, and the American Medical Informatics Association Annual Symposium.

The number of students enrolled in graduate programs from underrepresented groups has maintained steady over the last 15 years. Enrollment statistics by race:

- African Americans - 6 %

- Asians- between 6 -9%
- Hispanics –between 1-2%
- White between 67% and 53% (the trend of enrollment for white students has steadily decreased in the last 15 years. Currently only 53% of the graduate enrollment is white.
- Other /Unknown – between 4-8%. (the trend of enrollment of students of other/unknown race has fluctuated and is currently at 6%)
- International – between 16% and 22%. (the trend of enrollment of international students is currently 22%)

Additionally, the number of women students enrolled in graduate programs at CWRU has been higher than the number of men enrolled over the last 5 years.

Statewide Alternatives

The CWRU BHI program is distinct from other graduate programs in biomedical and health informatics offered across the state of Ohio. No other university in Ohio offers a MS/Ph.D. program in biomedical and health informatics that has a special emphasis on Big Data. At present, the Ohio State University (OSU) offers a MS program with specialization in biomedical informatics and a Ph.D. program in conjunction with biomedical sciences graduate program with two tracks: Computational Biology and Bioinformatics (CBB) and Translational Bioinformatics (TBI). The CBB track focuses on processing, integration and visualization of genomic sequencing, gene and protein expression profiling, and numerical simulation study data. The TBI track focuses on translation of biomedical data into actionable data for clinicians and researchers. Similarly, the University of Cincinnati (UC) offers a certificate and Ph.D. program in biomedical informatics. The Ph.D. program allows students to develop skills in data-driven biomedical sciences with training in clinical and laboratory information systems as well as general medical science. The UC programs requires at least 37 hours of coursework. The CWRU BHI program has three distinct focus of biomedical and health, quantitative data analytics, and computational and system design, which together with strong expertise in various areas of biomedical and health research, makes it well placed to deliver outstanding training to students. The specific emphasis on Big Data together with a focused biomedical and health informatics graduate program (in contrast to program tracks at OSU) is expected to ensure that the CWRU BHI program attracts students who have significant interest in biomedicine, health, and data sciences.

Due its physical proximity and close collaborative relationships to both University Hospitals and the Cleveland Clinic, the students enrolled in the BHI program will be uniquely positioned to take advantage of a multitude of learning opportunities to enhance their education in the biomedical and health informatics program. The students will have access to regularly scheduled presentations, talks, and seminars at the Cleveland Clinic and the University Hospitals.

SCHOOL OF MEDICINE
CASE WESTERN RESERVE UNIVERSITY

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August 15, 2017

David Kaelber, MD, PhD, MPH
Professor of Internal Medicine, Pediatrics, Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics
Clinical Informatics Fellowship Director, CWRU Clinical Informatics Fellowship Program

Satya Sahoo, PhD
Associate Professor of Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics

Dear David and Satya,

The Department of Population and Quantitative Health Sciences fully supports this proposal for new interdisciplinary MS and PhD degree programs in Biomedical and Health Informatics. These degrees will fill a void that currently exists here at CWRU. I think this is an important program for the University, and am prepared to provide the necessary resources of faculty and staff time. Students in these degree programs are welcome to take the department courses identified in this proposal.

As indicated in the proposal, Biomedical and Health Informatics is represented in courses across the University but currently there is no entry point at CWRU for healthcare professionals, researchers, and others to gain exposure through a structured and curated program. These new interdisciplinary MS and PhD degree programs will be administered by my department and housed in the ICB I direct, but will be fully collaborative with many other departments across CWRU. These new degree programs will provide current graduate students, healthcare professionals, and researchers the opportunity to further their knowledge of this diverse and ever expanding field.

I am fully committed to supporting these new MS and PhD degree programs.

Sincerely,

Jonathan L. Haines, PhD
Chair, Department of Population & Quantitative Health Sciences
Mary W. Sheldon, MD Professor of Genomic Sciences
Director, Institute for Computational Biology

CASE SCHOOL
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September 22, 2017

David Kaelber, MD, PhD, MPH
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Clinical Informatics Fellowship Director, CWRU Clinical Informatics Fellowship Program

Satya Sahoo, PhD
Associate Professor of Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics

Dear David and Satya,

I am pleased to write this letter in support of the proposal new interdisciplinary MS and PhD degree programs in Biomedical and Health Informatics from the Institute of Computational Biology (ICB). I believe this new degree programs will provide students unique opportunities to expand their quantitative skills and understanding. I particularly like that this proposal is a collaborative effort that spans both departments and schools here at CWRU to maximize current resources.

The new interdisciplinary MS and PhD degree programs in Biomedical and Health Informatics utilize several of our courses for distributional requirements and electives including: EMBE 410, EBME 419, EBME 473, EECS 458, EECS 433, EECS 454, EECS 477, EECS 493, EECS 494 (see Appendix A of the full proposal). I approve the use of these courses for these new degree programs.

Regarding tuition, it is expected that only a small percentage of students in the MS or PhD in Biomedical and Health Informatics program will be able to meet the prerequisites for relevant Engineering classes. We similarly expect students from Engineering in the Computer Science and the developing Data Science graduate programs will be taking courses in SOM/PQHS. Accordingly, we will begin this arrangement with no tuition sharing taking place, with the expectation that this will be reviewed periodically for possible imbalances and addressed as necessary. This tuition sharing agreement will be superseded by any future university-wide agreement on tuition sharing.

I look forward to the approval of these new degree programs.

Sincerely,

James D. McGuffin-Cawley
Interim Dean, Case School of Engineering
Arthur S. Holden Professor of Engineering

CASE WESTERN RESERVE UNIVERSITY
WEATHERHEAD SCHOOL OF MANAGEMENT

Simon Peck
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Associate Professor of Strategy
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September 25, 2017

David Kaelber, MD, PhD, MPH
Professor of Internal Medicine, Pediatrics, Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics
Clinical Informatics Fellowship Director, CWRU Clinical Informatics Fellowship Program

Satya Sahoo, PhD
Associate Professor of Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics

Dear David and Satya,

I am pleased to write this letter in support of the proposal new MS and PhD degrees Biomedical and Health Informatics from the Institute of Computational Biology (ICB). I believe these two new degrees will provide students a unique opportunity to expand their quantitative skills and understanding. I particularly like that this proposal is a collaborative effort that spans both departments and schools here at CWRU to maximize current resources.

The MS and PhD degrees in Biomedical and Health Informatics utilizes several of our courses as potential distributional electives: including HSMC 421, HSMC 420, HSMC 412, HSMC 456, and ACCT 401H. Two required core courses for the MS and PhD program will also utilize courses taught by Dr. Alan Dowling. I approve the use of these courses as electives and the one required core course for the proposed degree programs.

Regarding tuition, for MS in Biomedical and Health Informatics students, $750 of the WSOM per credit tuition for the core course(s) (home based in WSOM) will be billed by WSOM to the student's home school. This tuition sharing agreement will be superseded by any future university-wide agreement on tuition sharing.

I look forward to the approval of these exciting new MS and PhD degrees in Biomedical and Health Informatics.

Sincerely,

Simon Peck
Associate Dean of MBA Programs

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September 6, 2017

David Kaelber, MD, PhD, MPH
Professor of Internal Medicine, Pediatrics, Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics
Clinical Informatics Fellowship Director, CWRU Clinical Informatics Fellowship Program

Satya Sahoo, PhD
Associate Professor of Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics

Dear David and Satya,

I am pleased to write this letter in support of the proposal for the new interdisciplinary MS and PhD degree programs in Biomedical and Health Informatics from the Institute of Computational Biology (ICB). I believe these new degree programs will provide students unique opportunities to expand their quantitative skills and understanding across multiple fields. I particularly like that this proposal is a collaborative effort that spans departments and schools here at CWRU to maximize current resources.

I understand that the new interdisciplinary MS and PhD degree programs in Biomedical and Health Informatics require the students to choose at least 1 technical elective from the following: EECS 405, EECS 433, EECS 454, EECS 477, EECS 493, and EECS 494. These Electrical Engineering and Computer Science courses have been offered at least once in the past two years, and I anticipate most, if not all, of these courses will be offered in the future. The department will advise the program of any curricular changes in EECS to ensure that such changes are reflected in programmatic requirements of the degree programs, as applicable.

I look forward to collaborating with the faculty and students in this exciting new program.

Sincerely,

Alexis R. Abramson, Ph.D.

Interim Chair, Electrical Engineering and Computer Science
Milton and Tamar Maltz Professor of Energy Innovation

WEATHERHEAD
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18 August 2017

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Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics
Clinical Informatics Fellowship Director, CWRU Clinical Informatics Fellowship Program

Satya Sahoo, PhD
Associate Professor of Population and Quantitative Health Sciences
Academic Program Co-Director, CWRU Center for Education and Training in Health Informatics

Dear David and Satya,

I fully support the new interdisciplinary MS and PhD degree programs in Biomedical and Health Informatics. These degree programs will appeal to many students from diverse backgrounds. I am happy to have my course be required for these programs, Introduction to Health Informatics (MPHP 532/HSMC432), and lend my expertise as part of other core courses for the MS and PhD in Biomedical and Health Informatics curriculum.

I look forward to being a part of these new degree programs at CWRU.

Sincerely,

Alan F. Dowling, PhD, MS, MCS

afd4@case.edu
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Appendix A

Curriculum Requirements for MS in Biomedical and Health Informatics

1. Required core courses (3 courses, 9 credits)
    - Introduction to Health Informatics (MPHP 532/HSMC432)
    - Foundations of Computing in Biomedical and Health Informatics
    - Statistical Methods I (PQHS 431)

2. Required distribution of courses (3 courses, 9 credits), choose one from each core
    - Biomedical and Health (select a course from 4 courses)
    - Computation and System Design (select a course from 5 courses)
    - Data Analytics (select a course from 11 courses)

3. Elective courses (2-3 courses, 6-9 credits), choose additional electives from cores or from other approved electives (14 other courses))
    - Plan A: Concentration-specific elective courses (6 credits)
    - Plan B: Concentration-specific elective courses (9 credits)

4. Required thesis (6 credits, Plan A) or project (3 credits, Plan B)
    - Master's Thesis (PQHS 651, Plan A)
    - Master Project Research (PHQS 601, Plan B)

Total credits - 30

Students may obtain concentration designations as part of their MS in Biomedical and Health Informatics in the following three areas is they fulfill additional distribution requirements:

- Health Informatics Management
- Clinical Informatics
- Bioinformatics

Curriculum Requirements for PhD in Biomedical and Health Informatics

1. Required core courses (3 courses, 9 credits)
    - Introduction to Health Informatics (MPHP 532/HSMC432)
    - Foundations of Computing in Biomedical and Health Informatics
    - Statistical Methods I (PQHS 431)

2. Required distribution of courses (4 courses, 12 credits), choose one course from each core
    - Statistics II (PQHS 432)
    - Biomedical and Health (select a course from 4 courses)
    - Computation and System Design (select a course from 5 courses)
    - Data Analytics (select a course from 11 courses)

3. Elective courses (4 courses, 12 credits), choose additional electives from cores or from other approved electives (14 other courses))
    - The selection of elective courses is made by student in consultation with mentoring/advising committee

4. Required research activities (3 credits)
    - Research Seminar (0 credits - must take for at least 6 semesters)
    - Research Ethics: IBMS 500 (1 credit) AND PQHS 445 (0 credits)
    - Communicating in Population Health Science Research (PQHS 444) (2 x 1 credit)

5. Required Dissertation (at least 18 credits)
    - Required to pass written/oral qualifying exam prior to dissertation credits

Total Credits - at least 54 credits

Curriculum Details for MS/PhD Program in Biomedical and Health Informatics

Three sample programs for PhD. (Required courses in bold)

Example One: Bioinformatics focused PhD program.

Semester 1	**Courses**	**Title**	Credits	Graded or P/F
	MPHP 532/HSMC 432	**Introduction to Health Informatics**	3	Graded
	PQHS 431	**Statistics I**	3	Graded
	EECS 433	Database Systems	3	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**9**	
Semester 2	New Course	**Foundations of Computing in Biomedical Informatics**	3	Graded
	PQHS 471	Machine Learning & Data Mining	3	Graded
	PQHS 432	**Statistical Methods II**	3	Graded
	PQHS 501	Research Seminar	0	P/F
	PQHS 445	Research Ethics in Population Health Sciences	0	P/F
	IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	**1**	P/F
		Total Credits	**10**	
Semester 3	EECS 454	Analysis of Algorithms.	3	Graded
	PQHS 483	Causal Inference	3	Graded
	PQHS 444	Communicating in Population Health Science Research	1	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**7**	
Semester 4	PQHS 453	Categorical Data Analysis	3	Graded
	EECS 493	Software Engineering	3	Graded
	EECS 494	Introduction to Information Theory	3	Graded
	PQHS 444	Communicating in Population Health Science Research	1	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**10**	
Semester 5	PQHS 701	Dissertation Ph.D.	3	P/F
	PQHS 501	Research Seminar	0	P/F
Semester 6	PQHS 701	Dissertation Ph.D.	3	P/F
	PQHS 501	Research Seminar	0	P/F
Semester 7	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 8	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 9	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 10	PQHS 701	Dissertation Ph.D.	3	P/F
		Total Credits for 5 year Ph.D. Program	**54**	

Example Two: Clinical Informatics focused PhD program.

Semester 1	**Courses**	**Title**	Credits	Graded or P/F
	MPHP 532/HSMC 432	**Introduction to Health Informatics**	3	Graded
	PQHS 431	**Statistics I**	3	Graded
	PQHS 440	Introduction to Population Health	3	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**9**	
Semester 2	New Course	**Foundations of Computing in Biomedical Informatics**	3	Graded
	PQHS 432	**Statistics II**	3	Graded
	EECS 443	Database Systems	3	Graded
	PQHS 501	Research Seminar	0	P/F
	PQHS 445	Research Ethics in Population Health Sciences	0	P/F
	IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	**1**	P/F
		Total Credits	**10**	
Semester 3	PQHS 515	Secondary Analysis of Large Health Care Data Sets	3	Graded
	HSMC 420	Health Finance	3	Graded
	PQHS 468	The Continual Improvement of Healthcare	3	Graded
	PQHS 444	Communicating in Population Health Science Research	1	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**10**	
Semester 4	PQHS 467	Comparative and Cost Effectiveness Research	3	Graded
	PQHS 459	Longitudinal Data Analysis	3	Graded
	PQHS 444	Communicating in Population Health Science Research	1	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**7**	
Semester 5	PQHS 701	Dissertation Ph.D.	3	P/F
	PQHS 501	Research Seminar	0	P/F
Semester 6	PQHS 701	Dissertation Ph.D.	3	P/F
	PQHS 501	Research Seminar	0	P/F
Semester 7	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 8	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 9	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 10	PQHS 701	Dissertation Ph.D.	3	P/F
		Total Credits for 5 year Ph.D. Program	**54**	

Example Three: Public Health/Analytics focused PhD program.

Semester 1	**Courses**	**Title**	Credits	Graded or P/F
	MPHP 532/HSMC 432	**Introduction to Health Informatics**	3	Graded
	PQHS 431	**Statistics I**	3	Graded
	PQHS 490	Epidemiology: Introduction to Theory and Methods	3	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**9**	
Semester 2	New Course	**Foundations of Computing in Biomedical Informatics**	3	Graded
	PQHS 432	**Statistics II**	3	Graded
	PQHS 465	Design and Measurement in Population Health Sciences	3	Graded
	PQHS 501	Research Seminar	0	P/F
	PQHS 445	Research Ethics in Population Health Sciences	0	P/F
	IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	**1**	P/F
		Total Credits	**10**	
Semester 3	MPHP 406	History and Philosophy of Public Health	3	Graded
	PQHS 515	Secondary Analysis of Large Health Care Data Sets	3	Graded
	PQHS 440	Introduction to Population Health	3	Graded
	PQHS 444	Communicating in Population Health Science Research	1	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**10**	
Semester 4	PQHS 459	Longitudinal Data Analysis	3	Graded
	PQHS 471	Machine Learning & Data Mining	3	Graded
	PQHS 444	Communicating in Population Health Science Research	1	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**7**	
Semester 5	PQHS 701	Dissertation Ph.D.	3	P/F
	PQHS 501	Research Seminar	0	P/F
Semester 6	PQHS 701	Dissertation Ph.D.	3	P/F
	PQHS 501	Research Seminar	0	P/F
Semester 7	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 8	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 9	PQHS 701	Dissertation Ph.D.	3	P/F
Semester 10	PQHS 701	Dissertation Ph.D.	3	P/F
		Total Credits for 5 year Ph.D. Program	**54**	

Example Curriculum Outline: MS in Biomedical and Health Informatics

Year-by-year outline of study for the MS. Plans A and B: Required courses in Bold. Electives also listed.

Semester 1	**Courses**	**Title**	Credits	Graded or P/F
	MPHP 532/HSMC 432	**Introduction to Health Informatics**	3	Graded
	PQHS 431	**Statistics I**	3	Graded
	EECS 433	Database Systems	3	Graded
		Total Credits	**9**	
Semester 2	New Course	**Foundations of Computing in Biomedical Informatics**	3	Graded
	PQHS 471	Machine Learning & Data Mining	3	Graded
	PQHS 432	Statistical Methods II	3	Graded
	PQHS 501	Research Seminar	0	P/F
		Total Credits	**9**	
Semester 3	EECS 493	Software Engineering	3	Graded
	PQHS 432	Statistical Methods II	3	Graded
	Plan A: PQHS 651	Master's Thesis **(Plan A)**	3 **(A)**	P/F
	Plan B: ACCT 401H	Accounting for Healthcare **(Plan B)**	3 **(B)**	Graded
		Total Credits	**9**	
Semester 4	**Plan A:** PQHS 651	Master's Thesis **(Plan A)**	3 **(A)**	P/F
	Plan B: PQHS 601	Master's Project Research (Plan A)/Elective Course **(Plan B)**	3 **(B)**	P/F
		Total Credits	**3**	
		Total Credits for M.S. Program	**30**	

Academic Requirements for Master's Degree in Biomedical and Health Informatics

Plan A – MS with a thesis based on research and final oral examination
Plan B – MS requiring written comprehensive examinations or major project (no thesis)

Required: **Core** Course Descriptions
Total number of course: 3
Total course credits: 9

Course Number: MPHP 532/HSMC432
Course Title: Introduction to Health informatics/ Health Informatics Core Issues
Offered:
Duration: 1 semester
Credits: 3
Purpose: Introduction to biomedical and healthcare informatics, use of computational techniques in biomedical and healthcare settings, focus on clinical, biological, translational, and public health informatics. Review the use of computing technologies in biomedical and healthcare research as well as applications. Introduction to electronic health records (EHR), use of EHR systems in biomedical research, patient care, and impact of computing technology on healthcare. Explore the information requirements of healthcare and user community, current approaches to biomedical and healthcare data management.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

NEW COURSE
Course Title: Foundations of Computing in Biomedical and Health Informatics
Offered:
Duration: 1 semester
Credits: 3
Purpose: Explore techniques in programming and mathematical foundations of data analysis in biomedical and healthcare context. The topics include algorithm design and analysis, logic and reasoning foundations, data management concepts, including survey of database management systems. Explore natural language processing techniques, information retrieval, and image informatics. Introduction to Big Data technologies, including parallel and distributed computing, cloud infrastructure, and scalable systems.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 431
Course Title: Statistics I
Offered:
Duration: 1 semester
Credits: 3
Purpose: Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs. First part of year-long sequence. Offered as ANAT 431, BIOL 431, CRSP 431, PQHS 431 and MPHP 431.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Required: **Biomedical and Health** Course Descriptions
Total number of course: 1

Total course credits: 3

Course Number: EBME 410
Course Title: Medical Imaging Fundamentals
Offered:
Duration: 1 semester
Credits: 3
Purpose: Physical principles of medical imaging. Imaging devices for x-ray, ultrasound, magnetic resonance, etc. Image quality descriptions. Patient risk. Recommended preparation: EBME 308 and EBME 310 or equivalent. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: MPHP 406
Course Title: History and Philosophy of Public Health
Offered:
Duration: 1 semester
Credits: 3
Purpose: The purpose of this course is to introduce students to the science and art of public health through an understanding of the history and philosophies that represent its foundation. Students will learn about the essentials of public health and applications of those precepts throughout history and in the present. The course will examine public health case histories and controversies from the past and present, in order to better understand solutions for the future. Offered as MPHP 306 and MPHP 406. Prereq: Enrollment limited to MPH students (Plan A or Plan B) and EPBI students or instructor consent.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 440
Course Title: Introduction to Population Health
Offered:
Duration: 1 semester
Credits: 3
Purpose: Introduces graduate students to the multiple determinants of health including the social, economic and physical environment, health services, individual behavior, genetics and their interactions. It aims to provide students with the broad understanding of the research development and design for studying population health, the prevention and intervention strategies for improving population health and the disparities that exist in morbidity, mortality, functional and quality of life. Format is primarily group discussion around current readings in the field; significant reading is required.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 451
Course Title: A Data-Driven Introduction to Genomics and Human Health
Offered:
Duration: 1 semester

Credits: 3
Purpose: This course introduces the foundational concepts of genomics and genetic epidemiology through four key principles: 1) Teaching students how to query relational databases using Structure Query Language (SQL); 2) Exposing students to the most current data used in genomics and bioinformatics research, providing a quantitative understanding of biological concepts; 3) Integrating newly learned concepts with prior ones to discover new relationships among biological concepts; and 4) providing historical context to how and why data were generated and stored in the way they were, and how this gave rise to modern concepts in genomics. Offered as PQHS 451, GENE 451, and MPHP 451. Prereq: PQHS 431, PQHS 490 or requisites not met permission.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 465
Course Title: Design and Measurement in Population Health Sciences
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course focuses on common design and measurement approaches used in population health sciences research. This course covers the preliminary considerations used in selecting qualitative, quantitative and mixed methods research approaches including an understanding of different philosophical worldviews, strategies of inquiry and methods and procedures for each approach. The course also includes an introduction to survey design and related concepts of latent variables, factor analysis and reliability and validity. Students will develop an in-depth knowledge of these design and measurement approaches through readings, lectures, group discussions and written and oral project presentations. Prereq: PQHS 440, PQHS 431, PQHS 490, PQHS 432, PQHS 460, PQHS 444 and PQHS 445.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 490
Course Title: Epidemiology: Introduction to Theory and Methods
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course provides an introduction to the principles of epidemiology covering the basic methods necessary for population and clinic-based research. Students will be introduced to epidemiologic study designs, measures of disease occurrence, measures of risk estimation, and casual inference (bias, confounding, and interaction) with application of these principles to specific fields of epidemiology. Classes will be a combination of lectures, discussion, and in-class exercises. It is intended for students who have a basic understanding of the principals of human disease and statistics. Offered as PQHS 490 and MPHP 490. Prereq or Coreq: PQHS 431 or requisites not met permission.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Required: **Computation and System Design** Course Descriptions
Total number of course: 1

Total course credits: 3

Course Number: EECS 458
Course Title: Introduction to Bioinformatics
Offered:
Duration: 1 semester
Credits: 3
Purpose: Fundamental algorithmic methods in computational molecular biology and bioinformatics discussed. Sequence analysis, pairwise and multiple alignment, probabilistic models, phylogenetic analysis, folding and structure prediction emphasized. Recommended preparation: EECS 340, EECS 233
Assessment of Competency: Grades

Course Number: EECS 433
Course Title: Database Systems
Offered:
Duration: 1 semester
Credits: 3
Purpose: Basic issues in file processing and database management systems. Physical data organization. Relational databases. Database design. Relational Query Languages, SQL. Query languages. Query optimization. Database integrity and security. Object-oriented databases. Object-oriented Query Languages, OQL. Recommended preparation: EECS 341 and MATH 304.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: EECS 454
Course Title: Analysis of Algorithms
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course covers fundamental topics in algorithm design and analysis in depth. Amortized analysis, NP-completeness and reductions, dynamic programming, advanced graph algorithms, string algorithms, geometric algorithms, local search heuristics. Offered as EECS 454 and OPRE 454. Prereq: EECS 340.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: EECS 477
Course Title: Advanced Algorithms
Offered:
Duration: 1 semester
Credits: 3
Purpose: Design and analysis of efficient algorithms, with emphasis on network flow, combinatorial optimization, and randomized algorithms. Linear programming: duality, complementary slackness, total unimodularity. Minimum cost flow: optimality conditions, algorithms, applications. Game theory: two-person zero-sum games, minimax theorems. Probabilistic analysis and randomized algorithms: examples and lower bounds. Approximation algorithms for NP-hard problems: examples, randomized rounding of linear programs.

