Syllabus

> This is a single, concatenated file, suitable for printing or saving as a PDF for offline viewing. Please note that some animations or images may not work.

Course Description

> This module is also available as a concatenated page, suitable for printing or saving as a PDF for offline viewing.

MET CS580

Health Informatics

The CS580 course presents the fundamental principles, concepts, and technological elements that make up the building blocks of Health Informatics. It introduces fundamental characteristics of data, information, and knowledge in the domain, the common algorithms for health applications, and IT components in representative clinical processes. It also introduces the conceptual framework for handling the collection, storage and the optimal use of biomedical data. It introduces the concepts of population health and precision medicine and the information systems that support them. It covers basic principles of knowledge management systems in biomedicine, various aspects of Health Information Technology standards, and IT aspects of clinical process modeling. There is also a term project to access students' ability to understand and implement simple Health Informatics solutions. One guest speaker with many years of experience in health IT might be invited to share their first-hand experience with students.

Course Overview

Health informatics is a multi-disciplinary field at the intersection of information science, computer science, and health care. Health informatics is growing at a rapid pace and will continue to grow well into the future. A brief introduction to health informatics covers the key concepts, background disciplines, historical overview, and

challenges ahead. Students will be introduced to the definitions and concepts of knowledge hierarchy: data, information, knowledge and wisdom, and the building blocks of Health Informatics: algorithms, medical decision-making, and clinical process modeling. Knowledge management systems and health IT standards will be also covered. A selection of case studies will be used to illustrate the applications of the concepts and algorithms.

The assessment will consist of assignments, quizzes, and discussions that will test students' familiarity with study material and understanding of the concepts addressed in the materials and case studies. A final project tests students' overall understanding of the course content and requires students to develop a specific Health Informatics solution. The final exam will be based on the material covered in the course.

This course has been designed in accordance with Master's Degree curriculum requirements within the Accreditation Standards for Health Informatics and Health Information Management educational programs.

Course Objectives

This course will enable you to:

- Become familiar with the basic definitions, key concepts, terminology, and historical context of Health Informatics
- Understand fundamental characteristics of data, information, and knowledge in the Health Informatics domain
- Become familiar with common algorithms for health applications and IT components in representative clinical processes
- Develop understanding of population health and precision medicine
- Understand basic principles of knowledge management systems in biomedicine
- Develop understanding of various aspects of Health Information Technology standards
- Become familiar with IT aspects of clinical process modeling and health information systems

Course Outline

This course is presented as a series of six modules. The course material is also grouped in six modules. The seventh module represents the week of the Final Examination. Each of the Modules 1–6 will have two

lectures, one discussion topic, one quiz, and one assignment. There is also a term project to access the students' ability to understanding and implement simple Health Informatics solutions.

Readings - For each module, there are online lessons and research paper readings. Your professor may suggest additional readings during the running of the course.

Discussions - There will be graded discussions for each module between you and your classmates. These discussions might be moderated by professor. Postings for each discussion should be completed by the assigned due dates. Again, check the calendar for these due dates. There are also general discussions boards, which are not graded, for you to use to discuss any issues with your classmates. Please see the Discussion module on the home page for more details.

Assignments - There will be assignments for each module throughout the course. Please check the course site calendar for due dates.

Assessments/Quizzes - The quizzes they will be listed in the calendar. Be sure to check it to ensure that you complete them before the due date. Quizzes may be a combination of True/False, single/multiple choice, and short essay questions.

Module One – Introduction to Health Informatics & Data, Information, and Knowledge

Lecture One:

- Introduction to the U.S. healthcare system
- Introduction to health informatics and its significance
- Definitions and key concepts in health informatics
- Background disciplines, historical overview, and future challenges

Lecture Two:

- Introduction to knowledge hierarchy: Data, information, and knowledge
- The definitions of healthcare data and information
- Types of healthcare information (internal versus external data and information)
- The major purposes of maintain patient records
- The content and uses of patient records and claim content
- The common issues related to healthcare data quality
- The challenges associated with measuring and ensuring healthcare data quality
- Quality assessment including total quality management and data quality
- Introduction to biomedical research and publicly available resources

Module Two – The National Landscape of Healthcare IT

& History of Healthcare Information System

Lecture Three:

- The major influences shaping the health IT landscape in the US
- The roles played by the major government initiatives and private sectors in advancing health IT in the US
- The major events that have influences the adoption of health IT and systems

Lecture Four:

