December 12, 2017

**RESOLUTION TO APPROVE A GRADUATE
CERTIFICATE IN HEALTH INFORMATICS**

WHEREAS, Article II, Section 1 of the Bylaws of the Board of Trustees for Case Western Reserve University (the "University") states, in relevant part, that the Board of Trustees shall have the authority to establish policies to oversee the educational programs of the University; and

WHEREAS, Article V, Sec. A, Par. 2 of the Constitution of the University Faculty authorizes the Faculty Senate to make recommendations to the President for consideration and transmittal to the Board of Trustees with respect to new degrees; and

WHEREAS, at its meeting on November 28, 2017, the Faculty Senate approved a motion to recommend the proposed Graduate Certificate in Health Informatics.

NOW, THEREFORE, BE IT RESOLVED THAT:
the Executive Committee of the Board of Trustees approves the establishment of, and authorizes the University to take all necessary actions in order to create, the Graduate Certificate in Health Informatics.

**APPROVED by the
EXECUTIVE COMMITTEE
Case Western Reserve University
BOARD OF TRUSTEES**
Elizabeth J. Keefer
SECRETARY OF THE CORPORATION

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
fax 216.368.2820

casemed.case.edu

October 24, 2017

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

Dear Professor Colares:

As noted in the accompanying memo from Dr. Phoebe Stewart, Chair of the School of Medicine's Faculty Council, the Faculty Council has recommended approval of the Certificate in Health Informatics Graduate Program.

This interdisciplinary certificate program will meet the increasing demand for clinical or health informaticists in healthcare research and biomedical research in region and nationally. The proposed certificate program will be administered by the Department of Population and Quantitative Health Sciences.
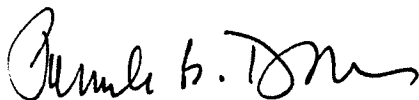
The proposal approval process is outlined in Dr. Stewart's memo. An *ad hoc* Committee was convened to review this new program and, after revisions and multiple presentations, the program was approved by the Faculty Council.

I concur with the Faculty of Medicine and recommend approval of this certificate program.

Please submit the proposed certificate program to the appropriate committees for their review at their earliest opportunity. I would be pleased to answer any questions that might arise during the review process.

Thank you.

Sincerely,

Pamela B. Davis, MD, PhD

cc: Phoebe Stewart, Chair, Faculty Council
        Nicole Deming, Assistant Dean for Faculty Affairs and Human Resources

enclosures

SCHOOL OF MEDICINE
CASE WESTERN RESERVE
UNIVERSITY

October 24, 2017

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

Dear Professor Colares:

As noted in the accompanying memo from Dr. Phoebe Steward, Chair of the School of Medicine's Faculty Council, the Faculty Council has recommended approval of the Certificate in Health Informatics Graduate Program.

This interdisciplinary certificate program will meet the increasing demand for clinical or health informaticists in healthcare research and biomedical research in region and nationally. The proposed certificate program will be administered by the Department of Population and Quantitative Health Sciences.

The proposal approval process is outlined in Dr. Stewart's memo. An *ad hoc* Committee was convened to review this new program and, after revisions and multiple presentations, the program was approved by the Faculty Council.

I concur with the Faculty of Medicine and recommend approval of this certificate program.

Please submit the proposed certificate program to the appropriate committees for their review at their earliest opportunity. I would be pleased to answer any questions that might arise during the review process.

Thank you.

Sincerely,

Pamela B. Davis, MD, PhD

cc: Phoebe Stewart, Chair, Faculty Council
        Nicole Deming, Assistant Dean for Faculty Affairs and Human Resources

enclosures

Appendix I

Example Certificate Programs

Institution	Required Coursework Topics	Credit Hour Requirements
Duke University, School of Nursing	- Health Information Exchange Standards, Methods and Models - Health Systems Project Management - Data, Information, and Knowledge Representation - Introduction to Health Informatics - System Design, Implementation, Evaluation and Maintenance - Synthesis of Specialty Practice	19 Credit Hours
John Hopkins, Bloomberg School of Public Health	- Health Information Systems: Design to Deployment - Introduction to Public Health and Biomedical Informatics - Health Information Technology Standards and Systems Interoperability - Public Health Informatics Certificate Practicum 6 credits of electives	21 Credit Hours
Cornell University, Weill Cornell Medical College (Certificate in Health Analytics)	- Health Data for Research - Health Data Mining - Introduction to Biostatistics - Biostatistics Lab (in Stata or R)	10 Credit Hours
University of Cincinnati, College of Medicine (Biomedical Informatics)	- Database Management - Introduction to Biostatistics - Introduction to Medical Informatics - Introduction to Bioinformatics - Biomedical Informatics Seminar 6 credits of electives	19 Credit Hours
Boston University (Biomedical Informatics -Online)	- Biomedical Sciences and Health IT - Health Informatics - Electronic Health Records - Advanced Health Informatics	16 Credit Hours
University of Pittsburgh, Department of Biomedical Informatics (Biomedical Informatics Training Certificate)	- Foundations in Clinical and Public Health Informatics - Foundations of Bioinformatics - Biomedical Informatics Journal Club - Research Methods 6 credits of electives	15 Credit Hours

Ohio State University, College of Medicine (Certificate in Biomedical Informatics)	• Introduction to Biomedical Informatics
	• Methods in Biomedical Informatics
	• Public Health Informatics
	
	4 Specialization Tracks:
	Clinical Informatics
	    • Introduction to Clinical Informatics
	    • Health Analytics
	Clinical Research Informatics
	    • Introduction to Research Informatics
	    • Design and Methodological Studies in BMI
	Health Analytics
	    • Health Analytics
	    • Design and Methodological Studies in BMI
	Translational Bioinformatics
	    • Introduction to Bioinformatics
	    • Introduction to Research Informatics
		15 Credit Hours