Prereq: EECS 302, EECS 340, MATH 201, MATH 380
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: EECS 493
Course Title: Software Engineering
Offered:
Duration: 1 semester
Credits: 3
Purpose: Introduction to software engineering; software lifecycle models; development team organization and project management; requirements analysis and specification techniques; software design techniques; programming practices; software validation techniques; software maintenance practices; software engineering ethics. Undergraduates work in teams to complete a significant software development project. Graduate students are required to complete a research project. Offered as EECS 393, EECS 393N, and EECS 493. Counts as SAGES Senior Capstone.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 471
Course Title: Machine Learning & Data Mining
Offered:
Duration: 1 semester
Credits: 3
Purpose: Vast amount of data are being collected in medical and social research and in many industries. Such big data generate a demand for efficient and practical tools to analyze the data and to identify unknown patterns. We will cover a variety of statistical machine learning techniques (supervised learning) and data mining techniques (unsupervised learning), with data examples from biomedical and social research. Specifically, we will cover prediction model building and model selection (shrinkage, Lasso), classification (logistic regression, discriminant analysis, k-nearest neighbors), tree-based methods (bagging, random forests, boosting), support vector machines, association rules, clustering and hierarchical clustering. Basic techniques that are applicable to many of the areas, such as cross-validation, the bootstrap, dimensionality reduction, and splines, will be explained and used repeatedly. The field is fast evolving and new topics and techniques may be included when necessary. Prereq: PQHS 431
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Required: **Data Analytics** Course Descriptions
Total number of course: 2
Total course credits: 6

Required Course for PhD
Course Number: PQHS 432
Course Title: Statistical Methods II
Offered:
Duration: 1 semester

Credits: 3
Purpose: Methods of analysis of variance, regression and analysis of quantitative data. Emphasis on computer solution of problems drawn from the biomedical sciences. Design of experiments, power of tests, and adequacy of models. Offered as BIOL 432, PQHS 432, CRSP432 and MPHP 432. Prereq: PQHS 431 or equivalent.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: EBME 419
Course Title: Applied Probability and Stochastic Processes for Biology
Offered:
Duration: 1 semester
Credits: 3
Purpose: Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 459
Course Title: Longitudinal Data Analysis
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course will cover statistical methods for the analysis of longitudinal data with an emphasis on application in biological and health research. Topics include exploratory data analysis, response feature analysis, growth curve models, mixed-effects models, generalized estimating equations, and missing data. Prereq: PQHS 432.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 453
Course Title: Categorical Data Analysis
Offered:
Duration: 1 semester
Credits: 3
Purpose: Categorical data are often encountered in many disciplines including in the fields of clinical and

biological sciences. Analysis methods for analyzing categorical data are different from the analysis methods for continuous data. There is a rich a collection of methods for categorical data analysis. The elegant "odds ratio" interpretation associated with categorical data is a unique one. This online course will cover cross-sectional categorical data analysis theories and methods. From this course students will learn standard categorical data analysis methods and its applications to the biomedical and clinical studies. This particular course will focus mostly on statistical methods for categorical data analysis arising from various fields of studies including clinical studies; those who take it will come from a wide variety of disciplines. The course will include video lectures, group discussion and brainstorming, homework, simulations, and collaborative projects on real and realistic problems in human health tied directly to the student's own professional interests. Focus will be given to logistic regression methods. Topics include (but not limited to) binary response, multi-category response, count response, model selection and evaluation, exact inference, Bayesian methods for categorical data, and supervised statistical learning methods. This course stresses how the core statistical principles, computing tools, and visualization strategies are used to address complex scientific aims powerfully and efficiently, and to communicate those findings effectively to researchers who may have little or no experience in these methods. Recommended preparation: Advanced undergraduate students, and graduate students in Biostatistics or other quantitative sciences with a background in statistical methods (at least one statistics course, equivalent to the PQHS 431 course experience)
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 515
Course Title: Secondary Analysis of Large Health Care Data Sets
Offered:
Duration: 1 semester
Credits: 3
Purpose: Development of skills in working with the large-scale secondary data bases generated for research, health care administration/billing, or other purposes. Students will become familiar with the content, strength, and limitations of several data bases; with the logistics of obtaining access to data bases; the strengths and limitations of routinely collected variables; basic techniques for preparing and analyzing secondary data bases and how to apply the techniques to initiate and complete empirical analysis. Recommended preparation: PQHS 414 or equivalent; PQHS 431 or PQHS 460 and PQHS 461 (for HSR students).
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 458
Course Title: Statistical Methods for Clinical Trials
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course will focus on special statistical methods and philosophical issues in the design and analysis of clinical trials. The emphasis will be on practically important issues that are typically not covered in standard biostatistics courses. Topics will include: randomization techniques, intent-to-treat analysis, analysis of compliance data, equivalency testing, surrogate endpoints, multiple comparisons, sequential testing, and Bayesian methods. Offered as PQHS 458 and MPHP 458. Prereq: PQHS 432 or MPHP 432.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 467

Course Title: Comparative and Cost Effectiveness Research
Offered:
Duration: 1 semester
Credits: 3
Purpose: Comparative effectiveness research is a cornerstone of healthcare reform. It holds the promise of improved health outcomes and cost containment. This course is presented in a convenient 5-day intensive format in June. There are reading assignments due prior to the 1st session. Module A, Days 1-2: Overview of comparative effectiveness research (CER) from a wide array of perspectives: individual provider, institution, insurer, patient, government, and society. Legal, ethical and social issues, as well as implications for population and public health, including health disparities will also be a component. Module B, Day 3: Introduction to the various methods, and their strengths, weaknesses and limitations. How to read and understand CER papers. Module C, Days 4-5: Cost-Effectiveness Analysis. This will cover costing, cost analysis, clinical decision analysis, quality of life and cost-effectiveness analysis for comparing alternative health care strategies. Trial version of TreeAge software will be used to create and analyze a simple cost-effectiveness model. The full 3-credit course is for taking all 3 modules. Modules A or C can be taken alone for 1 credit. Modules A and B or Modules B and C can be taken together for a total of 2 credits. Module B cannot be taken alone. If taking for 2 or 3 credits, some combination of term paper, project and/or exam will be due 30 days later. Offered as PQHS 467 and MPHP 467
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Required: PhD Courses Descriptions

Total number of course: 2
Total course credits: 2

Course Number: PQHS 444
Course Title: Communicating in Population Health Science Research
Offered:
Duration: 1 semester
Credits: 2
Purpose: Doctoral seminar on writing journal articles to report original research, and preparing and making oral and poster presentations. The end products are ready-to-submit manuscripts and related slide and poster presentations for the required first-year research project in the PhD program in the Department of Epidemiology and Biostatistics. While this course provides a nucleus for this endeavor, students work intensively under the supervision of their research mentors, who guide all stages of the work including providing rigorous editorial support. Seminar sessions are devoted to rigorous peer critiques of every stage of the projects and to in-depth discussions of assigned readings. Recommended preparation: PhD students in the Department of Biostatistics and Epidemiology. Non-PhD EPBI students permitted if space available. Fluency in English writing (e.g., in accord with the Harbrace College Handbook). Prereq: EPBI 431 and EPBI 490. Coreq: EPBI 432.
Course Format: Formal classroom-based course/Mentor
Assessment of Competency: Grades

Course Number: PQHS 501
Course Title: Research Seminar
Offered:

Duration: 1 semester
Credits: 0
Purpose: This seminar series includes faculty and guest-lecturer presentations designed to introduce students to on-going research at the University and elsewhere. Seminars will emphasize the application of methods learned in class, as well as the introduction of new methods and tools useful in research.
Course Format: Classroom seminar
Assessment of Competency: P/F

Electives

Course Number: ACCT 401H
Course Title: Accounting for Healthcare
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course exposes MSM-Healthcare students to ways that accounting information helps managers monitor and improve the performance of organizations. After studying the nature and limitations of accounting information, we explore how financial, cost, tax, and regulatory accounting are used by various stakeholders. From this effort, students become comfortable evaluating accounting recognition, valuation, classification, and disclosure issues that arise in an executive's career. Finally, we study how accounting is a feedback loop that enables managers to assess consequences of past decisions and think about what should be done going forward. Feedback loops, in turn, can give rise to observer effects and/or unpredictable outcomes. Course content contributes to achieving the program goal of strengthening a student's ability to promote positive change in healthcare. Prereq: MSM Healthcare students only.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: BETH 417
Course Title: Introduction to Public Health Ethics
Offered:
Duration: 1 semester
Credits: 3
Purpose: The course will introduce students to theoretical and practical aspects of ethics and public health. This course will help students develop the analytical skills necessary for evaluating of ethical issues in public health policy and public health prevention, treatment, and research. Will include intensive reading and case-based discussions. Evaluation based on class participation, a written exercise and a case analysis. Open to graduate students with permission from instructors
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: BETH 503
Course Title: Research Ethics and Regulation
Offered:
Duration: 1 semester
Credits: 3

Purpose: This course is designed to introduce students to the ethical, policy, and legal issues raised by research involving human subjects. It is intended for law students, post-doctoral trainees in health-related disciplines and other students in relevant fields. Topics include (among others): regulation and monitoring of research; research in third-world nations; research with special populations; stem cell and genetic research; research to combat bioterrorism; scientific misconduct; conflicts of interest; commercialization and intellectual property; and the use of deception and placebos. Course will meet once per week for 2 hours throughout the semester. Grades will be given based on class participation and a series of group projects and individual short writing assignments. Offered as BETH 503, CRSP 603 and LAWS 5225
Assessment of Competency: Grades

Course Number: BETH 422
Course Title: Clinical Ethics: Theory & Practice
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course will focus on both theoretical and practical issues in clinical ethics. Clinical ethics will be distinguished from other areas of bioethics by highlighting distinctive features of the clinical context which must be taken into account in clinical ethics policy and practice. Fundamental moral and political foundations of clinical ethics will be examined, as will the role of bioethical theory and method in the clinical context. Topical issues to be considered may include informed consent; decision capacity; end of life decision making; confidentiality and privacy; the role and function of ethics committees; ethics consultation; the role of the clinical ethicist; decision making in various pediatric settings (from neonatal through adolescent); the role of personal values in professional life (e.g., rights of conscience issues, self disclosure and boundary issues); dealing with the chronically non-adherent patient; ethical issues in organ donation and transplant; health professional-patient communication; medical mistakes; and other ethical issues that emerge in clinical settings.
Assessment of Competency: Grades

Course Number: CRSP 401
Course Title: Introduction to Clinical Research Summer Series
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course is designed to familiarize one with the language and concepts of clinical investigation and statistical computing, as well as provide opportunities for problem-solving, and practical application of the information derived from the lectures. The material is organized along the internal logic of the research process, beginning with mechanisms of choosing a research question and moving into the information needed to design the protocol, implement it, analyze the findings, and draw and disseminate the conclusion(s). Prereq: M.D., R.N., Ph.D., D.D.S., health professionals.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: EECS 494
Course Title: Introduction to Information Theory
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course is intended as an introduction to information and coding theory with emphasis on the

mathematical aspects. It is suitable for advanced undergraduate and graduate students in mathematics, applied mathematics, statistics, physics, computer science and electrical engineering. Course content: Information measures-entropy, relative entropy, mutual information, and their properties. Typical sets and sequences, asymptotic equipartition property, data compression. Channel coding and capacity: channel coding theorem. Differential entropy, Gaussian channel, Shannon-Nyquist theorem. Information theory inequalities (400 level). Additional topics, which may include compressed sensing and elements of quantum information theory. Recommended Preparation: MATH 201 or MATH 307. Offered as MATH 394, EECS 394, MATH 494 and EECS 494.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: HSMC 412
Course Title: Lean Services Operations
Offered:
Duration: 1 semester
Credits: 3
Purpose: The course will be delivered over four modules: 1) Service Process Blueprints, 2) Managing Capacity in Service Systems, 3) Mapping the Value Stream (current and future state), and 4) Inventory Management in Service Systems. The topics considered are viewed in the context of healthcare management, financial services, insurance firms, call centers, back-office operations, and other applications. Through these topics, the participants will be trained in tools that help them understand customers' expectations and needs and to identify service system characteristics that can meet these needs. We will learn how to identify errors in service and troubleshoot these problems by identifying the root causes of errors. Subsequently, we will discuss how one can modify the product or service design so as to prevent defects from occurring. Finally, we will establish performance metrics that help evaluate the effectiveness of the Lean system in place. These efforts will result to improved quality. This course is not oriented toward specialists in service management. Its goal is to introduce you to the environments and help you appreciate the problems that operations managers are confronted with. Then, we will typically discuss some system specifics and emphasize the principles and issues that play key role in their management. Offered as HSMC 412 and OPMT 412.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: HSMC 420
Course Title: Health Finance
Offered:
Duration: 1 semester
Credits: 3
Purpose: Exploration of economic, medical, financial and payment factors in the U.S. healthcare system sets the framework for the study of decisions by providers, insurers, and purchasers in this course. The mix of students from various programs and professions allows wide discussion from multiple viewpoints. Offered as BAFI 420 and HSMC 420. Prereq: ACCT 401 or ACCT 401H
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: HSMC 421
Course Title: Health Economics and Strategy
Offered:

Duration: 1 semester
Credits: 3
Purpose: This course has evolved from a theory-oriented emphasis to a course that utilizes economic principles to explore such issues as health care pricing, anti-trust enforcement and hospital mergers, choices in adoption of managed care contracts by physician groups, and the like. Instruction style and in-class group project focus on making strategic decisions. The course is directed for a general audience, not just for students and concentration in health systems management. Offered as ECON 421, HSMC 421, and MPHP 421.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: HSMC 456
Course Title: Health Policy and Management Decisions
Offered:
Duration: 1 semester
Credits: 3
Purpose: This seminar course combines broad health care policy issue analysis with study of the implications for specific management decisions in organizations. This course is intended as an applied, practical course where the policy context is made relevant to the individual manager. Offered as HSMC 456 and MPHP 456.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: IBMS 500
Course Title: On Being a Professional Scientist: The Responsible Conduct of Research
Offered:
Duration: 1 semester
Credits: 1
Purpose: The goal of this course is to provide graduate students with an opportunity to think through their professional ethical commitments before they are tested, on the basis of the scientific community's accumulated experience with the issues. Students will be brought up to date on the current state of professional policy and federal regulation in this area, and, through case studies, will discuss practical strategies for preventing and resolving ethical problems in their own work. The course is designed to meet the requirements for "instruction about responsible conduct in research" for BSTP and MSTP students supported through NIH/ADAMHA institutional training grant programs at Case. Attendance is required.
Assessment of Competency: Grades

Course Number: NEUR 478
Course Title: Computational Neuroscience
Offered:
Duration: 1 semester
Credits: 3
Purpose: Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended

preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 457
Course Title: Current Issues in Genetic Epidemiology: Design and Analysis of Sequencing Studies.
Offered:
Duration: 1 semester
Credits: 3
Purpose: Statistical methods to deal with the opportunities and challenges in Genetic Epidemiology brought about by modern sequencing technology. Some computational issues that arise in the analysis of large sequence data sets will be discussed. The course includes hands-on experience in the analysis of large sequence data sets, in a collaborative setting. Prereq: PQHS 451 and PQHS 452.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 468
Course Title: The Continual Improvement of Healthcare: An Interdisciplinary Course
Offered:
Duration: 1 semester
Credits: 3
Purpose: This course prepares students to be members of interprofessional teams to engage in the continual improvement in health care. The focus is on working together for the benefit of patients and communities to enhance quality and safety. Offered as PQHS 468, MPHP 468, NURS 468.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: PQHS 651
Course Title: MS Thesis
Offered:
Duration: 1-2 semesters
Credits: 1-6 units per semester
Purpose: Master's thesis course
Assessment of Competency:

Course Number: SYBB 459
Course Title: Bioinformatics for Systems Biology
Offered:
Duration: 1 semester
Credits: 3
Purpose: Description of omic data (biological sequences, gene expression, protein-protein interactions, protein-DNA interactions, protein expression, metabolomics, biological ontologies), regulatory network inference, topology of regulatory networks, computational inference of protein-protein interactions, protein interaction databases, topology of protein interaction networks, module and protein complex discovery, network alignment and mining, computational models for network evolution, network-based functional

inference, metabolic pathway databases, topology of metabolic pathways, flux models for analysis of metabolic networks, network integration, inference of domain-domain interactions, signaling pathway inference from protein interaction networks, network models and algorithms for disease gene identification, identification of dysregulated subnetworks network-based disease classification. Offered as EECS 459 and SYBB 459.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Course Number: SYBB 421/ EBME 473
Course Title: Fundamentals of Clinical Information Systems.
Offered:
Duration: 1 semester
Credits: 3
Purpose: Technology has played a significant role in the evolution of medical science and treatment. While we often think about progress in terms of the practical application of, say, imaging to the diagnosis and monitoring of disease, technology is increasingly expected to improve the organization and delivery of healthcare services, too. Information technology plays a key role in the transformation of administrative support systems (finance and administration), clinical information systems (information to support patient care), and decision support systems (managerial decision-making). This introductory graduate course provides the student with the opportunity to gain insight and situational experience with clinical information systems (CIS). Often considered synonymous with electronic medical records, the "art" of CIS more fundamentally examines the effective use of data and information technology to assist in the migration away from paper-based systems and improve organizational performance. In this course, we examine clinical information systems in the context of (A) operational and strategic information needs, (B) information technology and analytic tools for workflow design, and (C) subsequent implementation of clinical information systems in patient care. Legal and ethical issues are explored. The student learns the process of "plan, design, implement" through hands-on applications to select CIS problems, while at the same time gaining insights and understanding of the impacts placed on patients and health care providers. Offered as EBME 473, IIME 473 and SYBB 421.
Course Format: Formal classroom-based course
Assessment of Competency: Grades

Faculty Trainers (Confirmed and Potential Faculty Members)

Alan Dowling, PhD, MCS, MS
David Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI
Satya Sahoo, PhD
Colin Drummond, PhD, MBA
Mendel Singer, PhD, MPH
Rong Xu, PhD
William Bush, PhD
Dana Crawford, PhD
Mehmet Koyuturk, PhD
Jing Li, PhD
Jill S. Barnholtz-Sloan, PhD

December 7, 2017

To: Satya S. Sahoo, Ph.D.

From: Kathleen C. Blazar, M.S.L.S.

RE: MS/PHD Degree Program in Biomedical and Health Informatics

As per the Library Content and Resource Review Process for New Programs and Degrees,

I am providing the following information:

Adequacy of Current Content Resources

CWRU Resources – there are 131 items listed using the MeSH term, MEDICAL INFORMATICS, in the CWRU online catalog with publication dates of 2010 or newer – attached.

In the category of MEDICAL INFORMATICS in the Journal Citation Reports of the Web of Science, there are 24 journals listed. There are 5 to which CWRU does not have current access - attached. The recurring, annual cost for these titles is approximately $6764.00.

I have identified two book series from IGI Global. The information is attached in the same file as the journals. The initial costs for these two series is $7680.00. The recurring, annual cost is approximately $2000.00.

Additional books from other publishers may be added as they are published. I would advocate allowing a minimum of $2500.00 annually for these titles.

All these costs are subject to inflation.

Since you indicated to me that most of your online searching is from PubMed, there are no anticipated costs for databases at this time.