- History and evolution of healthcare information systems (HCIS)
- The major advances in information technology and significant federal initiatives that influenced the adoption of healthcare information systems
- The major types of administrative and clinical information systems used in healthcare
- Current issues pertaining to the use HCIS

Module Three – Medical Algorithms & Medical Decision Making

Lecture Five:

- Various ways to describe algorithms, such as flowchart, pseudocode, and conceptual graph
- Introduction to medical algorithms
- Algorithms in computer science, such as decision tree and regression
- Calculation of measurements of classification performance—sensitivity and specificity

Lecture Six:

- Decision-making process
- Medical decision-making process (diagnosis, treatment, monitoring, prognosis)
- Informatics in clinical decision-making
- Introduction to evidence-based medicine

Module Four – Modeling and Simulations & Population Health and Precision Medicine

Lecture Seven:

- Develop understanding of modeling and simulation
- Become familiar with applications of modeling and simulation in biomedicine

Lecture Eight:

- Data and information needs of health systems in managing population health
- Key health IT tools and strategies for population health management
- Concepts of precision medicine

Module Five – Standards in Health Informatics

Lecture Nine and Ten:

- Introduction to standards
- The Need for Health Informatics Standards
- The role of federal initiative and legislation that that have significant impact on the adoption of healthcare information standards in the United States
- Major types of healthcare information standards and the organization that develop or approve them
- The importance of healthcare IT standards to the future of the US health care delivery system

Module Six – Knowledge management system & Organizing Health IT services

Lecture Eleven:

- Introduction to knowledge management
- Knowledge discovery, data mining and text mining
- Knowledge management and decision making support in biomedicine

Lecture Twelve:

- The roles, responsibilities, and major functions of the IT department in healthcare organizations
- The roles, responsibilities, and major functions of the IT leaders
- The various ways to organize IT services
- The key attributes of highly effective IT departments
- The role and major function of the data analytics department
- Developing plans for evaluating the effectiveness of the IT function
- The components of an IT strategic plan
- How to develop an IT strategic plan
- The Gartner Hype Cycle

Module Seven - Prepare for and take the final exam

You will prepare for and take the proctored final exam.

The course will remain open two weeks, after the final exam, so that you can continue discussions and ask any questions about database technology, your grades, or the course. This is also a time when we enter into a dialog where we endeavor to learn from you how we can modify the course so that it better meets your needs.

Instructor

Vijai Diwania

Computer Science Department
Metropolitan College
Boston University

Email: vijaid@bu.edu

My name is Vijai Diwania, and I will be your instructor for this course. I hold a master's degree in computer science from a prestigious engineering college in India, and have been in information technology since 1990. I am skilled in various information technologies such as databases, web, Java, middleware, webservices, API, integration, interoperability, and many others.

I joined GEHA (Government Employee Health Association) – a nonprofit medical and dental insurance provider to federal and postal employees, retirees, and their families. I am managing a team of five people involved in integration and API's for the digital transformation initiative. I had worked with Boston Children's Hospital, Boston for more than fifteen years. At Boston Children's Hospital, I worked as manager - application development and infrastructure managing a great team of six to ten people involved in middleware administration, applications development, and integration. I also helped software engineers in database designs, writing efficient database code, and other database related tasks. Prior to Boston Children's Hospital, I worked with Liberty Mutual Insurance Group. I have worked as a programmer, manager, technical consultant, senior data analyst, data architect, integration / interoperability architect, and DBA in tire manufacturing, textile, automobile, insurance, and health care organizations.

Course Developers

Dr. Vladimir Brusic, M.Eng., M.App.Sci., Ph.D., M.B.A., is the initial course developer, who made significant contributions to all aspects of this course. He has worked in the biomedical informatics field since the 1980s and has been teaching health informatics classes at BU for several years. He holds Masters degrees in Biomedical Engineering (M.Eng., Belgrade, Yugoslavia), Information Technology (M.App.Sci., RMIT, Australia), and Business Administration (MBA, Rutgers, USA). He received a Ph.D. (LaTrobe, Australia) for doctoral work in bioinformatics. He is an Adjunct Professor in Computer Science at Boston University

Metropolitan College, where he teaches Health Informatics subjects and is a member of the Health Informatics Laboratory. He is the dean of School of Science and Technology, Nazarbayev University and adjunct member of Harvard Medical School. Previously he was the Director of Bioinformatics at Cancer Vaccine Center, Dana-Farber Cancer Institute, and a Principal Associate in Medicine, Harvard Medical School.