Drexel University	• Healthcare Informatics • Managing Health Informatics Projects • Healthcare Informatics: Planning & Evaluation	9 Credit Hours
University of Missouri	• Introduction to Health Informatics **Three of the Following:** • Health Information Technology • HIPAA, Social Media, and the Ethics of Health Information • Information Security, Evaluation, and Policy • Data Warehousing and Data/Text Mining for Health Care • Biomedical and Health Vocabularies and Ontologies • Enterprise Information Architecture • Health Data Analytics • Decision Support in Health Care Systems • Consumer Health Informatics • Knowledge Representation in Biology and Medicine	12 Credit Hours

Appendix II

<u>**Electives**</u>

EBME 473 / SYBB421 (3 Credit Hours) – Fundamentals of Clinical Information Systems
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.

EECS / SYBB 459 (3 Credit Hours) - Bioinformatics for Systems Biology
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.

EPBI 431 (3 Credit Hours) - Statistical Methods I
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.

EPBI 451 (3 Credit Hours) - A Data-Driven Introduction to Genomics and Human Health
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.

EPBI 457 (3 Credit Hours) - Current Issues in Genetic Epidemiology: Design and Analysis of Sequencing Studies

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.

EPBI 471 (3 Credit Hours) - Machine Learning & Data Mining

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.

EPBI 515 (3 Credit Hours) - Secondary Analysis of Large Health Care Data Bases

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.

MPHP 405 (3 Credit Hours) - Statistical Methods in Public Health

This one-semester survey course for public health students is intended to provide the fundamental concepts and methods of biostatistics as applied predominantly to public health problems. The emphasis is on interpretation and concepts rather than calculations. Topics include descriptive statistics; vital statistics; sampling; estimation and significance testing; sample size and power; correlation and regression; spatial and temporal trends; small area analysis; statistical issues in policy development. Examples of statistical methods will be drawn from public health practice. Use of computer statistical packages will be introduced.

MPHP 458 / EPBI 458 (3 Credit Hours) - Statistical Methods for Clinical Trials

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.

MPHP 467 / EPBI 467 (1-3 Credit Hours) - Comparative and Cost Effectiveness Research
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.

MPHP / EPBI 468 (3 Credit Hours) - The Continual Improvement of Healthcare: An Interdisciplinary Course
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.

CRSP 401 (3 Credit Hours) - Introduction to Clinical Research Summer Series
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).

ACCT 401H (3 Credit Hours) - Accounting for Healthcare
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.

HSMC 412 (3 Credit Hours) – Lean Service Operations
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.

HSMC 420 (3 Credit Hours) – Health Finance
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.

HSMC 456 (3 Credit Hours) – Health Policy and Management Decisions
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.

Appendix III

Electives by Domain of Academic Interest (pick 2 from 1 domain)

Health Informatics Management Concentration (Health Care Professionals)	Clinical Informatics Concentration (MPH/PhD PQHS Students)	Bioinformatics Concentration (MPH/PhD PQHS Students)
EBME 473 – Introduction to Clinical Information Systems	EPBI 515 – Large database / Healthcare analytics	EPBI 451 – A Data-Driven Introduction to Genomics and Human Health
CRSP 401 – Introduction to Clinical Research **OR** EPBI 431 – Statistical Methods 1	EPBI 471 – Machine learning and data mining	EPBI 471 – Machine learning and data mining
EPBI 471 – Machine Learning/Data Mining	EBME 473 / SYBB 431 – Introduction to Clinical Information Systems	EECS / SYBB 459 – Bioinformatics for Systems Biology
HSMC 420 – Health Finance	CRSP 401 – Introduction to Clinical Research **OR** EPBI 431 – Statistical Methods 1 **OR** MPHP 405 – Statistical Methods in Public Health	
HSMC 412 – Lean Service Operations	MPHP 467 – Comparative and Cost Effectiveness Research	
HSMC 456 – Health Policy and Management Decisions	MPHP 468 – The Continual Improvement of Healthcare: An Interdisciplinary Course	
	MPHP 458 – Statistical Methods for Clinical Trials	

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

College/School: _____School of Medicine_____
Department: _____Epidemiology and Biostatistics_____

PROPOSED: _____ **major**
                _____ **minor**
                __X__ **program**
                _____ **sequence**
                _____ **degree**

TITLE: ___Graduate Certificate in Health Informatics_____
_____

EFFECTIVE: ___Fall___ **(semester)**   __2017_____ **(year)**

DESCRIPTION: 12 credits, consisting of 2 required 3-credit courses plus two elective 3-credit courses. All courses are selected from currently offered courses.

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 Health Informatics. This graduate certificate program would be the first offering and form a starting point for an MS program, and eventually a PhD program.
2. The program is a project of the Institute for Computational Biology, a collaborative venture. This certificate 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 graduate students in many programs. Courses taken for other graduate degree programs at CWRU would be double-counted towards the certificate. This will add value to many programs at CWRU in which health informatics is a component.
4. No new courses need to be offered. Existing courses have room for the additional students.
5. All faculty/staff resources required are currently in place and available.

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* _____ March 20 2017
Department Chair: *Jonathan L. Haines* _____
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:** _____

1.   **Docket # will be filled in by the Dean's Office.**

** 2.   For a NEW major/minor/program/sequence/degree, include an outline of the requirements and provide a justification for establishment. For a CHANGE, describe specific changes in requirements and provide justification for all changes.**

3.   **The completed form (with accompanying documents) should be signed by the originating department's curriculum committee chair and department chair, other departments as required, then forwarded to the dean's office. Do not send forms directly to the Registrar's Office. The Provost and various deans' offices will coordinate transmittals.**

Graduate Certificate Program in Health Informatics

9/5/2017

Attention:

Please note that the one of the core required courses for this certificate program, EECS / EBME 480N, is in the process of relocating from EECS to Weatherhead. We anticipate that this exchange will be completed prior to the proposal being reviewed by the Faculty Council.