Should your faculty and students need additional resources for data management, systematic reviews, or other information, these resources and their costs will need to be assessed in the future. If these future endeavors will involve more library staff, additional funds will be needed for professional staff.

The Health Sciences Library does not have an adequate operating budget for these additional costs. All of our current books are purchased with proceeds from restricted endowments.

In the past, there was an endowment in the Epi/Bio department called the Dingle fund. It was for the support of the Epi/Bio departmental library named the Dingle library. I do not know what has happened to these funds, but I have seen a plaque outside the former library indicating that it is now a café. Perhaps there are still some resources available through this endowment.

The current costs now are for the journals at $6764 and for the book series at $7680 for a total of $14,444.

The recurring costs are for the journals at $6764, for the book series at $2000 and for the additional books at $2500 for a total of $11,264.

Appendix - Sample Template CWRU Libraries Resource and Service Assessment Report Regarding New or Revised Programs and Degrees

Assessment for:

Program level ☒ **graduate** ☐ **undergraduate**

Degree ☐ **Major** ☐ **Minor**

Title of proposed program or degree: Biomedical and Health Informatics

Sponsor (School/College or Department): School of Medicine

[For interdisciplinary proposals, list all schools/College affiliated with the proposal, and the libraries covered under this report.]

Report prepared by: [Librarian]: Kathleen C. Blazar, MSLS **Date of Report:** Dec. 7, 2017

ADEQUACY OF SERVICES

- **Current library staff expertise (depth and availability) in the area of the new program or degree**:
  Adequate until more research and data management occurs in the future
- **Ability of the library to accommodate funder data management requirements (e.g., access to essential technology or media) to support the program or degree**:
  Adequate until more research and data management occurs in the future

ADEQUACY OF CURRENT CONTENT AND ABILITY TO SUPPORT FUTURE NEEDS

- **General strength of the current collection to accommodate new program needs, including major available content resources currently available**:
  See attachment
- **Minimum additional required resources required to accommodate the new program needs**:

Content Category	Adequacy of Current Content Resources *	Additional Resources Required (list specific titles whenever possible)	One-time Cost to Fill Content Gaps	Recurring Cost to Fill Gaps for the next 5 years (including inflation)
Books: ***Essential***	See attachment	See attachment	$14,444 for everything	$11,264 for everything
Books: ***Supplemental***				
Journals: ***Essential***				
Journals: ***Supplemental***				
Databases: ***Essential***				
Databases: ***Supplemental***				
Media: ***Essential***				
Media: ***Supplemental***				

* "Current content" includes content available through OhioLINK.

Journal Data Filtered By: Selected JCR Year: 2016 Selected Editions: SCIE,SSCI Selected Categories: 'MEDICAL INFORMATICS' (WoS)						
Rank	Full Journal Title	Total Cites	Journal Impact Factor	Eigenfactor Score		Annual subscription - approximates
1	JOURNAL OF MEDICAL INTERNET RESEARCH	8,927	5.175	0.02434	Open Access in PubMed Central	
2	JMIR mHealth and uHealth	825	4.636	0.00251	not currently indexed in PubMed - may be Open Access	
3	STATISTICAL METHODS IN MEDICAL RESEARCH	3,128	3.953	0.00844	OhioLINK Electronic Journal Center	
4	JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	7,655	3.698	0.01723	at PMC with 12 month embargo	$1,048
5	IEEE Journal of Biomedical and Health Informatics	1,933	3.451	0.00584	IEEE Explore	
6	INTERNATIONAL JOURNAL OF MEDICAL INFORMATICS	4,069	3.21	0.00552	OhioLINK Electronic Journal Center	
7	Health Informatics Journal	536	3.021	0.0011	OhioLINK Electronic Journal Center	
8	JOURNAL OF BIOMEDICAL INFORMATICS	4,886	2.753	0.00815	OhioLINK Electronic Journal Center	
9	COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE	4,565	2.503	0.00728	OhioLINK Electronic Journal Center, ScienceDirect & ClinicalKey Flex	
10	JOURNAL OF MEDICAL SYSTEMS	3,239	2.456	0.00528	OhioLINK Electronic Journal Center	
11	MEDICAL DECISION MAKING	4,282	2.362	0.00952	OhioLINK Electronic Journal Center	
12	ARTIFICIAL INTELLIGENCE IN MEDICINE	1,807	2.009	0.00226	OhioLINK Electronic Journal Center, ScienceDirect & ClinicalKey Flex	
13	MEDICAL & BIOLOGICAL ENGINEERING & COMPUTING	5,088	1.916	0.00504	OhioLINK Electronic Journal Center	
14	STATISTICS IN MEDICINE	22,008	1.861	0.033	OhioLINK Electronic Journal Center	
15	METHODS OF INFORMATION IN MEDICINE	1,506	1.772	0.00202	in print at Allen 1962 - 1997	$1,107
16	BMC Medical Informatics and Decision Making	2,448	1.643	0.00724	Open Access - a variety of sources - PMC is one	
17	Applied Clinical Informatics	402	1.496	0.00151	at PMC with 12 month embargo	$1,164
18	Informatics for Health & Social Care	194	1.381	0.00038	at EBSCO journals with 18 month embargo	$2,485
19	CIN-COMPUTERS INFORMATICS NURSING	701	1.301	0.00121	available from OVID LWW Nursing	
20	JOURNAL OF EVALUATION IN CLINICAL PRACTICE	2,795	1.25	0.00542	OhioLINK Electronic Journal Center	

Rank	Full Journal Title	Total Cites	Journal Impact Factor	Eigenfactor Score		Annual subscription - approximates
21	Biomedical Engineering-Biomedizinische Technik	803	0.915	0.0015	in print at HCL 1972 - 1996	$960
22	INTERNATIONAL JOURNAL OF TECHNOLOGY ASSESSMENT IN HEALTH CARE	1,821	0.912	0.00261	OhioLINK Electronic Journal Center	
23	Health Information Management Journal	187	0.778	0.00024	available from Sage	
24	Therapeutic Innovation & Regulatory Science	143	0.442	0.00081	available from ProQuest Nursing & Allied Health	
					Total annual cost	$6,764.00

Book Series from IGI Global		one time cost	annual	
Advances in Healthcare Information Systems and Administration (AHISA): 32 Volumes (): Anastasius Moumtzoglou: Book Series | IGI Global		$4,835.00	$1,000.00	
	https://www.igi-global.com/book-series/advances-healthcare-information-systems-administration/37156			
Advances in Bioinformatics and Biomedical Engineering (ABBE): 20 Volumes (): Ahmad Taher Azar: Book Series | IGI Global		$2,845.00	$1,000.00	
	https://www.igi-global.com/book-series/advances-bioinformatics-biomedical-engineering/73671			
		$7,680.00	$2,000.00	

Medical Informatics Resources at CWRU

(2010 and newer)

http://catalog.case.edu/

Record 1 of 131
AUTHOR Gupta, Ashish.
TITLE Advances in Healthcare Informatics and Analytics.
IMPRINT Cham : Springer International Publishing, 2016.

Record 2 of 131
TITLE Basic engineering for medics and biologists : an ESEM primer / edited by T. Clive Lee and Peter F. Niederer.
IMPRINT Amsterdam : IOS Press, 2010.

Record 3 of 131
TITLE Bioinformatics in human health and heredity / edited by R. Chakraborty, C.R. Rao, P.K. Sen.
IMPRINT Amsterdam ; London : Elsevier, 2012.

Record 4 of 131
TITLE Brain informatics [electronic resource]
IMPRINT Berlin: Springer, [2014]-

Record 5 of 131
AUTHOR Pols, J. (Jeannette), 1966- author.
TITLE Care at a distance : on the closeness of technology / Jeannette Pols.
IMPRINT Amsterdam : Amsterdam University Press, [2012]
IMPRINT ©2012.

Record 6 of 131
AUTHOR Pols, J. (Jeannette), 1966- author.
TITLE Care at a distance : on the closeness of technology / Jeannette Pols.
IMPRINT Amsterdam : Amsterdam University Press, [2012]
IMPRINT ©2012.

Record 7 of 131
AUTHOR Malec, Brian T., author.
TITLE Careers in health information technology / Brian T. Malec, PhD.
IMPRINT New York : Springer Publishing Company, 2015.
IMPRINT ©2015.

Record 8 of 131
TITLE Champs informatique medicale, e-Santé. English.
TITLE Medical informatics, e-Health : fundamentals and applications / Alain Venot, Anita Burgun, Catherine Quantin, editors.
IMPRINT Paris : Springer, [2014]
IMPRINT ©2014.

Record 9 of 131
TITLE Clinical data as the basic staple of health learning : creating and protecting a public good : workshop summary / Roundtable on Value & Science-Driven Health Care ; Claudia Grossmann [and others] ; Institute of Medicine of the National Academies.
IMPRINT Washington, D.C. : National Academies Press, 2010.

Record 10 of 131
TITLE Clinical research informatics / Rachel L. Richesson, James E. Andrews, editors.
IMPRINT London ; New York : Springer, [2012]
IMPRINT ©2012.

Record 11 of 131
TITLE Cognitive informatics in health and biomedicine : case studies on critical care, complexity and errors / Vimla L. Patel, David R. Kaufman, Trevor Cohen, editors.
IMPRINT London ; New York : Springer, [2014]
IMPRINT ©2014.

Record 12 of 131
TITLE Cognitive search : evolution, algorithms, and the brain / edited by Peter M. Todd, Thomas T. Hills, and Trevor W. Robbins.
IMPRINT Cambridge, MA : MIT Press, ©2012.

Record 13 of 131
TITLE Comprehensive biomarker discovery and validation for clinical application / edited by Péter Horvatovich and Rainer Bischoff.
IMPRINT Cambridge : Royal Society of Chemistry, 2013.

Record 14 of 131
TITLE Comprehensive biomarker discovery and validation for clinical application / edited by Péter Horvatovich and Rainer Bischoff.
IMPRINT Cambridge : Royal Society of Chemistry, 2013.

Record 15 of 131
AUTHOR Lesselroth, Blake J.
TITLE Data visualization strategies for the electronic health record / Blake J. Lesselroth and David S. Pieczkiewicz.
IMPRINT Hauppauge, N.Y. : Nova Science Publisher's, Incorporated, [2011]
IMPRINT ©2011.

Record 16 of 131
TITLE Developments in healthcare information systems and technologies : models and methods / [edited by] Joseph Tan.
IMPRINT Hershey [Pa.] : Medical Information Science Reference, c2011.

Record 17 of 131
AUTHOR Barkhausen, Jörg, author.
TITLE Digitale Tomosynthese der Brust. English.
TITLE Digital breast tomosynthesis : technique and cases / Jörg Barkhausen, Achim Rody, Fritz K.W. Schäfer ; translator, Terry C. Telger ; illustrator, Karin Baum.
IMPRINT Stuttgart ; New York : Thieme, [2016]
IMPRINT ©2016.

Record 18 of 131
TITLE E-healthcare systems and wireless communications : current and future challenges / Mohamed K. Watfa, [editor]
IMPRINT Hershey, PA : Medical Information Science Reference, [2012]
IMPRINT ©2012.

Record 19 of 131
TITLE EHealth, care and quality of life / Antonio Gaddi, Fabio Capello, Marco Manca, editors ; forewords by Sergio Bertolucci and Gianfranco Gensini.
IMPRINT Milan : Springer, 2014.

Record 20 of 131
AUTHOR Sinha, Pradeep K. (Pradeep Kumar), author.
TITLE Electronic health record : standards, coding systems, frameworks, and infrastructures / Pradeep Sinha, Gaur Sunder, Prashant Bendale, Manisha Mantri, Atreya Dande.
IMPRINT Piscataway, NJ : IEEE Press ; Hoboken, New Jersey : John Wiley & Sons, Inc., [2013]
IMPRINT ©2013.

Record 21 of 131
AUTHOR ITCH (Conference) (2013 : Victoria, B.C.)
TITLE Enabling health and healthcare through ICT : available, tailored, and closer / edited by Karen L. Courtney, Omid Shabestari, and Alex Kuo.
IMPRINT Amsterdam : IOS Press, 2013.

Record 22 of 131
AUTHOR Balgrosky, Jean A., author.
TITLE Essentials of health information systems and technology / Jean A. Balgrosky, Lecturer, Field School of Public Health, University of California at Los Angeles, Los Angeles, California, Founder, Bootstrap Incubation, LLC, Solana Beach, California, Chief Information Officer, MD Revolution, La Jolla, California.
IMPRINT Burlington, MA : Jones & Bartlett Learning, [2015]

Record 23 of 131
TITLE External beam therapy / edited by Peter Hoskin.
IMPRINT Oxford : Oxford University Press, 2012.

Record 24 of 131
TITLE Handbook of research on patient safety and quality care through health informatics / Vaughan Michell, University of Reading, UK, Deborah J. Rosenorn-Lanng, Royal Berkshire NHS Foundation Trust, UK, Stephen R. Gulliver, University of Reading, UK, Wendy Currie, Audencia, Nantes, School of Management, France.
IMPRINT Hershey, PA : Medical Information Science Reference, an imprint of IGI Global, [2014]
IMPRINT ©2014.

Record 25 of 131
AUTHOR Australian National Health Informatics Conference (20th : 2012 : Sydney, N.S.W.)

TITLE Health Informatics : building a healthcare future through trusted information ; selected papers from the 20th Australian National Health Informatics Conference (HIC 2012) / edited by Anthony J. Maeder and Fernando J. Martin-Sanchez.
IMPRINT Amsterdam : IOS Press Inc., ©2012.

Record 26 of 131
AUTHOR National Health Informatics Conference (2013 : Adelaide, Australia)
TITLE Health informatics : digital health service delivery, the future is now! : selected papers from the 21st Australian National Health Informatics Conference (HIC 2013)
IMPRINT Amsterdam : IOS Press, 2013.
IMPRINT ©2013.

Record 27 of 131
TITLE Health informatics (Saint Louis, Mo.)
TITLE Health informatics : an interprofessional approach / [edited by] Ramona Nelson, PhD, RN-BC, ANEF, FAAN, Nancy Staggers, PhD, RN, FAAN.
IMPRINT St. Louis, Mo. : Elsevier Mosby, [2014]
CALL # W 26.5 H434he 2014.

Record 28 of 131
TITLE Health information management : concepts, principles, and practice / Kathleen M. LaTour, Shirley Eichenwald, Pamela Oachs, editors.
IMPRINT Chicago, Ill. : AHIMA, ©2013.

Record 29 of 131
TITLE Health information science and systems [electronic resource]
IMPRINT London : BioMed Central, 2013-

Record 30 of 131
TITLE Health systems (Basingstoke, England)
TITLE Health systems [electronic resource] / the OR Society.
IMPRINT Houndmills, Basingstoke, Hampshire, UK : Palgrave Macmillan, [2012]-
IMPRINT 2018- : London : Taylor & Francis.

Record 31 of 131
AUTHOR Kudyba, Stephan, 1963- author.
TITLE Healthcare informatics : improving efficiency through technology, analytics, and management / Stephan P. Kudyba.
IMPRINT Boca Raton : CRC Press, Taylor & Francis Group, [2016]
IMPRINT ©2016.

Record 32 of 131
AUTHOR HealthGrid 2010 (2010 : Orsay, France)
TITLE Healthgrid applications and core technologies : proceedings of HealthGrid 2010 / Tony Solomonides [and others]
IMPRINT Amsterdam : IOS Press, ©2010.

Record 33 of 131
AUTHOR HealthGrid 2012 (2012 : Amsterdam, Netherlands)

TITLE HealthGrid applications and technologies meet science gateways for life sciences / edited by Sandra Gesing [and others]
IMPRINT Amsterdam ; Washington, D.C. : IOS Press, ©2012.

Record 34 of 131
TITLE ICTs and the health sector : towards smarter health and wellness models.
IMPRINT Paris : OECD, [2013]

Record 35 of 131
AUTHOR Sewell, Jeanne P., author.
TITLE Informatics and nursing : opportunities and challenges / Jeanne Sewell, MSN, RN-BC, Associate Professor, School of Nursing, College of Health Sciences, Georgia College & State University, Milledgeville, Georgia.
IMPRINT Philadelphia : Wolters Kluwer, [2016]

Record 36 of 131
TITLE Informatics in oral medicine : advanced techniques in clinical and diagnostic technologies / [edited by] Andriani Daskalaki.
IMPRINT Hershey [Pa.] : Medical Information Science Reference, c2010.

Record 37 of 131
TITLE Informatics needs and challenges in cancer research : workshop summary / Sharyl J. Nass and Theresa Wizemann, rapporteurs ; National Cancer Policy Forum, Board on Health Care Services, Institute of Medicine of the National Academies.
IMPRINT Washington, District of Columbia : National Academies Press, [2012]
IMPRINT ©2012.

Record 38 of 131
AUTHOR Breslau, Joshua, author.
TITLE Information and communication technologies in behavioral health : a literature review with recommendations for the Air Force / Joshua Breslau, Charles C. Engel.
IMPRINT Santa Monica, Calif. : RAND Corporation, [2015]

Record 39 of 131
TITLE Information technology for patient empowerment in healthcare / edited by Maria Adela Grando, Ronen Rozenblum, David W. Bates.
IMPRINT Berlin ; Boston : Walter de Gruyter GmbH & Co. KG, [2015]

Record 40 of 131
AUTHOR Burke, Lillian.
TITLE Information technology for the health professions / Lillian Burke, Barbara Weill.
IMPRINT Upper Saddle River, NJ : Pearson Education, c2013.

Record 41 of 131
TITLE JMIR medical education [electronic resource]
IMPRINT Toronto, ON : JMIR Publications, [2015]-

Record 42 of 131
TITLE JMIR medical informatics [electronic resource]

IMPRINT Toronto : JMIR Publications, [2013]-

Record 43 of 131
TITLE JMIR mHealth and uHealth [electronic resource]
IMPRINT Toronto : JMIR Publications Inc., [2013]-

Record 44 of 131
TITLE JMIR serious games [electronic resource]
IMPRINT Toronto : JMIR Publications, [2013]-

Record 45 of 131
TITLE Knowledge based bioinformatics : from analysis to interpretation / edited by Gil Alterovitz, Marco Ramoni.
IMPRINT Chichester, West Sussex, U.K. : John Wiley & Sons, 2010.

Record 46 of 131
AUTHOR Cleophas, Ton J. M., author.
TITLE Machine learning in medicine-- Cookbook two / Ton J. Cleophas, Aeilko H. Zwinderman.
IMPRINT Cham : Springer, 2014.

Record 47 of 131
AUTHOR Smith, Philip A.
TITLE Making computerized provider order entry work / Philip A. Smith.
IMPRINT London ; New York : Springer, [2013]
IMPRINT ©2013.

Record 48 of 131
TITLE Medical and care compunetics. 6 / edited by Lodewijk Bos [and others]
IMPRINT Amsterdam : IOS Press, 2010.

Record 49 of 131
TITLE Methods in biomedical informatics [electronic resource] : a pragmatic approach / edited by Indra Neil Sarkar.
IMPRINT London : Academic Press, [2014]
IMPRINT ©2014.
CALL # QH324.2.

Record 50 of 131
AUTHOR Shatkay, Hagit.
TITLE Mining the biomedical literature / Hagit Shatkay and Mark Craven.
IMPRINT Cambridge, Mass. : MIT Press, ©2012.

Record 51 of 131
AUTHOR November, Joseph Adam, 1975-
TITLE Biomedical computing : digitizing life in the United States / Joseph November.
IMPRINT Baltimore : Johns Hopkins University Press, 2012.

Record 52 of 131
AUTHOR BIOCOMP'09 (2009 : Las Vegas, Nev.)
TITLE Advances in computational biology / Hamid R. Arabnia, editor.
IMPRINT New York ; London : Springer, 2010.

Record 53 of 131
AUTHOR European Federation for Medical Informatics. Special Topic Conference (11th : 2011 : Laško, Slovenia)
TITLE E-health across borders without boundaries : proceedings of the EFMI Special Topic Conference, 14-15 April 2011, Laško, Slovenia = E-salus trans confinia sine finibus / edited by Lăcrămioara Stoicu-Tivadar [and others]
IMPRINT Amsterdam : IOS Press, ©2011.

Record 54 of 131
TITLE Evolving Ambient Intelligence : AmI 2013 Workshops, Dublin, Ireland, December 3-5, 2013, revised selected papers / Michael J. O'Gracy [and 6 others], (eds.)
IMPRINT Cham : Springer, 2013.
IMPRINT ©2013.

Record 55 of 131
AUTHOR International Conference on Informatics, Management, and Technology in Healthcare (2013 : Athens, Greece)
TITLE Informatics, management and technology in healthcare / edited by John Mantas and Arie Hasman.
IMPRINT Amsterdam : IOS Press, 2013.

Record 56 of 131
AUTHOR European Federation for Medical Informatics. Special Topic Conference (12th : 2012 : Moscow, Russia)
TITLE Large scale projects in eHealth : partnership in modernization : proceedings of the EFMI Special Topic Conference, 18-20 April 2012, Moscow, Russia / edited by Bernd Blobel, Rolf Engelbrecht, and Michael A. Shifrin.
IMPRINT Amsterdam ; Washington, DC : IOS Press, [2012]
IMPRINT ©2012.

Record 57 of 131
AUTHOR MEDINFO (13th : 2010 : Cape Town, South Africa), author.
TITLE MEDINFO 2010 : proceedings of the 13th World Congress on Medical Informatics / edited by C. Safran, S. Reti and H.F. Marin.
IMPRINT Amsterdam : IOS Press, [2010]
IMPRINT ©2010.

Record 58 of 131
TITLE Patient safety informatics : adverse drug events, human factors, and IT tools for patient medication safety / edited by Vassilis Koutkias ... [et al.]
IMPRINT Amsterdam ; Washington, DC : IOS Press, c2011.