Dr. Guanglan Zhang developed the online course material based on the content of the on-campus course in 2012. Since then, she has modified and updated the course content multiple times to keep up with the ever-changing healthcare IT environment. She holds Masters degrees in Biomedical Engineering (M.Eng., Nanyang Technological University, Singapore) and Automatic Control Theory and Application (M.Eng., Northwestern Polytechnic University, China). She received a Ph.D. (Nanyang Technological University, Singapore) for doctoral work in bioinformatics. She is an Associate Professor in Computer Science at Boston University Metropolitan College, the Faculty Coordinator for Health Informatics Program, and an adjunct member of Dana-Farber Cancer Institute and Harvard Medical School. She also leads research activities in the MET Health Informatics Laboratory. Dr. Zhang has worked in the biomedical informatics field since 1998. The most important aspects of her work include development and implementation of biomedical databases, computational simulations of laboratory experiments, development of diagnostic methods for tissue typing, and computational support for vaccine development. Computational tools that she developed are used in the study of immunology, vaccinology, infectious disease, and cancer. She has authored more than 50 peer-reviewed scientific journal publications and developed dozens of biomedical specialist databases and computational systems.

Course Materials

Required textbook:
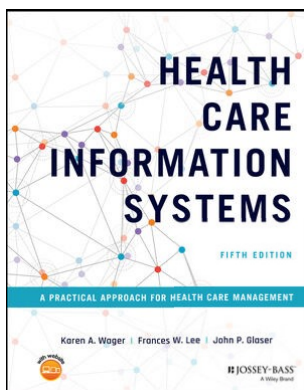
Wager, K. A., Lee, F. W., & Glaser, J. P. (2022). *Health care information systems: A practical approach for health care management,* **5th Edition.** Jossey-Bass.
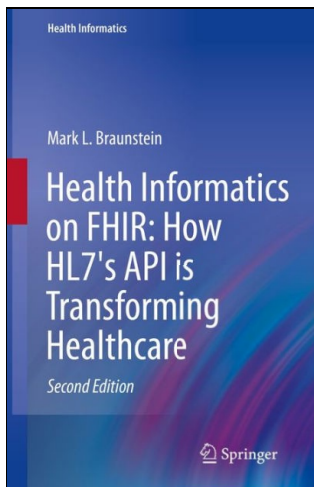
ISBN-13: 978-1119853862.

Note:

- This is also the required textbook for CS781.

An e-book is available through Barnes and Noble at Boston University and through the Amazon.

Recommended textbook:

Braunstein, M. L. (2022). *Health Informatics on FHIR: How HL7's API is Transforming Healthcare,* **2nd Edition**.
Springer International Publishing.

ISBN: 9783030915636.

Available through the BU Library

Available as e-book only through Barnes and Noble at Boston University An e-book is also available at Vitalsource.com or through Amazon. An e-book is available for free through the BU library.

Boston University Library Information

Boston University has created a set of videos to help orient you to the online resources at your disposal. An introduction to the series is below:

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All of the videos in the series are available on the Online Library Resources page, which is also accessible from the Campus Bookmarks section of your Online Campus Dashboard. Please feel free to make use of them.

As Boston University students, you have full access to the BU Library. From any computer, you can gain access to anything at the library that is electronically formatted. To connect to the library, use the link http://www.bu.edu/library. You may use the library's content whether you are connected through your online course or not, by confirming your status as a BU community member using your Kerberos password.

Once in the library system, you can use the links under "Resources" and "Collections" to find databases, eJournals, and eBooks, as well as search the library by subject. Some other useful links follow:

> Go to http://www.bu.edu/library/research/collections to access eBooks and eJournals directly.
>
> If you have questions about library resources, go to http://www.bu.edu/library/help/ask-a-librarian to email the library or use the live-chat feature.
>
> To locate course eReserves, go to http://www.bu.edu/library/services/reserves.

Please note that you are not to post attachments of the required or other readings in the water cooler or other areas of the course, as it is an infringement on copyright laws and department policy. All students have access to the library system and will need to develop research skills that include how to find articles through library systems and databases.

Study Guide

This course is divided into six (6) modules. Each module runs for two weeks.