Graduate Certificate Program in Health Informatics

Section I: Approved graduate program(s) sponsoring the certificate program

The Graduate Certificate Program in Health Informatics (GCHI) will be sponsored and administered through the Institute of Computational Biology's (ICB) Center for Education and Training in Health Informatics (CETHI). This certificate program will serve as the core courses for our future Master's and PhD Graduate Programs in Health Informatics (GPHI), which are currently being developed. Administrative support will be provided by the Department of Population and Quantitative Health Sciences (PQHS) through the Vice Chair for Education and the Administrative Director. The Graduate Committee on Informatics will function as a steering committee for the certificate program and will be responsible for oversight of all admissions, academic, and curricular issues for the program. The Graduate Committee on Informatics will consist of a chairperson (the academic program director), three faculty members of CETHI, and the vice chair for education from the Department of Population and Quantitative Health Sciences. The academic program director and the three faculty members of the graduate committee are appointed by the vice chair for education of the Department of Population and Quantitative Health Sciences. The Graduate Committee on Informatics will be responsible for reviewing and admitting individuals into the program, handling any student or faculty concerns as they arise, and periodic reviewing of the curriculum to assure maintenance of academic standards. The current academic program director and chairperson of the Graduate Committee on Informatics is David Kaelber, MD. The three members of the Graduate Committee on Informatics from CETHI are Satya Sahoo, PhD, Alan Dowling, PhD, MCS, MS, and Colin Drummond, PhD, MBA. Mendel Singer, PhD, MPH is the current Vice Chair for Education for PQHS.

Administrative aspects of the program will be conducted by the PQHS's Administrative Director of Non-Clinical Graduate Education. This position is currently filled by Nickalaus Koziura.

Section II: Need and demand for the certificate program

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 informaticists 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.

The Institute for Computational Biology (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 certificate program will be administered by the Department of Population and Quantitative Health Sciences.

This certificate program builds upon the School of Medicine's stated mission to provide excellence in medical education and to improve the health of our community by offering broad coverage over the basics in both clinical and health informatics. Students are expected to be from two broad categories: (1) physicians, fellows, nurses, pharmacists, and hospital quality department employees seeking to learn the core knowledge of clinical informatics so that they will be able to effectively design, manage, and access electronic health records (EHRs); (2) those who aspire to work as an informaticist in biomedical research or the healthcare industry seeking to learn the necessary technical and analytical skills to develop, manage, and analyze EHRs. Within these groups, we will specifically market to underrepresented groups in NEO. This twelve (12)-credit health informatics certificate program will be accessible to these professionals, filling an important role in workforce development. The demand for informatics is visible in how many departments at CWRU are offering informatics centric courses.

We anticipate enrollment increasing over 5 years up to a cap of 15 per year. This may necessitate a cap on the number of students accepted from any single graduate program. Below is a table that projects the expected enrollment targets in the certificate program. Although health informatics is an international field, we do not expect significant international enrollment during the first five (5)-year period.

Program	Year 1	Year 2	Year 3	Year 4	Year 5
Certificate - New Enrollees	5	10	10	15	15

Section III: Statement of educational objectives of the certificate program

The proposed certificate program is designed to provide students with a strong foundation in both clinical and health informatics. After completing the program, graduates will be prepared for utilizing health informatics to improve their professional performance. Based on the core competencies established by the American Medical Informatics Association (AMIA), we have developed a set of core competencies and education objectives for the certificate program. Upon the completion of the certificate program, individuals will be able to:

Domain	Core Competency	Coursework Supporting Competency
Fundamentals	Clinical Informatics	EECS/EBME 480N, MPHP 532/HSMC 432
	The Health System	EECS/EBME 480N, MPHP 532/HSMC 432
Clinical Decision Making and Care Process Improvement	Clinical Decision Support	EECS/EBME 480N, MPHP 532/HSMC 432
	Evidence-based Patient Care	EECS/EBME 480N, MPHP 532/HSMC 432
	Clinical Workflow Analysis, Process Redesign, and Quality Improvement	EECS/EBME 480N, MPHP 532/HSMC 432
Health Information Systems	Information Technology Systems	EECS/EBME 480N, MPHP 532/HSMC 432
	Human Factors Engineering	EECS/EBME 480N, MPHP 532/HSMC 432
	Health Information Systems and Applications	EECS/EBME 480N, MPHP 532/HSMC 432
	Clinical Data Standards	EECS/EBME 480N, MPHP 532/HSMC 432
	Information System Lifecycle	EECS/EBME 480N, MPHP 532/HSMC 432
	Leadership Models, Processes, and Practices	MPHP 532/HSMC 432

Leading and Managing Change	Effective Interdisciplinary Teams	MPHP 532/HSMC 432
	Effective Communications	MPHP 532/HSMC 432
	Project Management	MPHP 532/HSMC 432
	Strategic and Financial Planning for Clinical Information Systems	MPHP 532/HSMC 432
	Change Management	MPHP 532/HSMC 432

Section IV: Curriculum for the certificate program

A minimum of twelve (12) credit hours will be required for the successful completion of the program. Students who choose to complete 15 credits will have the certificate appear on their transcript. Each student must complete two (2) core courses (MPHP 532 / HSMC 432 & EECS / EBME 480N) and six-nine (6-9) credit hours from a list of acceptable electives. The core courses will be scheduled with one in the fall and one in the spring of each academic year. Students will be expected to complete the program within four (4) semesters of acceptance, but can complete the program in two (2) semesters. This time to completion expectation will allow students to maximize their available employee tuition benefit.