Record 59 of 131
AUTHOR International Conference on Wearable Micro and Nano Technologies for Personalized Health (12th : 2015 : Västerås, Sweden)
TITLE pHealth 2015 : Proceedings of the 12th International Conference on Wearable Micro and Nano Technologies for Personalized Health; 2-4 June 2015, Västerås, Sweden / edited by Bernd Blobel, Maria Lindén and Mobyen Uddin Ahmed.
IMPRINT Amsterdam : IOS Press, 2015.
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TITLE Quality of life through quality of information : proceedings of MIE2012 / edited by John Mantas, Stig Kjaer Andersen, Maria Cristina Mazzoleni, Bernd Blobel, Silvana Quaglini, and Anne Moen.
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TITLE Medicine meets virtual reality 19 : NextMed / edited by James D. Westwood [and others]
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[edited by] Patricia P. Sengstack, DNP, RN-BC, CPHIMS ; Charles M. Boicey, MS, RN-BC, PMP, CLNC, CPHIMS.
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TITLE PHealth 2013 : proceedings of the 10th International Conference on Wearable Micro and Nano Technologies for Personalized Health, June 26-28, 2013, Tallin, Estonia / edited by Bernd Blobel, Peter Pharow adn Liisa Parv.
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2017 – 2018

Department of Population & Quantitative Health Sciences

Student Handbook

PhD in Epidemiology & Biostatistics

SCHOOL OF MEDICINE
CASE WESTERN RESERVE UNIVERSITY

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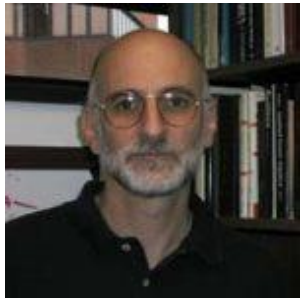
Welcome from the Graduate Program Director

Welcome to the Doctoral Program in Epidemiology and Biostatistics of the Department of Population and Quantitative Health Sciences at Case Western Reserve University, School of Medicine. This handbook is a general summary of academic program information for Ph.D. students and should be used in consultation with an academic adviser. Students should also review the Case Western Reserve University's Student Handbook that describes the University requirements for graduation (http://case.edu/gradstudies/) The Ph.D. Program in Epidemiology and Biostatistics within the Department has expectations and requirements for graduation above and in addition to those of the University. If, after reading this Handbook and the University's Handbook, a student is uncertain about a requirement or discovers a conflict in requirements, then the student should bring this to the attention of her/his academic adviser. Any variation in policy or expectations will be documented and notification will be sent to impacted students.

I look forward to your time in program and your development into independent scientists!

Sincerely,

Scott Williams, PhD
Graduate Program Director



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Mission, Values and General Orientation

The mission of the Doctoral Program in Epidemiology and Biostatistics is to prepare students for an active, fulfilling, and lifelong research career, having significant impact on human health and based on the concepts and tools of population and quantitative health sciences.

The program draws on the core disciplines of epidemiology and biostatistics, broadly defined, but may also include a wide range of other academic areas, ranging from human genetics to health policy. As part of their training students will develop the knowledge, skills, and competencies necessary to be leading researchers in areas that provide improved understanding of how to advance public health. Through challenging coursework and research opportunities, both independent and collaborative, students will develop a thorough understanding of the multiple determinants of population health outcomes, the individual and structural factors that may lead to disparities in those outcomes, and the way in which specific policies and interventions can influence the nature and impacts of population health determinants. A key aspect of the program is to train students to define important, unanswered questions and design appropriate strategies to solve our pressing health problems, locally, nationally and globally. In addition, the program in Epidemiology and Biostatistics is committed to developing the skills necessary for lifelong learning as we recognize this as being key to continued success.

The training program is designed to train students to address critical research questions to advance human and population health utilizing a wide variety of research tools and trans-disciplinary collaborations. This is distinct from historical training in a single discipline (e.g., statistics or genetics) or expertise in a small number of technical skills.

As part of their training in our program, students will master the rigorous scientific and analytic methods necessary to be at the forefront of efforts to not only describe, but effectively evaluate and improve population health. This mastery will include aspects of study design and advanced analyses of complex data. It is expected that students will develop an understanding of the complexity of solving health problems and how to draw on multiple areas of expertise to address them.

An integral part of our graduate education is the participation in student- and faculty-led seminars that provide an ongoing mechanism for keeping abreast of current literature, identifying important areas of research and collaborative

opportunities, and providing an open forum in which to discuss timely research questions. The seminars also serve to open dialogues among department members with the goal of stimulating new ways of thinking about health. Through our rigorous coursework, exposure to discussion of important health related issues, and their research experiences during graduate training, students will develop into junior colleagues of the faculty who through their training will develop the capacity to work independently. The department operates within a strong interdisciplinary framework involving faculty in the department, the School of Medicine, and across the entire university, as well as leaders in health care institutions and health-oriented organizations and agencies throughout the world.

The degree of Doctor of Philosophy is awarded in recognition of in-depth knowledge in a major field and comprehensive understanding of related subjects together with a demonstration of ability to perform independent investigation and to communicate the results of such investigation in a scholarly dissertation. Our goal is to produce leaders of the next generation of interdisciplinary health scientists. To prepare them, we train our students through courses and research to use analytic methods to understand biological, epidemiological, social and behavioral, and health service aspects of the population's health: ultimately to reduce and/or prevent morbidity and early mortality.

Admission

Graduates from accredited colleges and universities will be considered for admission to the department. All applicants must satisfy both CWRU School of Graduate Studies and departmental requirements for graduate admission. Students with broad backgrounds will be considered for admission, including but not limited to those who have studied biology, mathematics, statistics, epidemiology, and public and population health and health policy.

Students who receive financial support for their graduate training are expected to commit themselves full-time to the tasks necessary for both the completion of their degree and their professional development. For example, students are expected to work on their research activities, skills, knowledge, and professional development during the entirety of the program, including when classes are not in session. Fellowship, stipend, and other financial aid offers are made on an annual basis and will be renewed based upon performance (see additional discussion in Maintenance of Good Standing and Student Progress Reports) and availability of funds.

Professional Commitment and Culture

All students in the program are expected to maintain appropriate professional standards. This includes regular and on-time attendance at classes and seminars and participation in a variety of professional development activities. Strong involvement in research, service, and professional social activities is encouraged, with an emphasis on developing exceptional research credentials, independent critical thinking, and problem solving.

Students must recognize that enrollment in this rigorous graduate program may place demands on their time on evenings and weekends, and may prohibit them from participating in additional time-consuming activities. Pursuit of a doctoral degree takes time and commitment beyond that spent in the classroom, and students are expected to display maturity of character, interest in and enthusiasm for the practice of research, excellence in development of interpersonal communication, and high professional commitment to the program of study. The highest degree of integrity, honesty, and courtesy, all important professional values, is expected throughout their courses of study. Students are expected to contribute to their own professional development by taking initiative in organizing research seminars, leading journal clubs, organizing student-faculty retreats, and promoting other activities that enhance the stature of the program.

Planned Program of Study

In adherence with the School of Graduate Studies' policy, during the first semester of study, all students are responsible for ensuring that they have a Planned Program of Study (PPOS) on file, submitted through the Student Information System (SIS). The PPOS consists of all courses a student plans to take to meet the requirements for his/her degree. This includes all required coursework, electives, and seminars (even if they are for zero credit hours); however, the PPOS need not include registration of 701 credits. The PPOS must be approved by the student's academic adviser and should be submitted by October 15 of the first semester of study toward the degree specified, and updated, if necessary, by October 1 of each subsequent year in which the student is registered. Students are responsible for discussing their past background and future career goals with their academic adviser so that the best possible plan is developed. In the first year of study each student will be assigned an academic advisor by the department. After the student has chosen a research mentor (by the end of the first year of study) that faculty member will become the academic advisor. A complete step by step guide on how to submit a PPOS can be found through the University Registrar's webpage.

Student Responsibility

Students should consult with their academic adviser in their first year to develop their planned program of study (PPOS) to carry out their work towards the PhD. Nevertheless, it is solely the student's responsibility to become acquainted with and adhere to departmental and University rules, regulations, and administrative procedures governing graduate study, including the University's Standards of Conduct detailed in the Case General Bulletin, Graduate Student Handbook, School of Graduate Studies Statement of Ethics, University Guidelines on Authorship and Policy on Copyright, and the University Policy on Academic Integrity.

It is expected that students in the PhD program will take full responsibility for their academic progress. This will involve developing increasing independence as young scientists, who consult with their mentors and committee members. The gaining of independence during Ph.D. training represents a critical transition of students into full members of the scientific community.

It is also expected that all students in the PhD program will maintain the highest level of academic integrity. The expected standards of academic integrity can be found at: https://students.case.edu/policy/integrity.html

Academic Advisor

Upon acceptance into the PhD program, each student will be assigned an academic adviser with whom to confer about academic plans. The advisor will help guide the student through department and graduate school regulations, assist him/her in designing a PPOS, and track progress through the first year of the program. During this first year of study this faculty member will be key to ensuring that students make adequate progress in the required Core program of the department. In most cases, the initial academic advisor will be the Graduate Program Director. By the end of the first academic year, each student will select a research advisor who will serve as their academic advisor for the rest of their time in the program. Also, at the same time, in consultation with their new academic advisor each student will form a mentoring committee followed by a dissertation committee, as described later.

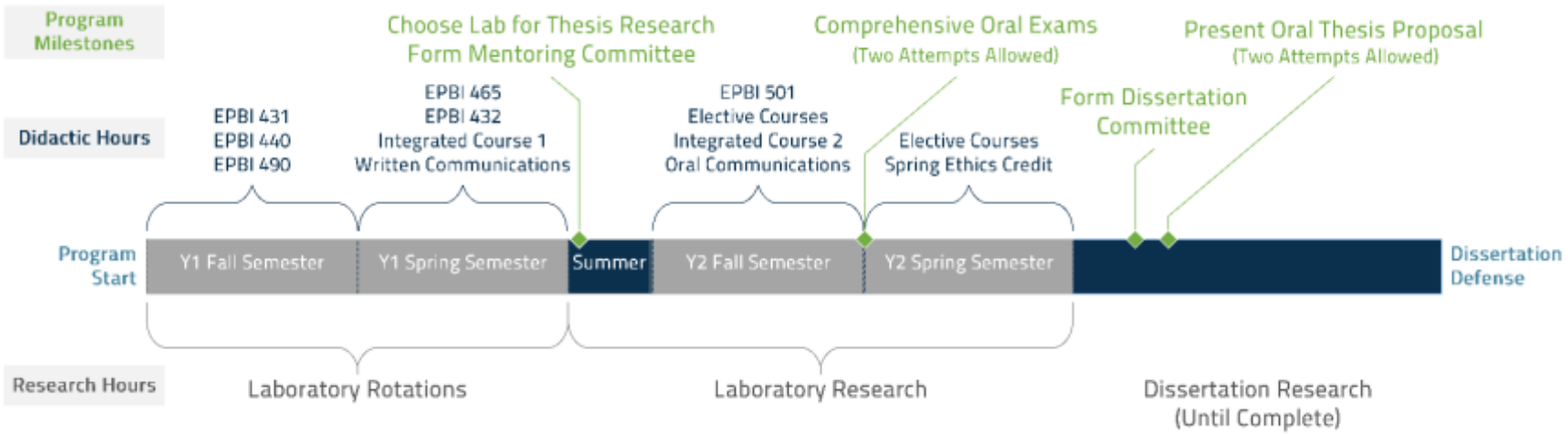
Students are required to meet with their academic advisor or mentoring/dissertation committee prior to registering each semester to discuss course plans for the semester. Once completed, the adviser will remove the "Advisor Hold" on the student's record within the Student Information System (SIS) so that he/she may register for classes.

During the course of their first year of study, students may request a change in academic advisor to another faculty member with a primary appointment in the department. To change advisors, students must complete and sign the form available on the department's website and deliver it to the Administrative Director of Non-Clinical Graduate Education. Subsequent changes of research advisors will follow the rules of the School of Graduate Studies.

Coursework for the Ph.D. Degree in Epidemiology and Biostatistics

All entering students will take a common set of courses into their second year. Students entering with prior graduate training may be eligible to enter with advanced standing and their coursework will be adjusted accordingly. Such situations will be handled on a case by case basis, following discussion with the Graduate Program Director.

Expected program of study is outlined below (Figure 1):



Year 1, Fall Semester		
PQHS 431	Statistical Methods I	3 Credit Hours
PQHS 440	Introduction to Population Health	3 Credit Hours
PQHS 490	Epidemiology : Introduction to Theory and Methods	3 Credit Hours
PQHS 501	Research Seminar	0 Credit Hours
		9 Credit Hours Total

Year 1, Spring Semester		
PQHS 432	Statistical Methods II	3 Credit Hours
PQHS 465	Design and Measurement in Population Health Sciences	3 Credit Hours
PQHS 444	Communicating in Population Health Sciences Research	1 Credit Hour
PQHS 472	Integrated Thinking in Population and Quantitative Health I	2 Credit Hours
PQHS 501	Research Seminar	0 Credit Hours
		9 Credit Hours Total

Students are required to enroll in PQHS 501 (Research Seminar) for at least 6 semesters. Beginning in their second year, students will be required to present their research at least once per year. This requirement applies to all students in the program, even those who have completed their PQHS 501 requirement. For more junior students, presentation of their research ideas or directions is expected. For more senior students, presentation of their research progress is expected. These presentations serve multiple purposes. The first is to help the student hone their speaking skills. The second is to encourage open discussion of projects with the hope that input from other department members will ultimately improve the research.

In addition to coursework in their first year all students will do three research rotations with potential mentors. Rotations will be at least 8 weeks and may begin the summer prior to matriculating. Students should discuss with prospective faculty mentors prior to rotations whether the faculty member has the resources to support the student after their first year. In case of ambiguity, the student should discuss options with the Graduate Program Director.

After each rotation both the student and the faculty member will report results of the rotation using an online form. Topics to be discussed by faculty may include each student's work ethic, skillset, and knowledge. Students may comment on faculty availability, mentoring style, and appropriateness of research projects for a PhD. Other relevant comments may also be added. All evaluations will be available to faculty who are considering having the students enter their research groups. Only the evaluations of the faculty will be available to students who are choosing research laboratories.

At the end of the first academic year students, in discussions with faculty with whom they have rotated, will choose a research laboratory in which to do their dissertation research. Only faculty with evidence of adequate financial support will be allowed to take students into their laboratories. Only a mentor who is a faculty member with a primary or secondary appointment in the department and is willing to be his/her research advisor may be chosen.

The research advisor will then assume the major responsibility for facilitating, guiding, and advising the student in his or her research. The research advisor will also assume financial responsibility for his/her students. This may include funding from other faculty on a collaborative basis. Each year a student support request form will be required to be filled out for each student by the research mentor and other faculty providing financial support. This form must then be submitted to the Administrative Director of Non-Clinical Graduate Education.

Mentoring Committee

Following the first academic year and choice of a research laboratory, students will also form a mentoring committee. This committee will consist of the research advisor and two other faculty members, at least one of whom who will have a primary appointment in the Department and will serve as the committee chair. This committee will help guide the student through his/her coursework and preliminary research. At the first committee meeting the PPOS will be re-assessed and revised.

The committee will meet at least once per semester until a dissertation committee is chosen. It is expected that all committee members will be present at each mentoring committee meeting. In rare cases, a member may participate via telephone or other electronic means, but he/she must still sign off on the post-meeting report.

After each meeting a report will be produced that describes the progress and goals for the overall academic and professional development plan, with specific milestones and corresponding timelines. After each meeting the committee is required to assess student progress and make an explicit statement about pace of progress (rated from outstanding to poor as listed on the meeting report form). In the case of a poor or fair evaluation the student, committee chair and research advisor will be required to meet with the Graduate Program Director to discuss remedying any issues. This

meeting may be with all parties or may involve individual meetings, depending on the situation. This report must be signed by all committee members. A template for the meeting report can be found on the department website.

Each committee meeting will begin with a brief consultation between the research advisor and the committee members in the absence of the student. Each meeting will also end with a similar consultation prior to reporting recommendations to the student. Finally, after the committee has reported its recommendations to the student, the committee will meet with the student in the absence of the research advisor to discuss either scientific or personal issues.

Year 2, Fall Semester		
PQHS 444	Communicating in Population Health Sciences Research	1 Credit Hour
PQHS 473	Integrated Thinking in Population and Quantitative Health II	2 Credit Hours
Electives as determined by Mentoring Committee		6Credit Hours
PQHS 501	Research Seminar	0 Credit Hours
		9 Credit Hours Total

Year 2, Spring Semester		
PQHS 445	Research Ethics in Population Health Sciences	0 Credit Hours
IBMS 500	Ethics & Biomedical Research	1 Credit Hour
Electives as determined by Mentoring Committee		8 Credit Hours*
PQHS 501	Research Seminar	0 Credit Hours
		9 -10 Credit Hours Total

*Students may need to take 9 credits (3 courses of 3 credits each) due to limited 2 credit options

By the end of the Fall semester of the 2nd year, all students will take the departmental general examination, which is a comprehensive oral examination (described below). Students may form their dissertation committee once they have passed their general examination.

Students who have passed their general examination have until the beginning of the fall semester of their third year to form a Dissertation Committee and defend a dissertation proposal (the "qualifying examination") to their committee. The format of the dissertation proposal is described below.

In summary the Doctor of Philosophy degree in the Department of Population and Quantitative Health Sciences comprises the following six components:

1. Core Curriculum (22 credits)
2. Electives (20 credits*)
3. Seminar Requirements
4. Passing the General Examination
5. Defending a Dissertation Proposal (including an oral public presentation of the proposal), the "qualifying examination".
6. Dissertation Research Credits (total of 18 credits)
7. Dissertation Completion (oral public defense and final written dissertation)

*Students may end up taking more than 20 credits in electives

General Examination

Students are required to sit for the department general examination before the beginning of the spring semester of their second year. This examination will be based on the analyses of a dataset chosen from several available sets given to the students at least 3 weeks prior to the oral examination. The student will perform analyses of the data, interpret the results in light of a defined scientific question, and design a next set of experiments/studies to be performed to follow-up the results. This will include the development of subsequent hypotheses in the area of research.

Each student will provide an in-depth oral analysis of the data set. This will include formal analysis and interpretation as well as the strengths and limitations of the provided data set. The student will also be expected to provide a research agenda on how they would extend the study from which the data was derived to better address the same problems or extend our understanding of the problem. This will be formally presented orally and an examining committee will determine whether the student has adequately analyzed and interpreted the data as well as proposed appropriate additional studies.

The examination will test the students' ability to the integrate materials and concepts they have learned across the core classes, providing evidence that they can think independently and can understand and apply the broader concepts underlying the core curriculum. In preparing for the examination, students should take the initiative to consider how the concepts and readings for one class apply to other classes and population health research in general. Students are encouraged to form discussion groups with their fellow students, read the relevant literature, and attend seminars to strengthen these skills.

The results will be presented to an examining committee made up of at least four but no more than 5 departmental faculty members. Each student will prepare an oral presentation lasting no more than 20 minutes. This will be followed by questioning regarding the analyses, interpretations and research plans going forward. It is expected that each student will be able to develop a cohesive research plan based on the analyses.

The examination may cover any topic covered in the PhD core coursework and contain questions that synthesize content across the different core courses. A student may pass the examination, pass the examination conditionally, or fail the examination. A conditional pass will be deemed appropriate when there exist minor deficiencies in the examination that

can be addressed by one or a few remedies within no more than one month. To pass or receive a conditional pass at least 4 members of the committee must support this decision. A student who fails the examination may retake the examination once no later than two months after the first attempt. A second failure will result in removal from the PhD program. A student who fails the department general examination may be eligible to complete requirements for a conciliatory MS degree. The requirements for an MS will be decided on a case by case basis by the PhD program Internal Oversight Committee.

Dissertation Committee

At the end of their second year in the program each student, in consultation with their research mentor (advisor), will choose a dissertation committee; inviting the committee members to be on their dissertation committee is the responsibility of the student. The committee will consist of at least four University faculty members and must include the research advisor, a committee chair (not the advisor), who must have a primary appointment in the department, a third member from the department, either primary or secondary, and according to Graduate School rules a fourth member from another department within the University. An additional member may be added to the committee but the total number should not exceed five. In exceptional cases committee members may come from outside the university but this requires permission of both the Graduate Program Director and (by petition) the Dean of the Graduate School. The petition is the responsibility of the student and the advisor. The Graduate Program Director will be an *ex officio* member of all dissertation committees.

The dissertation committee will meet at least once per semester throughout the course of graduate study. After each meeting a written report documenting progress and goals to be met prior to the next meeting will be prepared by the committee chair in consultation with the other members and the student. The final report must be signed and approved by all committee members. The report will be provided to the student and the Administrative Director of Non-Clinical Education no more than 2 weeks following the meeting. Progress will be judged in part by the accomplishment of described goals from prior meetings. A template for the meeting report can be found on the department website or supplied by request from the Administrative Director of Non-Clinical Graduate Education.

The dissertation committee will advise the student on his/her research program, evaluate progress towards the degree, and help in the professional development of the student. In addition, the committee will serve as the primary instrument for mediating any personal or professional issues that arise during the student's tenure at CWRU. This may involve addressing conflicts with the research advisor. The chair of the committee will ensure that all procedures of the program are followed and that meetings and all interactions between the student and the committee members proceed in a productive and professional manner. The committee chair will also be the first person who will address any issues regarding student performance or interactions with faculty. In the event that such conflicts arise that cannot be addressed by the committee or the committee chair, the committee chair will approach the Graduate Program Director to resolve the situation.

Each meeting will begin with a brief consultation between the research advisor and the committee members in the absence of the student. Each meeting will also end with a similar consultation prior to reporting recommendations to the student. Finally, after the committee has orally reported its recommendations to the students, the committee will meet with the student in the absence of the research advisor to discuss either scientific or personal issues.

To form a dissertation committee, students must complete the Dissertation Committee Notification from (available on the department website) and submit it to the Administrative Director of Non-Clinical Education. All dissertation committees must adhere to both the requirements of the School of Graduate Studies and the department and be approved by the Graduate Program Director.