Module 1 Study Guide and Deliverables

Readings: **Required Readings:**

Wager, et al. (2022)

- Appendix A: Overview of the Healthcare IT Industry

Recommended Readings:

Braunstein, (2022)

- Chapter 1: A Brief History and Overview of Health Information
- Chapter 2: The US Healthcare System

Fridsma DB. The scope of health informatics and the Advanced Health Informatics Certification. J Am Med Inform Assoc. 2016, 23(4):855-6.

Gadd CS, Steen EB, et al. Domains, tasks, and knowledge for health informatics practice: results of a practice analysis. Journal of the American Medical Informatics Association. 2020 Jun;27(6):845-52

Lectures:	Mondays, 1/27/25 and 2/3/25 from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102. Office hours will be before and after the lectures.
Discussions:	Discussion 1 postings
Assignments:	Assignment 1
Assessments:	Quiz 1

Module 2 Study Guide and Deliverables

Readings:	**Required Readings:**
	Wager, et al, (2022)

- Chapter 1: Evolution of Health Care Information Systems in the United States
- Chapter 2 Electronic Health

Record Systems

Recommended Readings:

Braunstein, (2022)

- Chapter 3: Health
  Informatics in the Real World

Lectures: Monday, 2/10/25 and Tuesday,
2/18/25 from 6:00 PM to 8:45 PM
EST at 565 Commonwealth Ave
room KCB 102. Office hours will be
before and after the lectures.

Discussions: Discussion 2 postings

Assignments: Assignment 2

Assessments: Quiz 2

Module 3 Study Guide and Deliverables

Readings: **Required Readings:**

Wager (2022)

- Chapter 11: Data
  Governance and Analytics

Recommended Readings:

Djulbegovic, B., & Guyatt, G. H.
(2017). Progress in evidence-based
medicine: a quarter century on. The
Lancet.

Sheridan, D. J., & Julian, D. G.
(2016). Achievements and
limitations of evidence-based
medicine. Journal of the American
College of Cardiology, 68(2),
204-213.

Lectures:	Mondays, 2/24/25 and 3/3/25 from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102. Office hours will be before and after the lectures. Mon, 3/10/25 is during spring recess.
Discussions:	Discussion 3 postings
Assignments:	Assignment 3
Assessments:	Quiz 3

Module 4 Study Guide and Deliverables

Readings:	**Required Readings:** Wager, et al, (2022) - Chapter 3: Role of HCIS in Improving Healthcare Delivery - Chapter 4: Realizing the Digital Health Promise with Electronic Health Records **Recommended Readings**: Braunstein, (2022) - Chapter 12 Public and Population Health Kindig, D., & Stoddart, G. (2003). What is population health?. American journal of public health,

93(3), 380-383.

Kaminski, M. What is Population Health? Ten Years On… Population health management. 2020 Dec 1;23(6):404-6.

König, I. R., Fuchs, O., Hansen, G., von Mutius, E., & Kopp, M. V. (2017). What is precision medicine? European Respiratory Journal, 50(4), 1700391.

Lectures:	Mondays, 3/17/25 and 3/24/25 from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102. Office hours will be before and after the lectures.
Discussions:	Discussion 4 postings
Assignments:	Term Project Topic Proposal
Assessments:	Quiz 4

Module 5 Study Guide and Deliverables

Readings:	**Recommended Readings:** Braunstein, (2022) • Chapter 7: Data and Interoperability Standards • Chapter 8: Pre-FHIR Interoperability and Clinical Decision Support Standards • Chapter 9: FHIR
Lectures:	Mondays, 3/31/25 and 4/7/25 from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102. Office hours will be before and after the lectures.

Discussions: Discussion 5 postings

Assignments: Assignment 5

Assessments: Quiz 5

Module 6 Study Guide and Deliverables

Readings:
- Moore, W., & Frye, S. (2019). Review of HIPAA, part 1: history, protected health information, and privacy and security rules. *Journal of nuclear medicine technology*, *47*(4), 269-272.
- Moore, W., & Frye, S. (2020). Review of HIPAA, part 2: limitations, rights, violations, and role for the imaging technologist. *Journal of nuclear medicine technology*, *48*(1), 17-23.
- Massoudi, B. L., & Sobolevskaia, D. (2021). Keep moving forward: health informatics and information management beyond the COVID-19 pandemic. *Yearbook of Medical Informatics*, *30*(01), 075-083.

Lectures: Mon, 4/14/25 and Wed 4/23/25 from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102. Office hours will be before and

after the lectures.

4/21 is Patriots Day.

