ISYE 4510 PUBLIC HEALTH SYSTEMS

Fall 2026

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COURSE DESCRIPTION

Health systems, public health, and medicine have evolved rapidly over the past several decades, driven by advances in data availability, analytics, and technology. These developments create substantial opportunities to improve public health outcomes, support disease prevention, early detection, and treatment, and promote healthier lifestyles at both individual and population levels. Quantitative methods play an increasingly important role in informing complex decision-making in public health and healthcare systems, particularly when resources are limited and trade-offs must be carefully evaluated. However, many decisions in practice continue to rely on experience- or case-based approaches, without fully leveraging modern quantitative decision-making tools. This course provides an overview of key components of health systems and public health, with an emphasis on how quantitative and analytical methods can improve decision quality, enhance efficiency and effectiveness, and ultimately support better health outcomes.

COURSE OBJECTIVES

By the end of this course, students will be able to:

- Understand the structure and functioning of health systems and public health frameworks.
- Recognize opportunities where quantitative and analytical methods can improve decision-making in healthcare delivery and public health.
- Evaluate trade-offs involved in public health and health system decisions under resource constraints.
- Apply quantitative reasoning to assess interventions related to prevention, early detection, and treatment of disease.
- Appreciate the role of data and technology in improving the efficiency, effectiveness, and equity of healthcare delivery.
- Develop a systems-level perspective on improving population health and overall health system performance.

PREREQUISITES

ISYE 3030 Basic Statistical Method OR BMED 2400 Intro to BIO Statistics OR (ISYE 3770/MATH 3670 Probability and Statistics with Applications AND some analytics knowledge, being comfortable with working with analytics concepts and data).

REQUIRED COURSE MATERIALS

The required course materials include the course slides, reading provided as part of the course lectures and assignments and data examples using a statistical software.

Recommended books

1. Holtz, C. (2016) *Global Health Care: Issues and Policies: Issues and Policies*. Jones & Bartlett Learning
2. Rouse, W., Serban, N. (2014). *Understanding and Managing the Complexity of Healthcare*. MIT Press.

Other recommended reading:

The National Academy of Medicine regularly publishes reports and books on various topics. Some of interest in the context of this course are:

- Sharing Health Data: The Why, the Will, and the Way Forward
- Action Collaborative on Decarbonizing the U.S. Health Sector
- Overview of the Current State and Future Possibilities of Integrating Artificial Intelligence in to Health Care

Other reading materials will be provided throughout the semester.

ATTENDANCE POLICY CRITERIA

Regular attendance is expected and essential for success in this in-person course. Because course activities, including lectures, in class exercises, discussions, and demonstrations, are designed to build understanding the course material progressively, students are responsible for being present and engaged at every scheduled class session unless an excused absence applies.

ADDITIONAL CRITERIA FOR SUCCESSFUL COMPLETION OF THE COURSE

In addition to earning a passing course grade, successful completion of this course requires the following:

- **Completion of all required assignments:** All homework, case studies, and required deliverables must be submitted on time. Late submissions do not receive credit, and no assignments are dropped.
- **Active and meaningful engagement:** Students are expected to attend class regularly, complete assigned readings, and participate constructively in discussions, in-class activities, and case analyses.
- **Academic integrity and independent work:** All submitted work must reflect the student's own effort and comply with the Georgia Tech Academic Honor Code and course policies on collaboration and use of Generative AI tools.
- **Professional conduct and communication:** Students are expected to communicate respectfully and professionally and to adhere to classroom policies, including those related to electronics use.
- **Responsibility for course communications:** Students are responsible for monitoring Canvas and course announcements and staying informed of updates, deadlines, and expectations.

COURSE ORGANIZATION

Course material and Communication

Course materials will be posted on the canvas class page, including reading materials, class slides and assignments, among others. Course updates will also be sent through the canvas platform. Please contact your instructors or teaching assistant via canvas. Students are responsible for all announcements made in class and for all changes in the schedule that are posted on the class website, Canvas, or via email from the instructor. We will send announcements about course changes through canvas. Check the canvas class page at least twice weekly for course schedule and/or assignment updates. You are responsible for staying abreast of these changes. Avoid missing deadlines and assignment rework by keeping updated through canvas.

Student Activities

Reading: Students will be assigned articles, case studies, or other reading materials, which will be discussed in class and/or students will write short summaries for as part of their homework. Class reading is required, and it will be part of the grade through class participation. Some of the reading material will be available through canvas. Please do not share outside of the classroom since some of the reading copies may be subject to copyright.