Two of the courses required for this certificate are already being offered, MPHP 532 / HSMC 432 and EECS/EBME 480N. Both of these existing courses are being updated to provide a strong foundation to the certificate's program of study. Students will develop individual planned programs of study (PPOS) with their advisors to identify a minimum of six (6) hours of electives that best align with their academic interests. This will ensure that students not only receive a strong foundation in health informatics but can focus on the aspects of health informatics that are most relevant to their career goals. Students will be able to petition the Program Director to allow for a course not listed as an elective to be counted toward the certificate. The Program Director will be the final decision maker for all substitution petitions, but can include the executive council in the decision making process.

See Appendix III for electives within the three alternative domains of academic interest: (1) Health Informatics Management, (2) Clinical Informatics, and (3) Bioinformatics.

Students who opt for the fifteen (15) credit program will need to choose 9 credits of electives. While six (6) must be from a single domain (see Appendix III), the other 3 credits can be taken from any domain or can be from credits taken at CWRU for a health informatics project, thesis or independent study.

<div align="center">**Core Courses**</div>

MPHP 532 / HSMC 432 (3 Credit Hours) – Introduction to Health Informatics
The course is intended to develop competence and confidence in the participant's ability to understand and manage the complex information environment, plan for computer-based information systems, specify their functional design, manage a system adoption project, deal with system vendors, and function as an intra- or extra-organizational consultant on health-related information systems. The course covers such issues as the evolution of health care information systems; the kinds of systems in use; information management and planning; the successful design, acquisition, implementation and evaluation of systems; legal and ethical issues; and the future of HCIS.

EECS / EBME 480N (3 Credit Hours) – Health Informatics Core Issues [Will be relocated to PQHS with a new course number and the following modified course description (content changed to fit health informatics certificate and coming MS/PhD since the previous student constituency doesn't exist anymore). Planned for Spring 2019.

New Title: Foundations of Computing in Biomedical Informatics

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.

See Appendix II for a list of electives.

Section V: Justification

The Health Informatics Certificate program is a twelve-fifteen (12-15) credit hour program. The twelve (12) credit option is critical for some students, such as medical fellows, who will only have time to take one (1) course per semester over two (2) years (and will be able to complete the competencies from the American Medical Informatics Association). Students who opt for the fifteen (15) credit option will have the certificate appear on their CWRU transcript. Students who successfully complete the required coursework will receive a Certificate in Health Informatics issued by CETHI. Based on the consideration of the critical competency-knowledge areas described above, the required six (6) credit hours of core coursework and a wide range of electives were identified. Credit hours and curricula of many existing certificate programs in health informatics/biomedical informatics were also considered. A representative sample of such programs can be found in Appendix I. The examined programs range from nine (9) to twenty-one (21) required credit hours and cover similar information.

Section VI: Entrance, performance, and exit standards for the certificate program

Entrance Standards: Entrance to the Certificate program will be administered by the Department of Population and Quantitative Health Sciences. Individuals who want to participate in the program will complete an application form that includes a brief personal statement describing the reason(s) for seeking health informatics training and a recent CV or resume.

We expect that most applicants to the Certificate program will have already obtained a postsecondary (e.g. AS, BS, BA, MS, PhD) or advanced clinical (e.g. MD, MSN, DMD) degree and be a current health or clinical professional. Per CWRU School of Graduate Studies requirements, individuals who are not already graduate degree-seeking students at CWRU must submit to the School of Graduate Studies a completed non-degree application form. Individuals who are not faculty, staff, or employees of CWRU must also submit a transcript or copy of their diploma, documenting completion of a baccalaureate degree. Per School of Graduate Studies requirements, non-degree-seeking individuals will not be required to provide their Test of English as a Foreign Language (TOEFL). However, the program may optionally require the TOEFL for individual students.

Individuals will be accepted into the program based on the Graduate Committee on Informatics' review of the personal statement, letters of reference, transcripts, and any supporting documentation required by the School of Graduate Studies. Majority vote of acceptance by the Committee members will be necessary for admittance. Once accepted into the Certificate program, participants will register for the courses through the Student Information System.

The program will have rolling admissions, so students may start in the fall, the spring, or the summer. Deadlines to apply to program will be the following: May 1st for summer, June 30th for fall, and December 1st for spring. The coursework for the Certificate will be listed on the official CWRU transcript. However, the Certificate in Health Informatics will be issued by the Department of Population and Quantitative Health Sciences, not the University. Although course credits will appear on the official CWRU transcript and will be transferable to fulfill requirements for advanced degrees, the certificate itself will only appear on the official CWRU transcript for students choosing the fifteen (15) credit option.

Length of Program: Once accepted into the program, individuals will have three (3) calendar years to complete the requirements. Most students will complete the program within four (4) semesters of acceptance, but the program can be completed in as little as two (2) semesters.

Performance Standards: A grade of B or higher in each core required course, and C or higher in every elective graded course and an overall GPA of 3.00 will be required for successful completion of the Certificate program. A minimum of twelve (12) credits must be graded. Enrollees will be responsible for keeping track of the courses they take. To oversee students' progress in the program, enrollees will be required to submit a one-page Program Progress

Checklist to the Administrative Director of Non-Clinical Graduate Education at the end of each semester indicating the course(s) completed that semester. The Administrative Director of Non-Clinical Graduate Education will notify the Graduate Committee on Informatics if any students are not making adequate progress towards the Certificate. The Committee will make recommendations for remediation or any further action to assist students in successfully completing the program.