Dissertation Proposal Defense

After passing their oral qualifying examination each student will choose a dissertation topic in consultation with their research mentor. Each student will write a dissertation proposal based on this topic. Although the student may receive advice on the dissertation proposal from the research mentor and other faculty, the document is to be written by the student in its entirety.

The proposal will be written in the format of an NIH R01 proposal. Each proposal must include a specific aims page. The main body of the proposal will be limited to 12 pages. The main body of the text will include a literature review delineating the background and significance of the proposed work, which research gaps it will fill and how it will fill them, its innovation, any preliminary data, and the explicit approaches designed to address the aims. The proposal should be written clearly, in English, at a level of understanding suitable for those outside the specialty area.

The proposal must be defended in a public presentation. At least two weeks prior to the scheduled oral presentation of the proposal, the proposal document must be made available to the entire committee. In the unusual circumstance in which there is concern about the dissertation, the committee may at this point recommend that the defense be postponed. At that same time, notice of the oral presentation of the proposal (including title, abstract, and official announcement of the proposal) must be submitted to the Administrative Director of Non-Clinical Graduate Education for public circulation including the departmental faculty and students. The oral presentation will be open to the public with an expected audience of Department faculty and students. All dissertation committee members are required to attend the public presentation.

Following the public proposal presentation and question and answer session, there is a closed oral defense before only the committee. The committee then meets privately to decide on whether to pass or fail the defense and decide on changes to be made to the proposal. The research advisor, optionally with the committee, then meets with the student to share the committee's decision. The committee will then submit to the Graduate Program Director its pass/fail recommendation and a copy of the written (possibly revised) proposal. A student may either pass, pass conditionally, or fail. In the case of failure, the student will have one more opportunity to defend the proposal. Two members of the committee voting to 'fail' will result in failure, regardless of the number of members on the dissertation committee. In the case of a conditional pass the range of changes requested can include minor revisions to the document or a second oral

defense of specific aspects of the proposed research; this is to be determined by the dissertation committee. The conditions must be met within four weeks after the proposal defense, unless otherwise specified by the committee and approved by the Graduate Program Director. Failure may necessitate rewriting of the written document, as determined by the committee, or simply another oral defense. In either case the exam will be retaken within two months of the first attempt.

In the case of a pass recommendation by the committee, the Graduate Program Director will review the documentation, materials, and committee recommendation. The Graduate Program Director will advance the student to candidacy except in the rare situations in which the Graduate Program Director deems there to be substantial concerns with the document or the oral defense. In this case, the Graduate Program Director will first consult with the Program Oversight Committee and then meet with the dissertation committee and the student to discuss how to remedy any deficiencies.

Once the proposal is approved, the student may commence independent research on his/her dissertation topic. This will include registration for PQHS 701 credits. To meet requirements for the Ph.D. each student must satisfactorily complete 18 credits of PQHS 701 in addition to the core courses and electives totaling to 42 credits. To register for PQHS 701, students must first complete and submit their Advancement to Candidacy form to the Administrative Director of Non-Clinical Education.

Students will be required to use the approved dissertation proposal as the basis of a grant proposal submission within six months of passing the proposal defense. In the case of US citizens and permanent residents this will usually be in the form of an NIH Ruth Kirchstein National Research Service Award (F31) application. For students not eligible or for those with topics not appropriate for an NRSA the student, the dissertation committee and Graduate Program Director will determine other appropriate venues for grant proposal submissions.

Advancement to Candidacy and PQHS 701

Students in the Ph.D. program advance to candidacy after:

1. Completion of all core courses.
2. Passing the general examination.
3. Completion and defense of a dissertation research proposal
4. Submitting the completed and signed advancement to candidacy form to the School of Graduate Studies.

Following admission to candidacy each student will engage primarily in their dissertation research. The Ph.D. dissertation research will be performed while in residence (see below) under the supervision of a faculty member (research adviser) of the department. Students who have advanced to candidacy may register for 1-9 credits of PQHS 701 each fall and spring semester (or up to 6 credits for the summer, when needed). Students should not register for dissertation credits, PQHS 701, until the student has been advanced to candidacy. In rare cases, a student may petition for permission to register for up to a total of 6 credits of 701 prior to advancement to candidacy. This requires a completed and signed Pre-Doctoral Standing form, approval by the research mentor and the Graduate Program Director and submitted to Office of Graduate Studies. Student should see the Administrative Director of Non-Clinical Graduate Education for details. Pre-Candidacy (Pre-Doctoral Standing) PQHS 701 credit hours can only be taken concurrently with course work upon both academic and research adviser approval and proper form submission. It is expected by both the department and the School of Graduate Studies that any student who applies for Predoctoral Standing, and begins taking 701 credit hours before advancing to candidacy, will advance to candidacy before the following semester. For permission to take 701 credits prior to candidacy see: students must compete and submit the Pre-Doctoral Standing form to the Administrative Director of Non-Clinical Graduate Education. In most cases individuals wishing to conduct research activities prior to advancement may elect to enroll in PQHS 601 Independent Research credits.

A minimum of 18 credit hours of PQHS 701 are required for the PhD degree. Once students have registered for PQHS 701, they must maintain registration (at least 1 credit) in each subsequent semester (fall and spring) until graduation, with the exception of approved leaves of absence. Note that leaves of absence do not extend the 5-year time limit to graduate after first enrolling in dissertation (PQHS 701) credit hours. Also note that there is no provision for "part-time" status during dissertation work. The School of Graduate Studies generally considers even a single credit hour of dissertation

research to represent full time student status. All students have a five year time limit, including leaves of absence, to complete their degree after registering for dissertation credit hours, unless they obtain an extension. A petition for extension of the 5-year limit must be approved by the research adviser and the Graduate Program Director, and submitted to the Dean of Graduate Studies. The extension should include a plan with a timeline for completion. If an extension is granted, the student must register for a minimum of 3 credit hours of 701 every semester.

Research Adviser Responsibilities

Becoming a mentor to a PhD student means that a faculty member assumes the commitment to be a life-long mentor to the student with the goal of helping each student to become a successful member of the scientific community. This includes:

- Commitment to the student's research project, helping with setting goals, and establishing research timelines.
- Meeting regularly with the student one-on-one to assess progress and provide guidance, preferably weekly if not more regularly.
- Aid in selecting other mentors, including the mentoring and dissertation committees.
- Help in developing communication skills essential to becoming a successful scientist.
- Provide guidance in the responsible conduct of research, rigor, and reproducibility. This includes issues of authorship, data sharing, ownership, and appropriate study design
- Encourage and support the student's participation in scientific meetings.
- Provide career advice.

- Finally, provide an intellectually stimulating and supportive environment in which each student can develop and flourish.

It is recognized that research work that is not the major focus of the student's dissertation may provide extremely useful training and when possible is encouraged. However, mentors may not demand that their students perform work that is unrelated to the student's dissertation research project or training unless agreed upon by both the student and the Mentor. In the case of possible disagreements, the dissertation committee will attempt to resolve any issues.

Advanced Standing for Students with a Prior Master's Degree

Some students will enter the PhD program after completing a relevant master's degree, such as a Master of Science (MS) or Master of Public Health (MPH) degree. If the student's MS or MPH degree is from CWRU, core courses that were taken as part of their master's degree need not be taken again as a PhD requirement, unless they were taken more than seven years prior to matriculation as a PhD student. In this case they will be evaluated on a case by case basis. Courses for which the student has had the equivalent elsewhere may be replaced (not waived, see below). However, a student entering with a related Master's degree may apply for advanced standing, thereby reducing the number of CWRU didactic credit hours required for the PhD.

Students who enter the PhD program with a related Master's degree may apply for advanced standing. Based on courses taken elsewhere but judged to be equivalent to CWRU courses, a student may have the total number of credits required for the PhD reduced. To be granted, the student must have a minimum of 12 credits of equivalent courses and may be granted a reduction in course requirements of up to 18 credits. If the student has fewer than 12 credits of equivalent courses, they may apply to waive or replace a course (see "Waiving or Replacing a Course"). Students who wish to apply for advanced standing may do so any time after acceptance into the program by submitting the appropriate form and attaching the syllabi for all courses being used as the basis for waiving courses. This petition must be signed by the student and Graduate Program Director.

Please note the following rules for a PhD student:

1. A minimum of 24 credit hours of coursework must be taken at CWRU.
2. All core courses (standard core or statistical alternative core) must be taken, except as waived by the Graduate Program Director, following consultation with the instructors of the core courses.
3. The student is responsible for everything covered in the core courses, and will take the full qualifying examination, regardless of whether any courses were waived.
4. An approved Master's degree may qualify for a reduction of 12-18 credits from the full 42 credit requirement. If fewer than 12 credits are considered "waivable", then it will not be deemed an approved Master's and the full 42 credits must be taken at CWRU – though the student may be able to replace courses equivalent to those taken elsewhere.
5. "Waiving" a course means that the student has taken, at another institution, nearly all or all of the material in the course being waived. If a student has taken a course that is deemed to be somewhat similar, but not equivalent, the student may be granted the right to "replace" the course with another course in the same subject area to strengthen the student's knowledge in the area. This will usually be a more advanced course. In this case, there would be no credit reduction.
6. The process for approving a waiver is similar to that of granting transfer credit. The instructor of the equivalent course will provide an evaluation based on materials submitted by the student, including at minimum, the course syllabus, as deemed appropriate by the instructor. In some cases, a short examination may be given to assess competency.

Waiving or Replacing a Course

To request being waived out of a required course, or to replace it, students may petition using the official Petition to Modify Course Requirements, which can be found on the department website. The petition must provide documentation of the relevant courses completed, with a grade of "B" or higher, a detailed description of the course(s), the syllabus, and textbook used in the completed course(s). The petition should be approved by the academic adviser and submitted to the Vice Chair for Education for approval.

The Graduate Program Director will approach the instructor of the course(s) in question with the petition. The instructor will then evaluate the student's petition, and can either approve or disapprove of the course being waived, or may instead approve replacing the required course with another, advanced course in the same area. In this last case, the replacement course needs to be specified with a plan for when to take it. Special attention must be paid to prerequisites for this replacement course and when it is offered.

For Core courses, it is important that students realize they will be held fully responsible for all content on the general exam, based on how it is taught here, even if the student got the course waived based on coursework elsewhere.

Students can petition to replace a maximum of 2 core courses.

Transfer of Credit

Transfer of credit from another university toward doctoral degree requirements is awarded for appropriate course work (not applied to another degree program) taken prior to admission. Transfer of credit should be requested in the student's first academic year, and must be appropriate for the student's planned program of study. No transfer of credit will be awarded towards the Ph.D. degree except by petition, and no credit for the doctoral dissertation may be transferred from another university. All transfer of credit requires approval from the student's academic adviser, the Graduate Program Director, and the Dean of Graduate Studies. Courses for which transfer credit is requested must have been taken within five years of first matriculation at CWRU and passed with grades of B or better.

Students who wish to receive credit for courses taken outside the university once they are enrolled must petition for approval prior to taking the courses.

Course Load and Financial Aid

Full-time students will normally take at least nine credit hours each semester. However, any time a student is registered for PQHS 701 (dissertation research), even if only for 1 credit hour, the student is considered by the University to be full-time.

All students entering the program as PhD students will be supported for the first year by institutional or departmental funds, unless fully funded through other, external sources. Following the first year, students will be eligible for training grant positions or for support from their research mentor or another faculty member. In addition, as stated above it is expected that students will seek independent funding to support their training; applying for external funding is considered part of the training.

It is expected that all students will be supported throughout their graduate tenure at CWRU by a combination of resources, as described above. However, to maintain support students are required to maintain a cumulative grade point average of 3.5.

Annual Progress Report

Students are reviewed twice annually (once per semester) by their mentoring or dissertation committees. If progress is deemed adequate by a committee, no other evaluations will be necessary and the reports signed the committee members will stand as the student evaluations. However, if progress is inadequate or marginal as determined by a student's committee, an additional evaluation by the Internal Advisory Committee will be performed in consultation with the student's adviser. A plan will be developed to remedy the problem and progress will be assessed at the next student committee meeting. If progress continues to be an issue, the student will meet with the Graduate Program Director to discuss options for continuation in the program. Options may include dismissal from the program with or without a Master's degree, depending on the stage at which the problem occurs. Such situations will be handled on a case by case basis.

The School of Medicine (SOM) requires PhD students after their first year to complete an Individualized Development Plan (IDP) by December 1 of each year. PhD students in their 1st year are asked by the SOM to complete their IDP after completion of their 1st year.

Conciliatory MS Degree

The department awards an MS degree in Biostatistics and a Master's of Public Health. The granting of a conciliatory MS degree option is available for PhD students, based on the university's Plan B model. To be granted a Conciliatory MS degree, students are required to complete 36 credit hours of graduate level course work. The Internal Advisory Committee will review these petitions and based on coursework taken and consultation with the student, create a new 36 credit PPOS. This may require additional courses for the granting of a degree. Courses already taken to fulfill department and concentration core requirements are counted toward the required 36 credit hours. The conciliatory degree is not an alternative terminal MS program, but rather is available for PhD students who are unable to complete their PhD studies.

Dissertation Defense

All candidates for the Ph.D. degree must submit a written dissertation as evidence of their ability to conduct independent research at an advanced level. The written dissertation must conform to the regulations of the School of Graduate Studies. Detailed instructions with regard to formatting and structure can be obtained from the School of Graduate Studies. Following successful defense of the dissertation, an unbound paper copy of the dissertation is to be submitted to the department.

The dissertation must represent a significant original contribution to existing knowledge in the area of research, and at least a portion of the content must be suitable for publication in a reputable professional journal or as a book or monograph. It is required that prior to the defense at least one paper will be published in a peer reviewed journal with the student as the first author. If this is not the case, permission to defend will be made by request to the Graduate Program Director and evaluated by the Internal Advisory Committee.

The final oral examination, chaired by the dissertation committee chair, must be widely publicized. A form with the date of defense must be signed, approved and submitted to the School of Graduate Studies (SGS) in time to obtain their approval at least three weeks prior to the date of defense. Students should endeavor to submit this form well in advance of the three-week deadline. SGS will not approve a defense date that is less than three weeks away. In such a case, the defense will have to be rescheduled. The examination consists of a defense of the dissertation and a final inquiry into the student's capabilities to conduct independent research.

All PQHS faculty members are encouraged to attend and participate in the student's Ph.D. examination. Students are also strongly encouraged to attend. All members of the dissertation defense committee are required to be present. Exceptions to this last rule must be approved by petition to the Dean of Graduate Studies and only under extraordinary circumstances; in any case, no more than one voting member can ever be absent, and the absent member must participate through real-time video or phone conferencing. Ph.D. candidates must submit the schedule for their final oral examination no later than three weeks before the date of the examination to the School of Graduate Studies and to the Administrative Director of Non-Clinical Graduate Education for circulation to the department. The members of the dissertation committee must have copies of this dissertation in hand at least two weeks before the defense. The student

must obtain all appropriate dissertation approval forms from the School of Graduate Studies and bring them to the examination.

The student passes the dissertation examination if not more than one member of the dissertation committee dissents. Additional work may be required based on the result of the examination prior to passing the student.

Maintenance of Good Standing

To remain in good standing within the PhD program, students must satisfy the following conditions:

- Respond in a timely fashion to department communications that require it (check Case e-mail!).
- Register each fall and spring semester unless on an official leave of absence that has been approved by the School of Graduate Studies.
- Maintain a minimum cumulative graduate GPA of 3.5 in all graduate work (including transfer courses).
- Receive a grade no lower than a "B" in any of the required core courses. Attend courses and seminars as scheduled. If illness or other circumstances intervene, the student must notify the course instructor and adviser as soon as possible.
- Satisfy all program deadlines and time limits as outlined in the Academic Guide.
- Remove Incomplete (I) grades within one semester, or by the time specified by the course instructor if that is later.
- Pass the General Exam within two attempts before the end of the spring semester of a student's second year
- Pass the Defense of the Dissertation Proposal within two attempts.
- Successfully defend the dissertation within five years of first PQHS 701 registration.

Students who fail to remain in good standing should expect to be placed on academic probation. Students on academic probation have 1 semester to return to good standing or risk being removed from the program. However, students who fail to pass either the General Exam or the Qualifying Exam (dissertation proposal) within two attempts will be removed from the program unless under rare circumstances, a special petition is granted to allow a third attempt. For the General

Exam, a petition would have to be approved by the Internal Advisory Committee, the Vice Chair for Education, and the Dean of Graduate Studies. For the qualifying exam, the petition must be signed by the research adviser and approved by the Internal Advisory Committee and the Vice Chair for Education.

Time Limitation

All requirements for the doctoral degree must be completed within a total of five consecutive calendar years beginning with the semester of the first credited registration in PQHS 701, Dissertation Research, including leaves of absence. Extensions may only be considered through formal petition to the School of Graduate Studies, signed by the research adviser and the Vice Chair for Education. To petition for an extension, students must complete and submit the Petition for an Extension form to the Administrative Director of Non-Clinical Graduate Education.

Changing a Course Grade

If a student needs to have a course grade changed from an incomplete, or from no entered grade, the instructor can change the grade online up to 1 year from the end of the semester. After that time period has elapsed, the instructor will need to fill out and sign a yellow change of grade card, and submit it to the Graduate Program Director for signature and submission to graduate studies.

Students have an obligation to check their course grades promptly after the end of the semester. On rare occasions, a student may feel the letter grade (A-F) assigned was incorrect or unfair. In such a case, the student needs to contact the instructor immediately. If the instructor feels the student is justified, the instructor may request a grade change using the yellow grade change card and submit to the Graduate Program Director for approval, signature, and submission to graduate studies. This request from the instructor must be made within 30 days of the grade posting to SIS, and must be accompanied by an e-mail to the Graduate Program Director explaining why the change is justified.

Repeating a Course

Graduate students may petition the Graduate Program Director to repeat a maximum of two courses during their degree program to improve their performance. A Course Repeat Request form must be completed and submitted to the Graduate Program Director.

Residency Requirement

Graduate students working toward the Ph.D. must meet minimal residency requirements. The intent of residency is to have continuity of the academic program as evidenced by course registration and contact with the program faculty. To fulfill the residency requirement, a student must be registered in at least six academic semesters (fall and spring) or six consecutive terms (fall, spring, and summer) between the time of matriculation and five years after the first credited hour of PQHS 701, Dissertation Research.

A foreign student must be registered for 9 credit hours per semester to maintain INS "residency as a full-time student". However, once a student has advanced to the dissertation stage, one hour of PQHS 701 per semester may be sufficient for this purpose. However, students should check with an international student adviser to be sure.

Academic Integrity

All students are held responsible for the preservation of standards of academic integrity. All forms of academic dishonesty, including forgery, cheating, plagiarism, misrepresentation, and obstruction, are violations of academic integrity standards. Plagiarism includes the presentation, without proper attribution, of another's words or ideas from printed or electronic sources. It is also plagiarism to submit, without the instructor's consent, an assignment in one class previously submitted in another (self-plagiarism). Student materials submitted to courses taken as part of the PQHS academic programs as well as seminars, dissertation proposals, dissertation documents, and other academic and research materials may be submitted by course instructors, advisors, and/or and the Graduate Program Director to electronic resources for evaluation of potential plagiarism.

The University's Academic Integrity Board can sanction violations by issuing failure in the work in question, failure in the course, university disciplinary warning, university disciplinary probation, university disciplinary suspension, or expulsion.

The University also has guidelines on authorship standards. Further details can be found in the University's policy on Academic Integrity.

Ethics in Conducting Research

All students within the Department of Population and Quantitative Health Sciences are required to complete training in Ethics in conducting health research, including intentional misrepresentation of data, interpretation of data, management practices, peer review, reporting research misconduct, collaboration and authorship, protection of human subjects, the institutional review board, humane treatment of animals, research involving vulnerable populations, and the use of unethically obtained data. To graduate, all students must complete the following requirements: (1) completion of the ethics requirement in the core curriculum (PQHS 445 for 0 credits; IBMS 500 for 1 credit) and (2) certification through the Continuing Research Education Credit (CREC) Program. More information regarding CREC certification can be found through the Office of Research and Technology Management.

All PhD students must complete their CREC certification by the end of the first semester enrolled in the program. Upon completion of the online certification program, students should provide the Student Affairs Coordinator a copy of their CREC certification. If a student comes into the program with a current certification, she/he should provide the certification to the Student Affairs Coordinator; however, if the certification expires within one year, a renewal certificate will be required. Thereafter, students are responsible for recertification before expiration of the original accreditation. Each student must give the department assistant the appropriate documents pertaining to recertification within two weeks of obtaining them. Students will not be allowed to pass the general qualifying examination and advance to candidacy without proof of certification, and lapses in status may affect the continuity of the Ph.D. research.

IRB Approval of all Research and Protection of Data

All dissertation work involving human subjects, even if involving only secondary data analysis, must have IRB approval or a documented IRB determination of exemption. The research adviser must be involved in this process. If the work is part of a larger project that has already received clearance, the student should be added as key personnel to the IRB protocol. All data must be securely maintained and privacy of participants protected. Students are required to adhere to the University's, School of Medicine's, and relevant IRB's data protection policies. Human subject data or study materials provided to, obtained from, or created by a student, may not be transmitted or shared with any other individuals (including another student) without explicit written permission from the study's principal investigator and/or the responsible investigator listed on the approved IRB protocol.

Publication of Electronic Thesis and Dissertation

The School of Graduate Studies partners with OhioLINK to electronically publish master's theses and doctoral dissertations through their ETD Center--a free, online database of Ohio's ETDs from participating OhioLINK member schools. It contains the abstract and full-text for all theses and dissertations, giving researchers immediate access to the most current research occurring on Ohio's campuses.

The ETD Center is freely accessible worldwide to anyone interested in searching, viewing, and downloading the theses and dissertations published in Ohio. Using a standard Web browser, users can search the database using basic keyword searching. Authors, university affiliation, and abstracts are all indexed.