Wed, 4/23/25, and Mon, 4/28/25 (final exam prepration after presentation) from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102. Office hours will be before and after the lectures.

Assignments:
- **Term project**
- **Term project presentations:**
    - **Wed, 4/23/25, and Mon, 4/28/25**
- **Final exam: Mon, 5/5/25 from 6:00 PM to 8:45 PM EST at 565 Commonwealth Ave room KCB 102.**

Final Exam Details

The Final Exam will be **open book/open notes** (but electronic devices, such as iPad and Kindle, are not allowed). The exam will be accessible only during the final exam period. You can access it from the Assessments Menu of the course. Your proctor will enter the password to start the exam.

Final exam duration: **Three hours**.

Course Grading Information

Please check the **Study Guide** in the syllabus for lecture dates. Please check the couse site calendar for due dates for discussions, assignments, assessments/quizzes, term project, presentation, and final exam.

Course Structure

The course material is grouped in six modules. Each module consists of two lectures. There are discussion

topics, quizzes, assignments, term project, term project presentation, and final exam. The term project is to assess students' understanding and implementing simple Health Informatics solutions.

Reading materials—Introduced in each module.

Assignments—This course will have four graded assignments.

Quizzes—This course will have five graded online quizzes.

Discussions—There are four graded discussion forums that involve posting and reviewing the answers to the discussion topics. Discussion topics are moderated by your professor. Each posting should be completed when the material is covered. Please see the discussion module on the home page for more details.

Term Project—The term project will test students' overall understanding and grasp of the course content.

Final Examination—There will be a proctored Final Exam in this course.

The final exam will be comprehensive and will cover material from the entire course. It will be an open-book exam consisting of questions similar to the ones in the quizzes and assignments.

Grade Weighting

The final grade for this course will be based on the following:

Deliverable	Weight
Quizzes	15%
Discussions	15%
Assignments	20%
Term Project	20%
Final Exam	30%

Letter Grade

The final letter grade in the course will correspond approximately with the following numeric grade range:

A	≥ 94

A−	≥ 90 < 94
B+	≥ 86 < 90
B	≥ 81 < 86
B−	≥ 76 < 81
C+	≥ 71 < 76
C	≥ 66 < 71
C−	≥ 61 < 66
D	≥ 56 < 61
F	< 56

Course Policies

Attendance & Absences: This is an oncampus course. The students are required to attend the lectures and access the material regularly in the course site.

Assignment completion & late work: All assignments have to be submitted by the due dates. Each 24 hours of delay will result in 10% penalty.

Academic Conduct Code: http://www.bu.edu/met/for-students/met-policies-procedures-resources/academic-conduct-code/

Discussion Grading Rubric

The discussion grading rubric below is the guide we use to evaluate your discussion contributions.

Criteria	65–69	70–79	80–89	90–94	95–100
Participation	Very limited	Participation	Reasonably	Frequently	Continually

		generally lacks frequency or relevance	useful relevant participation during the discussion period	relevant and consistent participation throughout the discussion period	relevant and consistent participation throughout the discussion period
Community	Mostly indifferent to discussion	Little effort to keep discussions going or provide help	Reasonable effort to respond thoughtfully, provide help, and/or keep discussions going	Often responds thoughtfully in a way that frequently keeps discussions going and provides help	Continually responds thoughtfully in a way that consistently keeps discussions going and provides help
Content	No useful, on-topic, or interesting information, ideas, or analysis	Hardly any useful, on-topic, or interesting information, ideas, or analysis	Reasonably useful, on-topic, and interesting information, ideas, and/or analysis	Frequently useful, on-topic, and interesting information, ideas, and analysis	Exceptionally useful, on-topic, and interesting information, ideas, and analysis
Reflection and Synthesis	No significant effort to clarify, summarize, or synthesize topics raised in discussions			Contributes to group's effort to clarify, summarize, or synthesize topics raised in discussions	Leads group's effort to clarify, summarize, or synthesize topics raised in discussions

Disability and Access Services

In accordance with University policy, every effort will be made to accommodate students with respect to speech, hearing, vision, or other disabilities. Any student who may need an accommodation for a documented disability should contact Disability and Access Services at 617-353-3658 or at access@bu.edu for review and

approval of accommodation requests.

Once a student receives their accommodation letter, they must send it to their instructor each semester. They must also send a copy to their Faculty & Student Support Administrator, who may need to update the course settings to ensure accommodations are in place. Accommodations cannot be implemented if the student does not send their letter.

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