Exit Standards: Students who complete all required coursework will submit a checklist to the Administrative Director of Non-Clinical Graduate Education that all coursework is completed. This administrator will verify with the registrar's office that all requirements have been met. After this verification, the Academic Program Director will approve the awarding of the certificate in writing, and the Program Director will issue a certificate to the enrollee documenting completion of the program. If the student has opted for the fifteen (15) credit certificate, the program will certify the student for graduation and submit paperwork to the School of Graduate Studies for processing, to ensure the awarding of the certificate appears on the student's transcript.

Section VII: Faculty expertise contributing to the certificate program

Faculty responsible for the Certificate program will be drawn from the CWRU School of Medicine's Department of Population and Quantitative Health Sciences, the Case School of Engineering's Department of Electrical Engineering and Computer Science, the Institute for Computational Biology and CWRU School of Medicine's Program in Systems Biology and Bioinformatics. Faculty members currently responsible for contributing to the core courses of the certificate program are listed below.

Alan Dowling, PhD, MCS, MS

Alan Dowling consults and researches internationally on health strategy; health information exchange; EHR and PHR adoption; technology-based process innovation and reengineering; and information systems design, adoption and outcome measurement. His education includes a PhD (MIT) in healthcare management and management information systems and master's degrees in computer science and engineering management with an emphasis in health systems engineering. He was a full-time faculty member of CWRU's School of Management and School of Medicine before becoming a partner at Ernest & Young, where he was responsible for health information systems consulting and later its Director of Global Health Consulting. He was also a Colonel in the USAF Medical Service Corps and served on numerous federal health task forces.

David Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI

Professor of Internal Medicine, Pediatrics, Department of Population and Quantitative Health Sciences. Case Western Reserve University. Areas of interest and research include personal health records, electronic health records, clinical decision support, telemedicine, the teaching of medical informatics, using electronic medical records for chronic disease detection and

management, and other areas of clinical informatics, as well as research in med-peds, primary care, and chronic diseases in children and adults.

Satya Sahoo, PhD

Assistant Professor, Department of Population and Quantitative Health Sciences, Case Western Reserve University. Research interests in biomedical informatics include biomedical big data, neuroinformatics, epilepsy neurological disorder, clinical text processing, sleep medicine, community health. Dr. Sahoo's research interests in computer Science include knowledge representation and reasoning (ontology engineering), distributed and parallel computing (Hadoop, data science), Semantic Web, provenance metadata, data integration, scientific workflows, and (Semantic) Web services.

Colin Drummond, PhD, MBA

Professor and Assistant Chair, Department of Biomedical Engineering. The Institute for Management and Engineering. Research interests include educational pedagogy, healthcare IT, entrepreneurship and innovation. Much of this research has a strong translational focus, resulting in collaboration and secondary appointments in the School of Medicine and the University Hospitals Cleveland Medical Center. Professor Drummond has conducted research in the areas of medical device design, microfabrication packaging, sensor systems, and cross-platform software systems integration. For over two decades, Colin has worked in the application of science and technology to the creation of products and services.

Mendel Singer, PhD, MPH

Associate Professor. Vice Chair for Education. Department of Population and Quantitative Health Sciences. Research interests in content areas obesity, infectious disease, antimicrobial resistance, and mental health. Research interests in methodology include school and community health interventions (especially among faith-based and Jewish communities), cost-effectiveness analysis (especially in developing nations), large databases, health care claims databases, and quality of life.

Section VIII: New resources, courses, etc., if any, necessary to support certificate program

Managerial and administrative tasks necessary for the proposed Certificate program will be added to the administrative director of Non-Clinical Graduate Education. The program will require no new courses. The projected cost of the program is $6,500 annually, which includes marketing to promote our program to target student groups and AMIA membership. The projected cost is itemized below. Additionally, the Dean of the School of Medicine has committed funds for the faculty support and marketing for the first two years of the program. The Institute for Computational Biology has committed administrative support staff and to cover

miscellaneous administrative expenses. The ICB is offering this certificate as a service to the university.

Category	Description	Annual Amount
Marketing	Funds for promotional material and efforts for programs	$2,500
AMIA	Annual membership	$4,000

Section IX: Tuition Transfer

Tuition return for students enrolled as non-degree students is automatically assigned based on registration. There is no need for any adjustment of this tuition money.

Tuition return for graduate students enrolled in a degree program, by default, is assigned to the student's home school. The health informatics program is one that will span multiple schools and programs, and will be helpful to many programs success (e.g. the Health Informatics major in the Master of Public Health program, the Medical Informatics major in the M.S. in Computer Science program). This is consistent with the Institute for Computation Biology, which is a very collaborative, multi-institutional endeavor. Further, the number of students in any specific elective class is not expected to be large, and many of these may be students from a degree program in that course's school. In the spirit of collegiality, there will be no special arrangement for tuition sharing for elective courses in this certificate program, i.e. the default University arrangement of tuition return going to home school will be maintained.

However, due to the anticipated size of this program, it is recognized that there needs to be tuition support for the core required courses that will be taught at Weatherhead. For these courses, when students in the certificate program are also enrolled in a degree program outside of Weatherhead, tuition for that course will be shared in the following manner: the student's home school will pay 37.5% of the tuition (based on WSOM's per credit hour tuition) to Weatherhead, with WSOM billing the appropriate school for that amount. This is based on the premise of allowing about 25% for overhead and splitting the balance equally between the student's home school and WSOM [Note: The fixed 37.5% figure is to simplify billing – in actuality, the University sends approximately 97% of tuition to the home school, not 100%]. There is one exception to this rule. Since the School of Medicine has invested money in the development of this program, and is assuming the cost and administrative responsibilities for the running of the program, SOM will be allowed to have up to 4 M.D. students per year enter the certificate program without having to pay WSOM any tuition when these students take the core required courses.