When you submit your ETD to OhioLINK, you are giving OhioLINK and CWRU permission to make your ETD available for open access on the Internet, including access through major Internet search engines.

More information about the electronic dissertation process through OhioLINK can be found through the School of Graduate Studies.

Points to Consider Prior to Submitting Your ETD

All copyrighted material (e.g. previously published in a journal, monograph, or chapter) must have permission from the journal, monograph or chapter publisher for reproduction/inclusion in the ETD. If they have already published part of their ETD in a journal or monograph, and have not retained/negotiated the right to include it again in the completed ETD, students must obtain copyright permission for their own published work. Students cannot alter published figures from themselves or others without copyright release.

Inclusion of any intellectual property as imposed by Material Transfer Agreements or participation of collaborators must appropriately consider legal, collegial, and ethical obligations. In particular, any unpublished data from collaborators should not be included in the ETD unless written consent is demonstrated and appended to the ETD.

All information in the ETD will be published when the ETD is submitted to OhioLINK. If there are near future plans to publish a portion of the ETD in a journal or monograph, submitting the ETD might compromise such future publication(s), unless you have first discussed this with the journal or monograph publisher, or intend to embargo the ETD to allow for future publication. If you have chosen a publisher and plan to publish a portion of your ETD, check the publisher's policy. Since 2004, Elsevier (major publisher of academic and professional journals) has allowed their authors to retain rights for pre- and post-publication of articles. If you publish with Elsevier in a journal, you can later include the work in your ETD without asking permission from Elsevier.

The ETD may be embargoed (held without release) after submission for up to two years. Petition forms are available on the School of Graduate Studies website. An embargoed ETD is still considered to be a completed work, and may not undergo any modification before release by OhioLINK.

Grievance Procedure

Any student who has a grievance should consult for resolution, in order, the academic advisor, the Graduate Program Director (who will refer the case to the Internal Advisory Committee or an appointed grievance committee), the Vice Chair for Education, the Department Chair, the Associate Dean of Graduate Education (School of Medicine) and the Dean of Graduate Studies. If the Grievance is with the advisor the student should consult his/her committee chair first, then follow the order as described above. There id no need to go further than the stage at which the issue is resolved.

Furthermore, the School of Graduate Studies has a general policy to assure that all students enrolled for graduate credit at Case Western Reserve University have adequate access to faculty and administrative consideration of their grievances concerning academic issues. A three-step procedure has been established for graduate students to present complaints about academic actions they feel are unfair. These policies are detailed by the Division of Student Affairs.

Leaves of Absence and Other Time-off

All students who are admitted to the PhD program in the Department of Population and Quantitative Health Sciences are expected to pursue their studies according to a systematic plan. If it becomes necessary for a student to interrupt studies before completion of the degree, the student must request, in writing to the Graduate Program Director, a leave of absence. The leave does not ordinarily extend the time limitation on progress to the degree. Leaves of absence may not exceed two consecutive academic semesters, and the maximum amount of leave permitted per graduate program is four semesters. Petitions for a leave of absence require a form available from the School of Graduate Studies and require the approval of the student's academic adviser, Graduate Program Director, and Dean of Graduate Studies. Leaves of absence may be used for the medical conditions related to pregnancy and childbirth.

Trainees with stipends are eligible for a total of two weeks of vacation per year and holidays. The period between semesters is considered to be an active time of research and research training and is not considered to be a vacation or holiday. Vacation timinig must be approved by the research advisor.

Trainees may receive stipends for up to 15 calendar days of sick leave per year. Sick leave may be used for the medical conditions related to pregnancy and childbirth. Trainees may also receive stipends for up to 30 calendar days of parental

leave per year for the adoption or the birth of a child. The use of parental leave must be approved by the Department Chair and the trainee's academic and research advisers (these two possibly being the same person).

Many international students are not eligible to take a leave without jeopardizing their student status; prior approval from International Student Services is required.

Support for Students

Graduate study may be a stressful time for students, revealing a need to engage additional resources. It is helpful to set goals and personal deadlines. Students may consider tutoring support for learning disabilities through Student Affairs/Educational services, and/or counseling through University Counseling Services. University Counseling Services (UCS) and the Divisions of Collegiate Behavioral Health (CBH) and Prevention and Recovery Services (PRS) provide individual, group and couples counseling, psychiatric consultation, psychological and learning disabilities testing, and referrals for community services for all students and their spouses or partners.

Graduation

To receive a degree, the student is required to apply for graduation through the Student Information System (SIS) in the School of Graduate Studies before the posted deadline during the semester the student expects to complete all degree requirements, and must be registered during the semester in which the degree is awarded. It is the responsibility of the student to secure signatures and return the necessary forms to the School of Graduate Studies on time. Each student who applies for graduation should consult the calendar from the School of Graduate Studies for the various deadlines.

Program Administration

The Ph.D. Program will be administered by the Graduate Program Director in close consultation with an Internal Advisory committee. The Internal Advisory Committee will consist of at least 3 faculty members with primary appointments in the department and one student representative. The Internal Oversight Committee is available to the Program Director for consultation and guidance on the doctoral program, and may make recommendations to the Program Director and the Curriculum Committee as appropriate The Graduate Program Director will consult the Internal Oversight committee in case of grievances or other non-standard operational matters such as issues of inadequate student progress. In the case of discussions of individual student issues or other confidential information, the student representative will be excused. Decisions of the committee will be by a majority vote.

The Graduate Program Director will be responsible for overseeing all aspects of the Ph.D. program. He/she will do so in regular consultation with the Vice Chair for Education, the Department Chair, and with guidance from the Internal Advisory Committee as needed. The Graduate Program Director will serve as the official spokesman for the Ph.D. program and will serve as its representative in matters related to University policy and programs. The Graduate Program Director will be responsible for the maintenance of high standards in the academic program, including the continuing evaluation of all required and elective courses in the program, the qualifications and diversity of the faculty. The Graduate Program Director will initiate and coordinate recruitment activities and will be also responsible for identifying and applying for (or assisting others in applying for) internal and external support for graduate training.

Communication Among Students, Faculty, and Staff

All students enrolled at Case Western Reserve University are given a Case Email address and Network ID. The general format for a CWRU email address is firstname.lastname@case.edu. Students also receive a Network ID, which generally consists of their first, middle, and last name initials followed by a number (ex: abc123@case.edu). This Network ID will give you access to your Case Webmail account, SIS, and any other University-related login systems that you have access to. If you use another email account, please ensure that you read both accounts regularly or that you forward the CWRU email to your regular email.

Students are responsible for reading the information and content of communications sent to their Case Email account at least once a day. Faculty, students, and staff often use the CWRU email system to communicate information about courses, seminars, events, etc., particularly when personal notification (e.g. during class) is not possible. You will be held accountable for missed information if you fail to check your email in a timely manner.

Student Information System (SIS)

The Student Information System (SIS) is a secure, flexible, web-based environment for creating and managing academic records at Case Western Reserve University.

The Student Center section of the SIS is the main launching point for accessing academic, financial and personal information. SIS can be accessed via the "quick link" section at the bottom of the CWRU homepage.

Students can access training guides, information, references, and FAQs through the University Registrar.

This site is updated any time there are changes made regarding the SIS. The University registrar is also available to help with SIS-related issues. The number to the registrar's office is 216.368.4310.

2017 – 2018

Department of Population & Quantitative Health Sciences

Student Handbook

MS in Epidemiology & Biostatistics

SCHOOL OF MEDICINE
CASE WESTERN RESERVE UNIVERSITY

Department of Population & Quantitative Health Sciences

School of Medicine, Wood Building, Room WG-57
Case Western Reserve University
10900 Euclid Avenue
Cleveland, Ohio 44106-4945
http://epbiwww.case.edu

Jonathan Haines, PhD
Chair, Mary W. Sheldon Professor of Genomic Sciences

Ena McDowell
Assistant to the Chair

Mendel Singer, PhD, MPH
Vice Chair for Education, Department of Population & Quantitative Health Sciences
MS Program Director
Email: mendel@case.edu
Phone: 216.368.1951

Nickalaus Koziura, EdM
Administrative Director of Non-Clinical Graduate Education
Email: nickalaus.koziura@case.edu
Phone: 216.368.5957

School of Graduate Studies
Tomlinson Hall, Room 203
(216) 368-4390 (phone)
(800) 368-4723 (toll free)
(216) 368-2000 (fax)
gradstudies.case.edu

Charles Rozek, PhD, Vice Provost & Dean

Lynmarie Hamel, JD, Associate Dean of Graduate Studies

Brandon Bowman, Manager of Graduate Academic Affairs

Additional University Offices

Access Services (IDs & Parking)
Crawford Hall, Room 18
(216) 368-2273
www.case.edu/finadmin/security/access/access.htm

Career Center
Sears Building, Room 206
(216) 368-4446
studentaffairs.case.edu/careers

Financial Aid
Yost Hall, Room 417A
(216) 368-4530
finaid.case.edu

Free Computer Support & Service
11424 Bellflower Rd.
(216) 368-4357
help.case.edu

Registrar
Yost Hall, Room 110
(216) 368-4310
www.case.edu/registrar

Student Affairs
Adelbert Hall, Room 110
(216) 368-2020
studentaffairs.case.edu

University Health Service (Student Medical Center)
2145 Adelbert Rd.
(216) 368-2450
studentaffairs.case.edu/health

University Counseling Services
Sears Building, Room 201
(216) 368-5872
studentaffairs.case.edu/counseling

Police & Security Services
Emergency - 911
Urgent Matters; Safe Ride; Escort Service: (216) 368-3333
Safe Ride Program (7pm-3am)
Security Escort Service (24 Hours)
Security (Information) - (216) 368-4630
www.case.edu/finadmin/security/

University Circle Police
2100 Euclid Avenue
(216) 791-1234

Welcome from the Graduate Program Director

Welcome to the Masters of Science Program in Epidemiology and Biostatistics in the Department of Population and Quantitative Health Sciences at Case Western Reserve University School of Medicine! This handbook is a general summary of academic program information and should be used in consultation with an academic advisor. Students should also review the Case Western Reserve University's Student Handbook which describes the University requirements for graduation . The Department of Population and Quantitative Health Sciences has additional expectations and requirements. Those expectations are detailed in this handbook. If a student is uncertain about a requirement or perceives a conflict, then the student should bring this to the attention of her/his academic advisor. Any variation in policy or expectations will be documented and notification will be sent to impacted students.

Congratulations on taking your first step and we are excited to have you in our program!

Sincerely,

Mendel Singer, PhD, MPH
MS Program Director
Vice Chair for Education, Department of Population and Quantitative Health Sciences

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Mission, Values and General Orientation

The mission of this program is to train outstanding biostatistics professionals who will become important contributors to primarily health-related research. Our graduates are prepared to be extremely competitive in the job market, while also being prepared for doctoral studies, which many of our graduates choose to pursue.

Biostatisticians are professionals who are part of teams that determine the best ways to prevent and treat disease, and increase knowledge of human health and disease to pave the way for future discovery. Our faculty, students and graduates aren't just "numbers people". They are health research professionals who are passionate about using their natural talent and training to improve health and save lives. As a biostatistician, you will design and analyze studies to ensure the goals of the study can be met, effectively and consistently. You will work in collaboration with clinical and scientific experts, and learn a great deal about the subjects you study. Our graduates are ready to be full-fledged co-investigators.

Students will master the rigorous scientific and analytic methods necessary to be at the forefront of efforts to not only describe, but effectively evaluate and improve population health. Research and professional development seminars will help you keep abreast of current literature and identify important areas of research and collaborative opportunities, as well as guide you in choosing a career path and prepare for the job search. The department operates within a strong interdisciplinary framework involving faculty and staff in the department, the School of Medicine, and across the entire university, as well as leaders in health care institutions and health-oriented organizations and agencies throughout the wider community. More than 200 graduate students outside the Biostatistics program are pursuing the Master of Public Health, PhD in Epidemiology and Biostatistics, or the M.S. in Clinical Research –and there are certificate students as well. Our M.S. in Epidemiology and Biostatistics program was previously divided into separate programs for students pursuing Epidemiology and those pursuing Biostatistics. At present, we offer only the Biostatistics program. We plan to introduce a more specialized Global Health Epidemiology program, possibly as soon as Fall 2018. The rich atmosphere provided by this mix of students simulates the "team science" approach that dominates research today. The diversity in students mirrors the diversity in areas of faculty expertise. Students are encouraged to engage with students and faculty from other programs.

Graduates from accredited universities and colleges will be considered for admission to the department. All applicants must satisfy both CWRU and department requirements for graduate admission. All incoming MS students take a required 31-credit curriculum, which includes 18 credits of core and 9 track-specific credits, 1 Biostatistical Consulting credit, and 3 Internship/Practicum credits. Current track options for the MS in Biostatistics are: Biostatistics, Genomics and Bioinformatics, Health Care Analytics, and Social & Behavioral Science (see descriptions below). On completion of the internship/practicum requirements, students must submit a written report detailing the project and their role. This written report serves as a comprehensive exam for the MS program.

Biostatistics Track

The biostatistics-track students will receive a carefully designed balanced training in biostatistical theories, methods, and biomedical applications. This track student will gain mastery of basic probability theory and statistical inference, learn the methods of longitudinal analysis, and still have the flexibility to choose an elective from advanced courses. The didactic methods and theory, and hands on analytical training would lead to either the pursuit of an advanced relevant degree and/or work as a master's level biostatistician in various settings, e.g. academia, industry, or government agencies.

Track-Required Courses:

Introduction to Mathematical Statistics (PQHS 480)
Longitudinal Data Analysis (PQHS 459)
One of the following courses:
- Machine Learning and Data Mining (PQHS 471)
- Multivariate Analysis and Data Mining. (STAT 426)

Track Leader:

Dr. Abdus Sattar, PhD
Email: sattar@case.edu
Phone Number: (216) 368-1501
Website: sattar.case.edu

Genomics and Bioinformatics Track

Students will be trained to work in genomics and bioinformatics areas. In addition to the basics in biostatistics, they will learn the designs, methods, techniques, and tools that are commonly used in genetic epidemiology, statistical genomics, and bioinformatics research. Target job positions are analyst, statistician and bioinformatics in a genomics or genetic epidemiology research team in a research institute/university, pharmaceutical or biotech company.

Track-Required Courses:

Introduction to Genomics and Human Health (PQHS 451)
Statistical Methods in Genetic Epidemiology (PQHS 452)
Design & Analysis of Sequencing Studies (PQHS 457)
Machine Learning & Data Mining (PQHS 471)*

*Replaces Survival Analysis (PQHS 435) as core requirement

Track Leader:

Chun Li, PhD
Email: cxl791@case.edu
Phone Number: (216) 368-5633

Health Care Analytics

Biostatistics is a vital part of clinical research, which includes both observational studies and randomized clinical trials. Modern clinical, or patient, research takes advantage of innovative methodologies for the design and analysis of such studies to increase the likelihood of success and minimize patient burden and the use of scarce resources. Clinical research biostatisticians work as part of multi-disciplinary teams with clinical and statistical investigators to develop and execute study designs and analysis plans with scientific rigor, and in support of regulatory requirements by sanctioning bodies and funding agencies. Principal roles include the design, analysis, coordination and reporting of observational and trial-based clinical research studies. Most of a clinical research biostatistician's work is dedicated to evaluating, executing and reporting on well-designed studies to help investigators meet their scientific objectives. Related job titles include biostatistician, lead, senior or principal biostatistician, consulting statistician, statistical researcher, statistical programmer, clinical informaticist, data scientist and clinical research manager. Such positions require strong written and verbal communication skills, and the ability to work as part of a team with subject matter experts on protocol development and statistical reporting. Biostatisticians completing the Health Care Analytics track will be well-positioned to apply for positions in industry, academia (including teaching hospitals) and government. Recent graduates of similar programs have found excellent positions with pharmaceutical companies, university and health system-based research groups, and within various health industries.

Track-Required Courses:

Large Health Care Databases and Electronic Health Records (PQHS 515)
Two of the following courses:

- Longitudinal Data Analysis (PQHS 459)
- Observational Studies (PQHS 500)
- Clinical Trials (PQHS 450)
- Machine Learning and Data Mining (PQHS 471)

Track Leader:

Thomas Love, PhD
Email: tel3@case.edu
Phone Number: 216.778.1265

Social & Behavioral Science

Students will be trained to work as analysts and research assistants in the social and behavioral sciences, including anthropology, sociology, psychology, psychiatry, and social work. Students will be trained in the most common study designs and analytic methods in these application areas. Such work often involves collaboration with multidisciplinary teams in community-practice / biomedical settings, with a focus on developmental, social/behavioral, cognitive, and/or mental health outcomes. This track is intended for students whose undergraduate work involved a major or minor in one of the social and behavioral sciences. It was created to serve the needs of social and behavioral science researchers who need research analysts trained in statistics, but with an understanding of their field and familiarity with qualitative and mixed methods as well. Target job positions are in academia, government, and research institutes.

Track-Required Courses:

Longitudinal Data Analysis (PQHS 459) *

*Replaces Survival Analysis (PQHS 435) as core requirement

Structural Equation Modeling (NURS 632)

Qualitative and Mixed Methods (MPHP 482)

One of the following courses:

Measurement of Behavior (PSCL 412 or PQHS 412)

Track Leader:

Arin Connell, PhD
Email: arin.connel@case.edu
Phone Number: 216.368.1550

General Requirements

The degree of Masters of Science in Biostatistics is awarded in recognition of general knowledge of foundational areas of biostatistics and specialized study in an area of application (one of four tracks). Graduates will have demonstrated their ability to perform biostatistical analysis and to communicate the results in a formal written project report. Our goal is to produce biostatisticians who will be full-fledged and valued collaborators in health-related projects. Students will also be prepared for success in a doctoral program.

The Masters of Science in Biostatistics degree in the Department of Population and Quantitative Health Sciences comprises the following components:

- Core Curriculum (18 credit hours)
- Track-required course (9 credit hours)
- Biostatistical Consulting (1 credit hour)
- Internship/Practicum (3 credit hours)
- Written report from internship/practicum (Serves as final exam for MS degree)

Core Curriculum (19 credits)

The basic core curriculum is designed to provide MS students with the foundational material for all tracks within the Department. The Basic Core Curriculum is comprised of 18 credits in the following courses:

Data Management and Statistical Programming (3 credits) PQHS 414 (Fall)
Statistical Methods in Biological and Medical Sciences I (3 credits) PQHS 431 (Fall)
Statistical Methods in Biological and Medical Sciences II (3 credits) PQHS 432 (Spring)
Survival Analysis (3 credits) PQHS 435* (Spring)
Categorical Data Analysis (3 credits) PQHS 453 (Summer)
Introduction to Epidemiology (3 credits) PQHS 490 (Fall)
Introduction to Biostatistical Consulting (1 credit) PQHS 602 – Section 102 (Fall)

*Survival Analysis is replaced by Machine Learning (PQHS 471) in the Genomics and Bioinformatics track and by Longitudinal Data Analysis (PQHS 459) in the Social and Behavior Science track.

Tracks – Required Courses (9 credits)

The MS coursework requirement also consists of concentrated studies within one of the four tracks offered by our department: Biostatistics, Genomics and Bioinformatics, Health Care Analytics, Social and Behavioral Science.

Most MS students will specify a track when they apply to or after being accepted to the program. Students seeking to complete the program using the intensive 1-year format must declare a track prior to beginning of their first semester of courses. Students seeking to complete the program using the 2-year format must declare a track by the end of their first spring semester.

Track Required Courses

Biostatistics (9 credits)

Introduction to Mathematical Statistics (PQHS 480)
Longitudinal Data Analysis (PQHS 459)
One of the following courses:
Machine Learning and Data Mining (PQHS 471)
Multivariate Analysis and Data Mining. (STAT 426)

Genomics and Bioinformatics (9 credits)

Introduction to Genomics and Human Health (PQHS 451)
Statistical Methods in Genetic Epidemiology (PQHS 452)
Design & Analysis of Sequencing Studies (PQHS 457)
Machine Learning & Data Mining (PQHS 471)*
*Replaces Survival Analysis (PQHS 435) as core requirement

Health Care Analytics (9 credits)

Large Health Care Databases and Electronic Health Records (PQHS 515)
Two of the following courses:
Longitudinal Data Analysis (PQHS 459)

Observational Studies (PQHS 500)
Clinical Trials (PQHS 450)
Machine Learning and Data Mining (PQHS 471)

Social & Behavioral Science (9 credits)
Longitudinal Data Analysis (PQHS 459) *
*Replaces Survival Analysis (PQHS 435) as core requirement
Structural Equation Modeling (NURS 632)
Qualitative and Mixed Methods (MPHP 482)
One of the following courses:
Measurement of Behavior (PSCL 412or PQHS 412)

Internship/Practicum – 3 credits – PQHS 602

The internship/practicum is a crucial part of the student's training, where the student can experience the life cycle of an analysis and participate in the research process and see how a biostatistician collaborates. This experience helps prepare the student for future job interviews and jobs, and may lead directly to a job. All students must complete a 3 credit internship/practicum, registering for 3 credits of PQHS 602 in the section for their track leader. Each internship must be approved, using the form to be filled out by the student and signed by the preceptor and the student. The internship/practicum approval form is available from the Administrative Director for Non-Clinical Graduate Education. These may be completed at any time of year. It is perfectly fine for the time period to straddle more than 1 academic semester, in which case the student will typically register in the final semester in the internship/practicum period. We define an internship as being done on-site, while a practicum is done off-site under the supervision of a faculty member. The internship/practicum requires at least 160 hours of work (may be paid or unpaid) and be conducted under the supervision of a suitably trained preceptor, usually a biostatistician. We encourage off-campus internships (e.g. at affiliated hospitals or NIH or a pharmaceutical company) when appropriate. During an internship or practicum the student will complete an analysis from start to finish and write a full report of the project, with their role clearly stated. A typical report should include a substantive write-up of the study's background, methods, results and discussion – much like a published

paper or formal internal company study report. Students may not have been a participant in every aspect of the study, and should be clear in the write-up as to what they themselves did. Regardless of their role, the report should include relevant aspects of the background and methods sections so the study itself is adequately described. There should also be a one page abstract. Writing this report is an important part of the internship/practicum experience, and serves as the written exam for the MS degree. It is graded (A-F) by the track leader.