In the event that a student in a degree program outside of Weatherhead has, prior to enrolling in the certificate program, already taken one or both of the core required

courses with no tuition sharing with WSOM, WSOM reserves the right to back charge the student's home school (according to the rule above) as a requirement for completion of the certificate.

There has been some movement towards a University policy of tuition sharing for graduate students taking courses in a different school. That has not happened as of the time of this proposal. If such a policy becomes implemented automatically, it will supersede the arrangement proposed here.

Appendix I

Example Certificate Programs

Institution	Required Coursework Topics	Credit Hour Requirements
Duke University, School of Nursing	- Health Information Exchange Standards, Methods and Models - Health Systems Project Management - Data, Information, and Knowledge Representation - Introduction to Health Informatics - System Design, Implementation, Evaluation and Maintenance - Synthesis of Specialty Practice	19 Credit Hours
John Hopkins, Bloomberg School of Public Health	- Health Information Systems: Design to Deployment - Introduction to Public Health and Biomedical Informatics - Health Information Technology Standards and Systems Interoperability - Public Health Informatics Certificate Practicum 6 credits of electives	21 Credit Hours
Cornell University, Weill Cornell Medical College (Certificate in Health Analytics)	- Health Data for Research - Health Data Mining - Introduction to Biostatistics - Biostatistics Lab (in Stata or R)	10 Credit Hours
University of Cincinnati, College of Medicine (Biomedical Informatics)	- Database Management - Introduction to Biostatistics - Introduction to Medical Informatics - Introduction to Bioinformatics - Biomedical Informatics Seminar 6 credits of electives	19 Credit Hours
Boston University (Biomedical Informatics -Online)	- Biomedical Sciences and Health IT - Health Informatics - Electronic Health Records - Advanced Health Informatics	16 Credit Hours
University of Pittsburgh, Department of Biomedical Informatics (Biomedical Informatics Training Certificate)	- Foundations in Clinical and Public Health Informatics - Foundations of Bioinformatics - Biomedical Informatics Journal Club - Research Methods 6 credits of electives	15 Credit Hours

Ohio State University, College of Medicine (Certificate in Biomedical Informatics)	• Introduction to Biomedical Informatics
	• Methods in Biomedical Informatics
	• Public Health Informatics
	
	4 Specialization Tracks:
	Clinical Informatics
	    • Introduction to Clinical Informatics
	    • Health Analytics
	Clinical Research Informatics
	    • Introduction to Research Informatics
	    • Design and Methodological Studies in BMI
	Health Analytics
	    • Health Analytics
	    • Design and Methodological Studies in BMI
	Translational Bioinformatics
	    • Introduction to Bioinformatics
	    • Introduction to Research Informatics
		15 Credit Hours

Drexel University	• Healthcare Informatics • Managing Health Informatics Projects • Healthcare Informatics: Planning & Evaluation	9 Credit Hours
University of Missouri	• Introduction to Health Informatics **Three of the Following:** • Health Information Technology • HIPAA, Social Media, and the Ethics of Health Information • Information Security, Evaluation, and Policy • Data Warehousing and Data/Text Mining for Health Care • Biomedical and Health Vocabularies and Ontologies • Enterprise Information Architecture • Health Data Analytics • Decision Support in Health Care Systems • Consumer Health Informatics • Knowledge Representation in Biology and Medicine	12 Credit Hours

Appendix II

<u>**Electives**</u>

EBME 473 / SYBB421 (3 Credit Hours) – Fundamentals of Clinical Information Systems
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.

EECS / SYBB 459 (3 Credit Hours) - Bioinformatics for Systems Biology
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.

EPBI 431 (3 Credit Hours) - Statistical Methods I
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.

EPBI 451 (3 Credit Hours) - A Data-Driven Introduction to Genomics and Human Health
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.

EPBI 457 (3 Credit Hours) - Current Issues in Genetic Epidemiology: Design and Analysis of Sequencing Studies

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.

EPBI 471 (3 Credit Hours) - Machine Learning & Data Mining

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.

EPBI 515 (3 Credit Hours) - Secondary Analysis of Large Health Care Data Bases

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.

MPHP 405 (3 Credit Hours) - Statistical Methods in Public Health

This one-semester survey course for public health students is intended to provide the fundamental concepts and methods of biostatistics as applied predominantly to public health problems. The emphasis is on interpretation and concepts rather than calculations. Topics include descriptive statistics; vital statistics; sampling; estimation and significance testing; sample size and power; correlation and regression; spatial and temporal trends; small area analysis; statistical issues in policy development. Examples of statistical methods will be drawn from public health practice. Use of computer statistical packages will be introduced.

MPHP 458 / EPBI 458 (3 Credit Hours) - Statistical Methods for Clinical Trials

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.

MPHP 467 / EPBI 467 (1-3 Credit Hours) - Comparative and Cost Effectiveness Research
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.

MPHP / EPBI 468 (3 Credit Hours) - The Continual Improvement of Healthcare: An Interdisciplinary Course
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.

CRSP 401 (3 Credit Hours) - Introduction to Clinical Research Summer Series
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).

ACCT 401H (3 Credit Hours) - Accounting for Healthcare
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.

HSMC 412 (3 Credit Hours) – Lean Service Operations
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.

HSMC 420 (3 Credit Hours) – Health Finance
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.

HSMC 456 (3 Credit Hours) – Health Policy and Management Decisions
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.