Track Comparison Chart

	Biostatistics	Health Care Analytics	Genomics & Bioinformatics	Social & Behavioral Science
Required Courses	PQHS 414 – Data Management and Statistical Programming (Fall) – 3 Credits			
	PQHS 431 (Section 100) – Statistical Methods in Biological and Medical Science I (Fall) – 3 Credits			
	PQHS 432 – Statistical Methods in Biological and Medical Science II (Spring) – 3 Credits			
	PQHS 453 Categorical Data Analysis (Summer) – 3 Credits			
	PQHS 490 – Epidemiology: Introduction to Theory and Methods (Fall) – 3 Credits			
	PQHS 602 (Section 102) – Introduction to Biostatistical Consulting (Fall) – 1 Credit			
	PQHS 602 – Internship/Practicum (Summer) – 3 Credits			
Track Specific Courses	PQHS 435 – Survival Analysis (Spring) – 3 Credits		PQHS 471- Machine Learning & Data Mining (Spring) – 3 Credits	PQHS 459 - Longitudinal Data Analysis (Spring) – 3 Credits
	PQHS 480 – Intro to Statistical Theory (Fall) – 3 Credits	PQHS 515 – Secondary Analysis of Large Health Care Data Bases (Fall) – 3 Credits	PQHS 451 – A Data Driven Introduction to Genomics and Human Health (Fall) – 3 Credits	NURS 632 – Advanced Statistics: Structural Equation Modeling (Spring) – 3 Credits
	PQHS 459 - Longitudinal Data Analysis (Spring) – 3 Credits	**Select 2 of the Following**	PQHS 452 – Statistical Methods for Genetic Epidemiology (Spring) – 3 Credits	MPHP 482 – Qualitative and Mixed Methods Research (Fall) – 3 Credits
	Select 1 of the Following	PQHS 459 - Longitudinal Data Analysis (Spring) – 3 Credits	PQHS 457 – Design & Analysis of Sequencing Studies (Spring) – 3 Credits	**Select 1 of the Following**
	PQHS 471- Machine Learning & Data Mining (Spring) – 3 Credits	PQHS 500 – Design & Analysis of Observational Studies (Spring) – 3 Credits		*PSCL 412- Measurement of Behavior (Spring) – 3 Credits
	STAT 426 – Multivariate Analysis & Data Mining (Spring) – 3 Credits	PQHS 450 Clinical Trials (Spring) – 3 Credits		*PQHS 412 - Measurement of Behavior (Spring) – 3 Credits
		PQHS 471- Machine Learning & Data Mining (Spring) – 3 Credits		* Taught in alternating years

Planned Program of Study

In adherence with the School of Graduate Studies' policy, during the first semester of study, all students are responsible for ensuring that they have a Planned Program of Study (PPOS) on file, submitted through the Student Information System (SIS). The PPOS consists of all courses a student plans to take to meet the requirements for his/her degree. This includes all required coursework and electives. The Planned Program of Study must be approved by the student's academic advisor and should be submitted by October 15 of the first semester of study toward the degree specified, and updated, if necessary, by October 1 of each subsequent year in which the student is registered. Students are responsible for discussing their background and future academic and career goals with their academic advisor so that the best possible plan is developed.

Students enrolled in the MS program are expected to successfully complete all coursework, research, and other requirements for the Masters of Science degree.

Academic Advisor

Upon acceptance into the MS program, each student will be assigned an initial academic advisor (usually the Program Director) who will guide the student through department and graduate school regulations, assist him or her in designing their first semester course registration and an initial draft of their program of study. Students will often switch their academic advisor to their track leader or other program faculty, and this is encouraged. This can be done by first contacting the current advisor and then emailing the Administrative Director of Non-Clinical Graduate Education. The academic advisor will track the student's progress toward degree completion, help with selecting electives and provide career advice.

Students are required to meet with their academic advisors prior to registering each semester to discuss course plans for the semester. Once completed, the advisor will remove the "Advisor Hold" on the student's record within the Student Information System (SIS) so that he/she may register for classes.

Student Responsibility

Students should consult with their academic advisor to plan their planned program of study (PPOS) in order to carry out their work in accordance with applicable laws, regulations, and procedures. Nevertheless, it is solely the student's responsibility to become acquainted with and adhere to Departmental and University rules, regulations, and administrative procedures governing graduate study, including the University's Standards of Conduct detailed in the Case General Bulletin, Graduate Student Handbook, School of Graduate Studies Statement of Ethics, University Guidelines on Authorship and Policy on Copyright, and the University Policy on Academic Integrity.

Sample Planned Program of Studies (PPOS)

Half-Time Planned Program of Study (PPOS)

Half-Time – Biostatistics Track

	Year 1			Year 2		
	Fall	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
	PQHS 431 - 100	PQHS 432	PQHS 453	PQHS 490	Track Elective	Practicum/Internship
	PQHS 480	PQHS 435		PQHS 414	Track Elective	
				PQHS 602 - 102(1)		
Total Credits	6 credits	6 credits	3 credits	7 credits	6 credits	3 credits

Half-Time – Genomics and Bioinformatics Track

	Year 1			Year 2		
	Fall	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
	PQHS 431 - 100	PQHS 432	PQHS 453	PQHS 414	PQHS 452	Practicum/Internship
	PQHS 490	PQHS 471		PQHS 451	PQHS 457	
				PQHS 602 - 102(1)		
Total Credits	6 credits	6 credits	3 credits	7 credits	6 credits	3 credits

Half-Time – Healthcare Analytics Track

	Year 1			Year 2		
	Fall	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
	PQHS 431 - 100	PQHS 432	PQHS 453	PQHS 414	Track Elective	Practicum/Internship
	PQHS 490	PQHS 435		PQHS 515	Track Elective	
				PQHS 602 – 102 (1)		
Total Credits	6 credits	6 credits	3 credits	7 credits	6 credits	3 credits

Half-Time – Social and Behavioral Science

	Year 1			Year 2		
	Fall	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
	PQHS 431 - 100	PQHS 432	PQHS 453	PQHS 414	NURS 632	Practicum/Internship
	PQHS 490	PQHS 459		MPHP 482	PSCL/PQHS 412	
				PQHS 602 – 102 (1)		
Total Credits	6 credits	6 credits	3 credits	7 credits	6 credits	3 credits

Intensive (11-month) Planned Program of Study

Intensive Format – Biostatistics Track

Fall	Spring	Summer
PQHS 431 - 100 (3 credits)	PQHS 432 (3 credits)	PQHS 453 (online) (3 credits)
PQHS 490 (3 credits)	PQHS 435 (3 credits)	PQHS 602 (3 credits)
PQHS 414 (3 credits)	PQHS 459 (3 credits)	
PQHS 480 (3 credits)	PQHS 471 or STAT 426 (3 credits)	
PQHS 602 – 102 (1 credit)		
13 credits	12 credits	6 credits

Intensive Format – Genomics and Bioinformatics Track

Fall	Spring	Summer
PQHS 431 - 100 (3 credits)	PQHS 432 (3 credits)	PQHS 453 (online) (3 credits)
PQHS 490 (3 credits)	PQHS 452(3 credits)	PQHS 602 (3 credits)
PQHS 414 (3 credits)	PQHS 457 (3 credits)	
PQHS 451 (3 credits)	PQHS 471 (3 credits)	
PQHS 602 – 102 (1 credit)		
13 credits	12 credits	6 credits

Intensive Format – Health Care Analytics Track

Fall	Spring	Summer
PQHS 431 - 100 (3 credits)	PQHS 432 (3 credits)	PQHS 453 (online) (3 credits)
PQHS 490 (3 credits)	PQHS 435 (3 credits)	PQHS 602 (3 credits)
PQHS 414 (3 credits)	Two of the Following:	
PQHS 515 (3 credits)	PQHS 450 (3 credits)	
PQHS 602 – 102 (1 credit)	PQHS 459 (3 credits)	
	PQHS 471 (3 credits)	
	PQHS 500 (3 credits)	
13 credits	12 credits	6 credits

Intensive Format – Social and Behavioral Science Track

Fall	Spring	Summer
PQHS 431 - 100 (3 credits)	PQHS 432 (3 credits)	PQHS 453 (online) (3 credits)
PQHS 490 (3 credits)	NURS 632 (3 credits)	PQHS 602 (3 credits)
PQHS 414 (3 credits)	PQHS 459 (3 credits)	
MPHP 482 (3 credits)	PQHS 412 or PSCL 412 (3 credits)	
PQHS 602 – 102 (1 credit)		
13 credits	12 credits	6 credits

Student Information System (SIS)

The Student Information System (SIS) is a secure, flexible, web-based environment for creating and managing academic records at Case Western Reserve University.

The Student Center section of the SIS is the main launching point for accessing academic, financial and personal information. SIS can be accessed via the "quick link" section at the bottom of the CWRU homepage.

Students can access training guides, information, references, and FAQs through the University Registrar.

This site is updated any time there are changes made regarding the SIS. The University registrar is also available to help with SIS-related issues. The number to the registrar's office is 216.368.4310.

Professional Commitment and Culture

The MS program in Biostatistics is a professional degree with a deep commitment to lifelong learning, and students in the program are expected to maintain appropriate professional standards. This includes regular, on-time attendance of classes and participation in a variety of professional development activities. Strong involvement in research, service, and professional social activities is encouraged, with an emphasis on developing impeccable research credentials, independent critical thinking, and problem solving. Students must recognize that voluntary enrollment in this rigorous graduate program may place demands on their time on evenings and weekends, and may prohibit them from taking on outside activities. Students must display maturity of character, interest in the practice of research, excellence in development of interpersonal communication, and high professional commitment to the program of study; they must espouse integrity, honesty, and courtesy, all important professional values.

Communication Among Students, Faculty, and Staff

All students enrolled at Case Western Reserve University are given a Case Email address and Network ID. The general format for a CWRU email address is firstname.lastname@case.edu. Students also receive a Network ID, which generally consists of their first, middle, and last name initials followed by a number (ex: abc123@case.edu). This Network ID will give you access to your Case Webmail account, SIS, and any other University-related login systems that you have access to. If you use another email account, please ensure that you read both accounts regularly or that you forward the CWRU email to your regular email.

Students are responsible for reading the information and content of communications sent to their Case Email account at least once a day. Faculty, students, and staff often use the CWRU email system to communicate information about courses, seminars, events, etc., particularly when personal notification (e.g. during class) is not possible. You will be held accountable for missed information if you fail to check your email in a timely manner.

Waiving a Course

If a student has taken a course elsewhere that is equivalent to a required course, the student may petition the MS Program Director to waive the course requirement and replace it with an elective. Waiving a requirement does not change the number of credits required at CWRU for the degree. Only petition for transfer of credits (using courses taken elsewhere that were not used towards a degree) can reduce the credit requirement.

If the course taken elsewhere is not deemed equivalent but has large overlap, the student may be given the option to replace the required course with another, more advanced one in the same subject area. Similarly, the student may initially request to replace the required course with a more advanced one, rather than to waive it entirely.

To request being waived out of a required course, or to replace it, students may petition using the official Petition to Modify Course Requirements, which can be found on the department website. The petition must provide documentation of the relevant courses completed, with a grade of "B" or higher, a detailed description of the course(s),

the syllabus, and textbook used in the completed course(s). The petition should be approved by the academic advisor and submitted to the MS Program Director for approval.

The MS Program Director will approach the instructor of the course(s) in question with the petition. The instructor will then evaluate the student's petition, and can either approve or disapprove of the course being waived, or may instead approve replacing the required course with another, advanced course in the same area. In this last case, the replacement course needs to be specified with a plan for when to take it. Special attention must be paid to prerequisites for this replacement course and when it is offered.

Students can petition to replace a maximum of 2 core courses.

Repeating a Course

Graduate students may petition the Vice Chair for Education to repeat a maximum of two courses during their degree program in order to improve their performance. The appropriate form, together with details of this policy can be found at http://gradstudies.case.edu/current/forms.html

Transfer of Credit

Transfer of credit from another university toward degree requirements is awarded for appropriate course work (not applied to another degree program) taken prior to admission. Transfer of credit should be requested in the student's first academic year, and must be appropriate for the student's planned program of study. Transferred credit is limited to six credits of graduate-level courses, and no credit for a master's thesis may be transferred from another university. No transfer of credit will be awarded towards the MS degree except by petition.

Students who wish to receive credit for courses taken outside the university once they are enrolled must petition for approval. All transfer of credit requires approval from the student's academic advisor, the MS Program Director, and the Dean of Graduate Studies. Such courses must have been taken within five years of first matriculation at CWRU and passed with grades of B or better.

Internal Transfer of Credit

Students of exceptional ability in the undergraduate programs of Case Western Reserve University who have the approval of the Office of Undergraduate Studies and the School of Graduate Studies may apply to receive credit for graduate courses completed in excess of the undergraduate degree requirements.

Graduate students who internally transfer to another degree program may seek approval to transfer coursework from the original degree program by petition.

Students who initially took program courses as non-degree students and later matriculate into the program, can have these courses transferred so they fully count towards degree requirements. In general, we discourage students from taking many courses non-degree without entering the program as this typically leaves them out of the advising loop and could potentially lead them to take courses that might not count for the program. Students are bound by the program rules in effect when they officially *enter* the program, not from when they started taking courses as a non-degree student.

Waiver of Registration

It is a requirement of the School of Graduate Studies that a student be registered for credit in the semester in which he or she completes all the requirements to graduate in accordance with established deadlines for that semester. If a student will not be able to meet the degree requirements to graduate in one semester, but will finish before the next semester begins, he or she can apply for a waiver of the requirement to be registered in the semester of graduation. To be granted a waiver of registration, students must be registered for the PQHS 602 in the semester (or summer session) immediately preceding the semester of graduation, complete all degree requirements including a current application to graduate, and submit a copy of all required materials to the Administrative Director of Non-Clinical Graduate Education and the originals to the School of Graduate Studies by the end of the Drop/Add period of the next semester.

A student who qualifies for the waiver will be awarded the degree at the next graduation without the need to be registered. If a student fails to meet the waiver deadline, he or she will be required to register for PQHS 602 in the next semester, and to reapply for graduation in that semester.

Ethics in Conducting Research

All MS students must complete their CREC certification prior to beginning their internship/practicum. Upon completion of the online certification program, students should provide the Administrative Director of Non-Clinical Graduate Education a copy of their CREC certification. If a student comes into the program with a current certification, she/he may provide that certification instead; however, if the certification expires within one year, a renewal certificate will be required. Thereafter the student is responsible for recertification upon expiry of the original accreditation. She/he must give the Administrative Director of Non-Clinical Graduate Education the appropriate documents pertaining to recertification within two weeks of obtaining them.

More information regarding CREC certification can be found through the Office of Research and Technology Management.

Academic Integrity

All students are held responsible for the preservation of standards of academic integrity. All forms of academic dishonesty, including forgery, cheating, plagiarism, misrepresentation, and obstruction, are violations of academic integrity standards. Plagiarism includes the presentation, without proper attribution, of another's words or ideas from printed or electronic sources. It is also plagiarism to submit, without the instructor's consent, an assignment in one class previously submitted in another (self-plagiarism).

The University's Academic Integrity Board can sanction violations by issuing failure in the work in question, failure in the course, university disciplinary warning, university disciplinary probation, university disciplinary suspension, or expulsion.

The University also has guidelines on authorship standards. Further details can be found in the

University's policy on Academic Integrity: http://www.case.edu/gradstudies/current/policies.html

Changing a Course Grade

If a student needs to have a course grade changed from an incomplete, or from no entered grade, the instructor can change the grade online up to 1 year from the end of the semester. After that time period has elapsed, the instructor will need to fill out and sign a yellow change of grade card, and submit it to the Vice Chair for Education for signature and submission to graduate studies. A guide on how to submit an online grade change can be found through the University Registrar.

Students have an obligation to check their course grades promptly after the end of the semester. On rare occasion, a student may feel the letter grade (A-F) assigned was incorrect or unfair. In such a case, the student needs to contact the instructor immediately. If the instructor feels the student is justified, the instructor may request a grade change using the online grade change form in SIS. Justification for the grade change needs to be included in online form. Once a grade

change has been submitted it will be sent to the Vice Chair for Education and then to the Office of Graduate Studies for approval. This request from the instructor must be made within 30 days of the grade posting to SIS.

Grievance Procedure

Any student who has a grievance should consult, in order, the academic advisor, the MS Program Director, and the Vice Chair for Education (who will refer the case to an appointed grievance committee) and the Department Chair. Further, the School of Graduate Studies has a general policy to assure that all students enrolled for graduate credit at Case Western Reserve University have adequate access to faculty and administrative consideration of their grievances concerning academic issues. A three-step procedure has been established for graduate students to present complaints about academic actions they feel are unfair. These policies are detailed in the Student Code of Conduct.

Leaves of Absence

All students who are admitted to the MS program in the Department of Population and Quantitative Health Sciences are expected to pursue their studies according to a systematic plan. If it becomes necessary for a student to interrupt studies before completion of the degree, the student must request, in writing to the Vice Chair for Education, a leave of absence. The leave does not ordinarily extend the time limit to complete the degree (see Graduation below). Leaves of absence may not exceed two consecutive academic semesters, and the maximum amount of leave permitted per graduate program is four semesters. Petitions for a leave of absence require a form available from the School of Graduate Studies and require the approval of the student's academic advisor, Vice Chair for Education and Dean of Graduate Studies. Leaves of absence may be used for the medical conditions related to pregnancy and childbirth.

Many international students are not eligible to take a leave without jeopardizing their student status; prior approval from International Student Services is required.

Support for Students

Graduate study may be a stressful time for students, revealing a need to engage additional resources. It is helpful to set goals and personal deadlines. Students may consider tutoring support for learning disabilities through Student Affairs/Educational services, and/or counseling through University Counseling Services. University Counseling Services (UCS) and the Divisions of Collegiate Behavioral Health (CBH) and Prevention and Recovery Services (PRS) provide individual, group and couples counseling, psychiatric consultation, psychological and learning disabilities testing, and referrals for community services for all students and their spouses or partners.

Maintenance of Good Standing

To remain in good standing within the MS program, students must satisfy the following conditions:

- Respond in a timely manner to all department communications requiring it (check Case e-mail!).
- Register each fall and spring semester unless on an official leave of absence that has been approved by the School of Graduate Studies.
- Maintain a minimum cumulative graduate GPA of 3.00 in all graduate work.
- Receive a grade no lower than a "B" in any of the required core courses. If illness or other circumstances intervene, the student must notify the course instructor and advisor as soon as possible.
- Satisfy all program deadlines and time limits as outlined in the Academic Guide.
- Remove Incomplete (I) grades within one semester, or by the time specified by the course instructor.
- Complete written report from internship/practicum

Graduation

To receive a degree, the student is required to apply for graduation through the Student Information System (SIS) in the Office of Graduate Studies before the posted deadline during the semester the student expects to complete all degree requirements, and must be registered during the semester in which the degree is awarded. It is the responsibility of the student to secure signatures and return the necessary forms to the Office of Graduate Studies on time. Each student who applies for graduation should consult the calendar from the School of Graduate Studies for the various deadlines. Questions about graduation can be directed to the Administrative Director of Non-Clinical Graduate Education.

All MS students need a minimum GPA of 3.0 to graduate, and have a maximum of 5 years from matriculation to complete the degree requirements. Students who fail to complete the degree requirements after 5 years may petition the Office of Graduate Studies for an extension. This petition must be approved by the academic advisor, the MS Program Director, and the Vice Chair for Education for the department.

Summary of Deadlines

Application Submission	June 30th of each year.
Application Decision	July 31st of each year
Deadline to submit a form indicating that the student has read the Handbook *(to be submitted to Administrative Director)*	September 15th of the first semester of study
Plan of Study *(submitted via SIS)*	October 15th of the first semester of study
University Calendar of Deadlines:	http://www.case.edu/gradstudies/current/calendar.ht
Commonly Used Forms:	http://www.case.edu/gradstudies/current/forms.html

December 7, 2017

To: Satya S. Sahoo, Ph.D.

From: Kathleen C. Blazar, M.S.L.S.

RE: MS/PHD Degree Program in Biomedical and Health Informatics

As per the Library Content and Resource Review Process for New Programs and Degrees,

I am providing the following information:

Adequacy of Current Content Resources

CWRU Resources – there are 131 items listed using the MeSH term, MEDICAL INFORMATICS, in the CWRU online catalog with publication dates of 2010 or newer – attached.

In the category of MEDICAL INFORMATICS in the Journal Citation Reports of the Web of Science, there are 24 journals listed. There are 5 to which CWRU does not have current access - attached. The recurring, annual cost for these titles is approximately $6764.00.

I have identified two book series from IGI Global. The information is attached in the same file as the journals. The initial costs for these two series is $7680.00. The recurring, annual cost is approximately $2000.00.

Additional books from other publishers may be added as they are published. I would advocate allowing a minimum of $2500.00 annually for these titles.

All these costs are subject to inflation.

Since you indicated to me that most of your online searching is from PubMed, there are no anticipated costs for databases at this time.

Should your faculty and students need additional resources for data management, systematic reviews, or other information, these resources and their costs will need to be assessed in the future. If these future endeavors will involve more library staff, additional funds will be needed for professional staff.

The Health Sciences Library does not have an adequate operating budget for these additional costs. All of our current books are purchased with proceeds from restricted endowments.

In the past, there was an endowment in the Epi/Bio department called the Dingle fund. It was for the support of the Epi/Bio departmental library named the Dingle library. I do not know what has happened to these funds, but I have seen a plaque outside the former library indicating that it is now a café. Perhaps there are still some resources available through this endowment.