Appendix III

Electives by Domain of Academic Interest (pick 2 from 1 domain)

Health Informatics Management Concentration (Health Care Professionals)	Clinical Informatics Concentration (MPH/PhD PQHS Students)	Bioinformatics Concentration (MPH/PhD PQHS Students)
EBME 473 – Introduction to Clinical Information Systems	EPBI 515 – Large database / Healthcare analytics	EPBI 451 – A Data-Driven Introduction to Genomics and Human Health
CRSP 401 – Introduction to Clinical Research **OR** EPBI 431 – Statistical Methods 1	EPBI 471 – Machine learning and data mining	EPBI 471 – Machine learning and data mining
EPBI 471 – Machine Learning/Data Mining	EBME 473 / SYBB 431 – Introduction to Clinical Information Systems	EECS / SYBB 459 – Bioinformatics for Systems Biology
HSMC 420 – Health Finance	CRSP 401 – Introduction to Clinical Research **OR** EPBI 431 – Statistical Methods 1 **OR** MPHP 405 – Statistical Methods in Public Health	
HSMC 412 – Lean Service Operations	MPHP 467 – Comparative and Cost Effectiveness Research	
HSMC 456 – Health Policy and Management Decisions	MPHP 468 – The Continual Improvement of Healthcare: An Interdisciplinary Course	
	MPHP 458 – Statistical Methods for Clinical Trials	

SCHOOL OF MEDICINE
CASE WESTERN RESERVE
UNIVERSITY

Jonathan L. Haines, PhD
Professor and Chairman
Department of Epidemiology and Biostatistics
Mary W. Sheldon, MD Professor of Genomic Sciences
Director, Institute for Computational Biology

Wolstein Research Building
Suite 2-529
2103 Cornell Avenue
Cleveland, Ohio 44106

Phone 216.368.3197

March 13, 2017

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

Dear David,

The Department of Epidemiology & Biostatistics fully supports this proposal for a new certificate in Health Informatics. As you may know, the department is in the process of changing its name to Population and Quantitative Health Sciences, a change that will be officially announced in the next month. The certificate in Health Informatics will fill a significant 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 to make it a success. Students in this certificate program are welcome to take the departmental courses identified in this proposal. As indicated in the proposal, health informatics is represented in courses across the University but currently there is no entry point at CWRU for healthcare professionals and researchers to gain exposure through a structured and curated program. This new certificate is administered by my department and housed in the Institute for Computational Biology (which I direct). Importantly it is fully collaborative with about a half dozen other departments across CWRU and 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 this new certificate program.

Sincerely,

Jonathan L. Haines, PhD
Professor and Chairman
Department of Population & Quantitative Health Sciences (né Epidemiology and Biostatistics)
Director, Institute for Computational Biology
Mary W. Sheldon, MD Professor of Genomic Sciences
Case Western Reserve University School of Medicine

CENTER FOR
HEALTH CARE
RESEARCH AND POLICY

Doug Einstadter, MD, MPH
Professor of Medicine,
Epidemiology & Biostatistics

E-mail: deinstadter@metrohealth.org
Phone: 216-778-3902
Fax: 216-778-3945

March 13, 2017

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

Dear Dr. Kaelber:

I wish to express my enthusiasm and support for the new certificate program in Health Informatics that you have proposed at CWRU. The proposed certificate program undoubtedly will appeal to students across many disciplines and will enhance their educational experience at CWRU. I am pleased to include my course, CRSP 401 (Introduction to Clinical Research Summer Series) as a relevant option for students in both the Health Informatics Management Concentration and the Clinical Informatics Concentration. I welcome students interested in either of these concentrations to take CRSP 401. Additionally, I expect that the Health Informatics Certificate program also will be of great interest to students enrolled in the CRSP program.

Sincerely,

Douglas Einstadter
Professor of Medicine, Epidemiology & Biostatistics
Center for Health Care Research and Policy
CWRU at MetroHealth Medical Center

Center for Health Care Research and Policy
MetroHealth Medical Center • Rammelkamp Research & Education Building, R221
2500 MetroHealth Drive • Cleveland, Ohio 44109-1998
Phone: 216-778-3901 • Fax: 216-778-3945
www.chrp.org • www.betterhealthpartnership.org

MetroHealth

SCHOOL OF MEDICINE
CASE WESTERN RESERVE
UNIVERSITY

Colin K. Drummond, Ph.D, MBA
Department of Biomedical Engineering
Case School of Engineering
Case Western Reserve University
Cleveland OH. 44106

March 14, 2017

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

Dear Professor Kaelber

I am delighted with the development of the proposed certificate in Health Informatics through the Institute for Computational Biology and am writing to provide my enthusiastic support for this initiative. Indeed, I have been involved in the process of developing this program and am particularly excited with the inter-professional approach and collaborative approach used in the development of the program.

My expectations are that there will be a number of potential students interested in this program and certainly even graduate students from Biomedical Engineering, the Translational Health Track, or the Masters of Engineering and Management and other programs I am affiliated with to pursue this certificate. My sense is that EBME 473 (Fundamentals of Clinical Information Systems) – a course I teach every fall -- would be an excellent elective for students interested in the Clinical Informatics Concentration of the proposed certificate. I would welcome students from this program to take my course.

As a person who works with many graduate students with an interest in Informatics I am pleased to support this initiative and am excited about the doors this can open for our graduate students. If you have any questions or would like to discuss this in more detail, please call me at 216.368.6970.