The current costs now are for the journals at $6764 and for the book series at $7680 for a total of $14,444.

The recurring costs are for the journals at $6764, for the book series at $2000 and for the additional books at $2500 for a total of $11,264.

Appendix - Sample Template CWRU Libraries Resource and Service Assessment Report Regarding New or Revised Programs and Degrees

Assessment for:

Program level ☒ **graduate** ☐ **undergraduate**

Degree ☐ **Major** ☐ **Minor**

Title of proposed program or degree: Biomedical and Health Informatics

Sponsor (School/College or Department): School of Medicine

[For interdisciplinary proposals, list all schools/College affiliated with the proposal, and the libraries covered under this report.]

Report prepared by: [Librarian]: Kathleen C. Blazar, MSLS **Date of Report:** Dec. 7, 2017

ADEQUACY OF SERVICES

- **Current library staff expertise (depth and availability) in the area of the new program or degree**:
  Adequate until more research and data management occurs in the future
- **Ability of the library to accommodate funder data management requirements (e.g., access to essential technology or media) to support the program or degree**:
  Adequate until more research and data management occurs in the future

ADEQUACY OF CURRENT CONTENT AND ABILITY TO SUPPORT FUTURE NEEDS

- **General strength of the current collection to accommodate new program needs, including major available content resources currently available**:
  See attachment
- **Minimum additional required resources required to accommodate the new program needs**:

Content Category	Adequacy of Current Content Resources *	Additional Resources Required (list specific titles whenever possible)	One-time Cost to Fill Content Gaps	Recurring Cost to Fill Gaps for the next 5 years (including inflation)
Books: ***Essential***	See attachment	See attachment	$14,444 for everything	$11,264 for everything
Books: ***Supplemental***				
Journals: ***Essential***				
Journals: ***Supplemental***				
Databases: ***Essential***				
Databases: ***Supplemental***				
Media: ***Essential***				
Media: ***Supplemental***				

* "Current content" includes content available through OhioLINK.

Journal Data Filtered By: Selected JCR Year: 2016 Selected Editions: SCIE,SSCI Selected Categories: 'MEDICAL INFORMATICS' (WoS)						
Rank	Full Journal Title	Total Cites	Journal Impact Factor	Eigenfactor Score		Annual subscription - approximates
1	JOURNAL OF MEDICAL INTERNET RESEARCH	8,927	5.175	0.02434	Open Access in PubMed Central	
2	JMIR mHealth and uHealth	825	4.636	0.00251	not currently indexed in PubMed - may be Open Access	
3	STATISTICAL METHODS IN MEDICAL RESEARCH	3,128	3.953	0.00844	OhioLINK Electronic Journal Center	
4	JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	7,655	3.698	0.01723	at PMC with 12 month embargo	$1,048
5	IEEE Journal of Biomedical and Health Informatics	1,933	3.451	0.00584	IEEE Explore	
6	INTERNATIONAL JOURNAL OF MEDICAL INFORMATICS	4,069	3.21	0.00552	OhioLINK Electronic Journal Center	
7	Health Informatics Journal	536	3.021	0.0011	OhioLINK Electronic Journal Center	
8	JOURNAL OF BIOMEDICAL INFORMATICS	4,886	2.753	0.00815	OhioLINK Electronic Journal Center	
9	COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE	4,565	2.503	0.00728	OhioLINK Electronic Journal Center, ScienceDirect & ClinicalKey Flex	
10	JOURNAL OF MEDICAL SYSTEMS	3,239	2.456	0.00528	OhioLINK Electronic Journal Center	
11	MEDICAL DECISION MAKING	4,282	2.362	0.00952	OhioLINK Electronic Journal Center	
12	ARTIFICIAL INTELLIGENCE IN MEDICINE	1,807	2.009	0.00226	OhioLINK Electronic Journal Center, ScienceDirect & ClinicalKey Flex	
13	MEDICAL & BIOLOGICAL ENGINEERING & COMPUTING	5,088	1.916	0.00504	OhioLINK Electronic Journal Center	
14	STATISTICS IN MEDICINE	22,008	1.861	0.033	OhioLINK Electronic Journal Center	
15	METHODS OF INFORMATION IN MEDICINE	1,506	1.772	0.00202	in print at Allen 1962 - 1997	$1,107
16	BMC Medical Informatics and Decision Making	2,448	1.643	0.00724	Open Access - a variety of sources - PMC is one	
17	Applied Clinical Informatics	402	1.496	0.00151	at PMC with 12 month embargo	$1,164
18	Informatics for Health & Social Care	194	1.381	0.00038	at EBSCO journals with 18 month embargo	$2,485
19	CIN-COMPUTERS INFORMATICS NURSING	701	1.301	0.00121	available from OVID LWW Nursing	
20	JOURNAL OF EVALUATION IN CLINICAL PRACTICE	2,795	1.25	0.00542	OhioLINK Electronic Journal Center	

Rank	Full Journal Title	Total Cites	Journal Impact Factor	Eigenfactor Score		Annual subscription - approximates
21	Biomedical Engineering-Biomedizinische Technik	803	0.915	0.0015	in print at HCL 1972 - 1996	$960
22	INTERNATIONAL JOURNAL OF TECHNOLOGY ASSESSMENT IN HEALTH CARE	1,821	0.912	0.00261	OhioLINK Electronic Journal Center	
23	Health Information Management Journal	187	0.778	0.00024	available from Sage	
24	Therapeutic Innovation & Regulatory Science	143	0.442	0.00081	available from ProQuest Nursing & Allied Health	
					Total annual cost	$6,764.00

Book Series from IGI Global		one time cost	annual	
Advances in Healthcare Information Systems and Administration (AHISA): 32 Volumes (): Anastasius Moumtzoglou: Book Series | IGI Global		$4,835.00	$1,000.00	
	https://www.igi-global.com/book-series/advances-healthcare-information-systems-administration/37156			
Advances in Bioinformatics and Biomedical Engineering (ABBE): 20 Volumes (): Ahmad Taher Azar: Book Series | IGI Global		$2,845.00	$1,000.00	
	https://www.igi-global.com/book-series/advances-bioinformatics-biomedical-engineering/73671			
		$7,680.00	$2,000.00	

Medical Informatics Resources at CWRU

(2010 and newer)

http://catalog.case.edu/

Record 1 of 131
AUTHOR Gupta, Ashish.
TITLE Advances in Healthcare Informatics and Analytics.
IMPRINT Cham : Springer International Publishing, 2016.

Record 2 of 131
TITLE Basic engineering for medics and biologists : an ESEM primer / edited by T. Clive Lee and Peter F. Niederer.
IMPRINT Amsterdam : IOS Press, 2010.

Record 3 of 131
TITLE Bioinformatics in human health and heredity / edited by R. Chakraborty, C.R. Rao, P.K. Sen.
IMPRINT Amsterdam ; London : Elsevier, 2012.

Record 4 of 131
TITLE Brain informatics [electronic resource]
IMPRINT Berlin: Springer, [2014]-

Record 5 of 131
AUTHOR Pols, J. (Jeannette), 1966- author.
TITLE Care at a distance : on the closeness of technology / Jeannette Pols.
IMPRINT Amsterdam : Amsterdam University Press, [2012]
IMPRINT ©2012.

Record 6 of 131
AUTHOR Pols, J. (Jeannette), 1966- author.
TITLE Care at a distance : on the closeness of technology / Jeannette Pols.
IMPRINT Amsterdam : Amsterdam University Press, [2012]
IMPRINT ©2012.

Record 7 of 131
AUTHOR Malec, Brian T., author.
TITLE Careers in health information technology / Brian T. Malec, PhD.
IMPRINT New York : Springer Publishing Company, 2015.
IMPRINT ©2015.

Record 8 of 131
TITLE Champs informatique medicale, e-Santé. English.
TITLE Medical informatics, e-Health : fundamentals and applications / Alain Venot, Anita Burgun, Catherine Quantin, editors.
IMPRINT Paris : Springer, [2014]
IMPRINT ©2014.

Record 9 of 131
TITLE Clinical data as the basic staple of health learning : creating and protecting a public good : workshop summary / Roundtable on Value & Science-Driven Health Care ; Claudia Grossmann [and others] ; Institute of Medicine of the National Academies.
IMPRINT Washington, D.C. : National Academies Press, 2010.

Record 10 of 131
TITLE Clinical research informatics / Rachel L. Richesson, James E. Andrews, editors.
IMPRINT London ; New York : Springer, [2012]
IMPRINT ©2012.

Record 11 of 131
TITLE Cognitive informatics in health and biomedicine : case studies on critical care, complexity and errors / Vimla L. Patel, David R. Kaufman, Trevor Cohen, editors.
IMPRINT London ; New York : Springer, [2014]
IMPRINT ©2014.

Record 12 of 131
TITLE Cognitive search : evolution, algorithms, and the brain / edited by Peter M. Todd, Thomas T. Hills, and Trevor W. Robbins.
IMPRINT Cambridge, MA : MIT Press, ©2012.

Record 13 of 131
TITLE Comprehensive biomarker discovery and validation for clinical application / edited by Péter Horvatovich and Rainer Bischoff.
IMPRINT Cambridge : Royal Society of Chemistry, 2013.

Record 14 of 131
TITLE Comprehensive biomarker discovery and validation for clinical application / edited by Péter Horvatovich and Rainer Bischoff.
IMPRINT Cambridge : Royal Society of Chemistry, 2013.

Record 15 of 131
AUTHOR Lesselroth, Blake J.
TITLE Data visualization strategies for the electronic health record / Blake J. Lesselroth and David S. Pieczkiewicz.
IMPRINT Hauppauge, N.Y. : Nova Science Publisher's, Incorporated, [2011]
IMPRINT ©2011.

Record 16 of 131
TITLE Developments in healthcare information systems and technologies : models and methods / [edited by] Joseph Tan.
IMPRINT Hershey [Pa.] : Medical Information Science Reference, c2011.

Record 17 of 131
AUTHOR Barkhausen, Jörg, author.
TITLE Digitale Tomosynthese der Brust. English.
TITLE Digital breast tomosynthesis : technique and cases / Jörg Barkhausen, Achim Rody, Fritz K.W. Schäfer ; translator, Terry C. Telger ; illustrator, Karin Baum.
IMPRINT Stuttgart ; New York : Thieme, [2016]
IMPRINT ©2016.

Record 18 of 131
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2018 online compliance training for faculty & staff

Lisa Palazzo
Univ. Chief Compliance & Privacy Officer

Case Western Reserve University EST. 1826
think beyond the possible℠

Background of university-wide compliance training

- Employees should be aware of their organization's policies and standards
- Best practices for healthy organizations include regular employee training
- This will be third time for online compliance training at CWRU
- Opportunity to proactively address and/or anticipate compliance concerns so that we can avoid problems

Development of 2018 module

Responses to 2017 survey questions informed development of 2018 module

Responders liked:

-Convenience of doing it online when & where they wanted
-Thorough content, good explanations, efficient
-Provided web links to policies and more university information
-The real-world examples clearly illustrated the concepts
-That the university values ethics

Responders disliked:

-The most common suggestion:
"Make it more interesting and interactive, perhaps by include video/visual content"
-Don't read slides verbatim
-Improve the quality of the recording
-Clearly state which platforms will not work

2018 module: The user experience

- Jan – March 2018 training period

- Increased the “interesting to watch” factor; Qualtrics delivery vehicle

- Around 40 minutes to complete

- Main topics for 2018:
  - -Alcohol on campus & at university events
  - -Tobacco-Free Campus Policy
  - -Youth programs

- Live sessions will supplement the online module for appropriate groups

Questions

GSC Charlottesville Resolution

To Denounce and Condemn All Acts of Racism, Violence and Bigotry

Sahil Gulati
Vice president of Academic Affairs, Graduate Student Council

Respectfully submitted on behalf of the Graduate Student Council by:

Rita Tohme
President, Graduate Student Council

Sahil Gulati
Vice president of Academic Affairs, Graduate Student Council

Amendment to the GSC Charlottesville Resolution

"Core values of Diversity and Inclusion" section shall be amended to read as follows:

Resolved that the Graduate Student Council will uphold Case Western Reserve University's core values of Diversity and Inclusion for all groups of people, regardless of their race, ethnicity, religion, nationality, sexual orientation, gender identity/expression, political affiliation, or disability.

Questions…

Graduate Student Council Resolution 2017.2

To Denounce and Condemn All Acts of Racism, Violence and Bigotry

Presented on September 6th, 2017

Whereas the Graduate Student Council works to eliminate obstacles to academic and professional success for all graduate students;

Whereas recent demonstrations in Charlottesville, VA on August 12, 2017, with white supremacists publicly opposing social progress and compromising the safety of historically marginalized peoples, have compromised the safety of marginalized peoples and opposed social progress have caught the attention of the national media and student governments across the nation;

Whereas these demonstrations, though widely covered in the national media and discussed across college campuses, have a long precedent in this nation and are not inherently new or unique;

Whereas it is the responsibility of Graduate Student Council to advocate on behalf of all graduate students and to promote their dignity and worth;

Whereas the contributions of students are unique and essential because of – and not despite – their experiences and identities;

Whereas tenets of racial and ethnic superiority, purity, and hierarchy are incommensurate with the values of Graduate Student Council and Case Western Reserve University; and

Whereas critical engagement with history, politics, social trends, and diverse cultures is paramount to the progress of the human condition.

Therefore, by the Graduate Student Council acting in full session, be it

Resolved that the Graduate Student Council will uphold Case Western Reserve University's core values of Diversity and Inclusion for all groups of people, regardless of their ethnicity, religion, sexual orientation, gender identity/expression, political affiliation, or disability;

Resolved that the Graduate Student Council formally condemns the violent demonstrations and acts not only in Charlottesville, but around the globe throughout time;

Resolved that the Graduate Student Council will take actionable measures that promote celebration of diversity and that rebuke any threat to the safety of marginalized groups of people;

Resolved that the Graduate Student Council will engage the campus and community in meaningful dialogues surrounding issues of diversity and inclusion; and

Resolved that the Graduate Student Council will advocate tirelessly on behalf of graduate students' needs and desires related to increasing representation and access on campus.

Respectfully submitted on behalf of the Graduate Student Council by:

Rita Tohme
Pesident, Graduate Student Council
PhD Candidate
Department of Molecular Medicine

Brandon Benjamin
Vice President for Diversity and Inclusion,
Graduate Student Council
M.A. Student, Department of Cognitive Science

Sahil Gulati
Vice President for Academic Affairs,
Graduate Student Council
PhD Candidate, Department of Pharmacology

Amendment to the Graduate Student Council Resolution 2017.2

To Denounce and Condemn All Acts of Racism, Violence and Bigotry

Date: December 6th, 2017

"Core values of Diversity and Inclusion" section shall be amended to read as follows:

Resolved that the Graduate Student Council will uphold Case Western Reserve University's core values of Diversity and Inclusion for all groups of people, regardless of their race, ethnicity, religion, nationality, sexual orientation, gender identity/expression, political affiliation, or disability.

CASE WESTERN RESERVE UNIVERSITY
Faculty Senate Executive Committee
Regular Meeting, Tuesday, December 5, 2017

Draft Resolution on Section 1204(e) of the House Version of H.R. 1

Whereas the United States House of Representatives has adopted H.R. 1, the "Tax Cuts and Jobs Act," and the United States Senate has adopted an amended version with substantial changes, so that the bill now is referred to a Conference Committee; and

Whereas Section 1204(e) of the House version would amend Section 119(d) of the Internal Revenue Code to render graduate student tuition waivers imputed income, taxable to the graduate student without production of any cash income to pay that additional tax; and

Whereas graduate education is indispensable to the tripartite mission of research universities in the United States to advance scientific, technical, scholarly, and professional research, to educate citizens and intellectual and professional leaders, and to contribute to the cultural and social betterment of the United States and the world; and

Whereas the faculty and administration of Case Western Reserve University have both a professional and moral obligation to support our graduate student colleagues and to work to prevent this legislation from being adopted; and

Whereas the faculty and administration are united in our commitment to persuade our elected representatives to avoid the damage to the international leadership of United States research universities that would result from this flawed public policy;

The Faculty Senate of Case Western Reserve University resolves:
1) To denounce the proposal to tax graduate student tuition waivers as flawed public policy that unjustly targets a small and vulnerable population and erodes United States leadership in research and scholarship; and

2) To direct the Chair of the Faculty Senate and the Secretary of the University Faculty to transmit copies of this resolution to both Senators from Ohio and to all members of the Ohio congressional delegation, asking them to work in the Conference Committee to ensure that this provision is removed from the final legislation; and

3) To work with and support the University administration collaboratively to maximize the influence that the University, and higher education more generally, can bring to bear to avoid the severe damage that passage of this provision would inflict; and

4) To direct the Chair of the Faculty Senate and the Secretary of the University to transmit a copy of this resolution to the Graduate Student Council of Case Western Reserve University.

University Health & Counseling Services

MISSION

The mission of UH&CS is to advance the well-being, development, and academic success of our diverse student body through integrated medical, mental health, and wellness services.

DIVISION OF STUDENT AFFAIRS
CASE WESTERN RESERVE UNIVERSITY

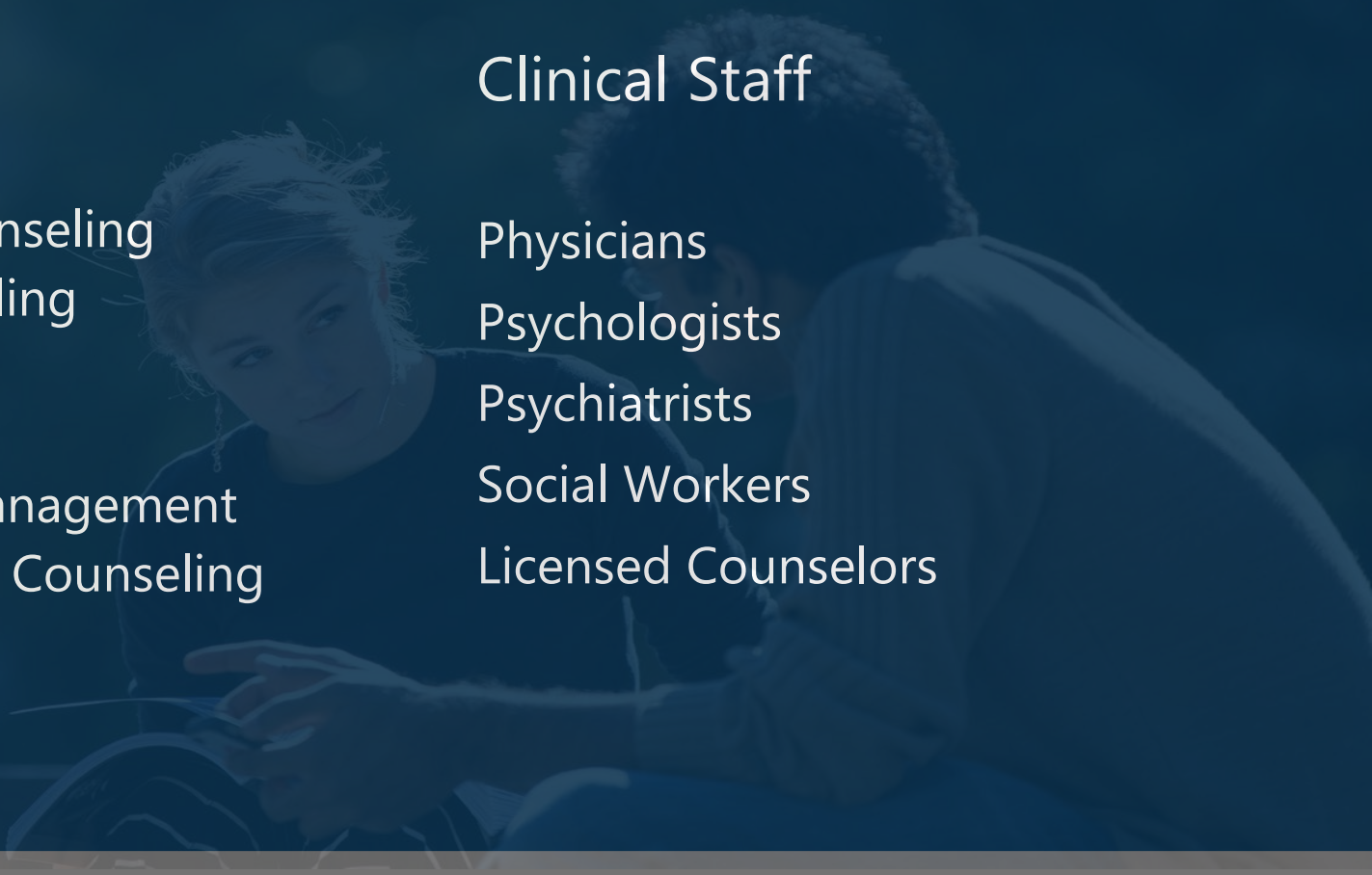
Mental Health Services at UH&CS

Services

Individual Counseling
Group Counseling
Primary care
Psychiatry
Medication management
Substance Use Counseling

Clinical Staff

Physicians
Psychologists
Psychiatrists
Social Workers
Licensed Counselors



DIVISION OF STUDENT AFFAIRS
CASE WESTERN RESERVE UNIVERSITY

Health Services – 2145 Adelbert Road
Counseling Services – 220 Sears Library Building

Accessing Counseling Services

Student Walk In

- Walk in to establish care
- Walk in for emergencies
- Walk in and be seen **same day**

Faculty resources

- Bring student to walk in
- Consult with Counselor on Call 24/7

Care and Crisis Management

- UH&CS Care Management: specialty referrals, post hospital discharge planning
- Collaborative Care Meeting (DOS/UGS/GS)
- Care Team
- TABIT—Threat Assessment/Behavioral Intervention Team (chaired by Provost's Office)

Suicide Prevention

- SAMHSA grant
- Connect CWRU
- QPR (Question, Persuade, Refer) trainings
- Postvention Planning
- Means Restriction Survey