Sincerely,

Colin Drummond, PhD, MBA
Professor and Assistant Chair

Electrical Engineering & Computer Science
Case Western Reserve University
10900 Euclid Avenue, Cleveland, Ohio 44106
Phone: +1 (216) 368-2963
e-mail: mehmet.koyuturk@case.edu
http://compbio.case.edu/koyuturk/

March 14, 2017

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

Dear David,

I wholeheartedly support the ICB's new certificate program in Health Informatics. I believe that students interested in the Bioinformatics Concentration of the certificate program would benefit greatly from taking my course SYBB 459 (Bioinformatics for Systems Biology) and I welcome students from this certificate program to take my course. I believe that this certificate program will be useful for students throughout the School of Medicine, including graduate students in my department.

Sincerely,

Mehmet Koyutürk, Ph.D.
T. & A. Schroeder Associate Professor of Computer Science and Engineering

CASE WESTERN RESERVE
UNIVERSITY
WEATHERHEAD SCHOOL OF MANAGEMENT

Simon Peck
Associate Dean of Graduate Programs
Associate Professor of Strategy
Department of Design & Innovation

Case Western Reserve University
10900 Euclid Ave.
Cleveland, Ohio 44106-7235

Phone: 216/368-3824
Fax: 216/368-4785
E-mail: simon.peck@case.edu
http://weatherhead.case.edu

April 28, 2017

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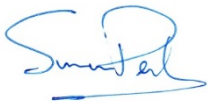
Dear David,

I am pleased to write this letter in support of the proposal certificate in Health Informatics from the Institute of Computational Biology (ICB). I believe this new track 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 in an attempt to maximize current resources. I look forward to continuing to work with the ICB and the certificate's Graduate Education Committee to continue to identify further opportunities for collaboration.

This certificate program's Health Informatics Management Concentration utilizes several of our courses as electives: including HSMC 421, HSMC 420, HSMC 412, HSMC 456, and ACCT 401H. The 2 required core courses for the certificate program will also utilize courses taught by Dr. Alan Dowling. I approve the use of these courses as electives and the 2 required core courses for the proposed certificate. I anticipate some of our graduate students will seek this certificate.

Regarding tuition, for non-degree students, the default CWRU university-wide standard tuition flows will be maintained. For student enrolled in a degree program outside of the Weatherhead School of Management (WSOM), 37.5% of the WSOM per credit tuition for the 2 core courses (home based in WSOM) will be billed by WSOM to the student's home school. In recognition of the School of Medicine's financial support for developing and maintaining this certificate program, up to 4 new MD students per year can be enrolled in the certificate program and take the 2 core courses without any tuition sharing.

I look forward to the approval of this exciting new certificate program.

Sincerely,

Simon Peck
Associate Dean of MBA Programs

<div align="center">Memorandum</div>

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

From: Phoebe Stewart, PhD
Chair, Faculty Council

Re: New Graduate Certificate in Health Informatics

Date: October 11, 2017

At its September 18, 2017 meeting, the Faculty Council voted to recommend approval of a new Graduate Certificate in 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.

The proposed certificate will be sponsored by the Institute of Computational Biology. Jonathan Haines is the Director of the institute and Chair of the Department of Population and Quantitative Health Sciences. The program includes faculty from multiple schools and affiliated institutions. As noted by Dr. Singer while there is a fast growing demand for people trained in health informatics, there is a major shortage of people who have the actual training and experience.

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 none abstained. The motion passed.

After your review, I hope you will join me in recommending approval of the Graduate Certificate in 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

January 16, 2018

RESOLUTION TO APPROVE A MASTER OF SCIENCE PROGRAM IN BIOMEDICAL AND HEALTH INFORMATICS

WHEREAS, Article II, Section 1 of the Bylaws of the Board of Trustees for Case Western Reserve University (the "University") states, in relevant part, that the Board of Trustees shall have the authority to establish policies to oversee the educational programs of the University; and

WHEREAS, Article V, Sec. A, Par. 2 of the Constitution of the University Faculty authorizes the Faculty Senate to make recommendations to the President for consideration and transmittal to the Board of Trustees with respect to new degrees; and

WHEREAS, at its meeting on December 11, 2017, the Faculty Senate approved a motion to recommend the proposed Master of Science Program in Biomedical and Health Informatics.

NOW, THEREFORE, BE IT RESOLVED THAT:
the Executive Committee of the Board of Trustees approves the establishment of, and authorizes the University to take all necessary actions in order to create, the Master of Science Program in Biomedical and Health Informatics.

**APPROVED by the
EXECUTIVE COMMITTEE
Case Western Reserve University
BOARD OF TRUSTEES
Elizabeth J. Keefer
SECRETARY OF THE CORPORATION**

January 16, 2018

RESOLUTION TO APPROVE A DOCTOR OF PHILOSOPHY PROGRAM IN BIOMEDICAL AND HEALTH INFORMATICS

WHEREAS, Article II, Section 1 of the Bylaws of the Board of Trustees for Case Western Reserve University (the "University") states, in relevant part, that the Board of Trustees shall have the authority to establish policies to oversee the educational programs of the University; and

WHEREAS, Article V, Sec. A, Par. 2 of the Constitution of the University Faculty authorizes the Faculty Senate to make recommendations to the President for consideration and transmittal to the Board of Trustees with respect to new degrees; and

WHEREAS, at its meeting on December 11, 2017, the Faculty Senate approved a motion to recommend the proposed Doctor of Philosophy Program in Biomedical and Health Informatics.

NOW, THEREFORE, BE IT RESOLVED THAT:
the Executive Committee of the Board of Trustees approves the establishment of, and authorizes the University to take all necessary actions in order to create, the Doctor of Philosophy Program in Biomedical and Health Informatics.

**APPROVED by the
EXECUTIVE COMMITTEE
Case Western Reserve University
BOARD OF TRUSTEES
Elizabeth J. Keefer
SECRETARY OF THE CORPORATION**