Homework**:** All homework assignments are required. Some homework assignments may be based on case studies and will be done in groups. Depending on their length and difficulty, the total number of points in each homework might vary. *Every student must turn in his/her own written solutions in his/her own words*. (An exception to this is for group case study, in which case a student will be assigned to a group and turn in a single report for the group.) Homework is meant to be a learning tool. If you are having difficulty, contact the instructors or TA right away, don't wait until you fall even further behind! All assignments must be submitted electronically via Canvas before the due date. ***Late submissions will not receive credit.*** None of the homework assignments will be dropped, so please make every effort to submit all work on time.

Case studies and classroom games: There will be case studies and interactive classroom games. As part of homework, students will submit short reports or simple data analysis prior to and/or after case discussions and classroom game participation.

Class Project: Georgia Tech has acquired a large database of administrative claims for Medicaid-insured children and adults nationwide for years 2010-2022. It is a unique opportunity for students taking this class to be exposed to working with this massive dataset of claims records, all in all 10's of trillions of claims records for more than 70 million children and adults enrolled in Medicaid nationwide.

Students will be assigned to project groups/teams and work on a real-practice project related to the Medicaid claims data. The team will select its project depending on the shared interest among the team members. Each team will consist of approximately 5 students, a large enough team to be able to achieve sufficient work as part of the project but not to be too large to be hard to manage. The class project will have the following deliverables:

Proposal Presentation Submission: September 15th
Proposal Report Submission: September 17th
Midterm Presentation Submission: October 19th
Midterm Report Submission: October 23rd
Final Presentation Submission: November 18th
Final Report Submission: November 30th

Class participation: Students are expected to attend all lectures. Lectures will consist of class presentations on specific topics, and discussion topics based on homework reading. In addition to the course instructors, the course will include guest lectures.

Course Technology/Software Requirements

- Internet connection (DSL, LAN, or cable connection desirable)
- R statistical software or python software (free download)
- Adobe Acrobat PDF reader (free download; see https://get.adobe.com/reader/)

GRADING POLICY

95% of the grade will be based on homework, including short reports related to case studies and class project; 5% based on class participation, in particular, participation in the discussions about the reading assignments. Depending on their length and difficulty, homework and group assignments might carry different weights. None of the grades will be dropped, so please make every attempt to submit all requirements.

Participation: Participation does not simply mean attendance. Participation means being part of the lectures, class discussions and course support, as well as the personal health and wellbeing practices outside of class, whatever that will involve! We don't expect students to participate in every single lecture (or at the same time!) but to participate meaningfully.

The final course grade will be converted into letter grades as follows:
A – 90 to 100
B- 80 to 89
C – 70 to 79
D – 50 to 69
F – below 50

COURSE TOPICS

Topic 1: Health Systems

In this topic, we will cover characteristics of healthcare systems, with their interconnectedness and constraints. We will discuss various important aspects, stakeholders & relationships, complexity; cost and their implications; and incentives. While we will primarily focus on the US healthcare system, we will also discuss healthcare systems within a more general framework. Below are the sub-topics covered.

Sub-Topic 1.1: Health System Overview
Sub-Topic 1.2: US Health System
Sub-Topic 1.3: Healthcare Complexity
Sub-Topic 1.4: Healthcare Cost
Sub-Topic 1.5: The 3 E's Framework: Equity, Efficiency and Effectiveness

Topic 2: Healthcare Access and Equity

Healthcare delivery is complex since it can come in many forms, and it can be provided by various provider types. This topic will cover traditional care modalities, such as in-clinic, compared to more adaptive and

accommodating approaches such as mobile health, telehealth, in-home and in-school care. Other topics will be considered based on students' feedback.
Sub-topic 2.1: Healthcare Access: Measurement and Inference
Sub-topic 2.2: Equity and Health Disparities
Sub-topic 2.3: Health and Place: Geographic Access, Epidemiology and GIS
Sub-topic 2.4: Community and Population Health
Topic 3: Prevention & Wellbeing
In this topic, we will cover two main focus areas of healthcare: prevention and wellbeing. As presented in this topic, students will learn that prevention covers both infectious and non-infections conditions. We will discuss different types of diseases, transmission patterns, prevention and intervention measures based on disease type, outcomes metrics of interest. Disease modeling overview with a few examples will follow based on different prevention and wellbeing contexts. Specific examples include childhood vaccination catch-up scheduling; Covid19 - evaluation of interventions; disease spread projection and decision-support for interventions; screening for non-infectious diseases; mental health prevention; among other topics. Below are the sub-topics covered.
Sub-Topic 3.1: Wellbeing and Prevention
Sub-Topic 3.2: Infectious diseases
Sub-Topic 3.3: Non-Infectious diseases
Topic 4: Overview: Data and Methods
Data and methodologies are at the core of innovation in public health. The large amount of data collected within the healthcare system can be used to advance personalized medicine, target interventions, evaluate guidelines and practices and identify fraud among many others. It can provide opportunities to set up "policy" labs where policies and intervention can be tested without their direct deployment to the public; to a great extent, the methodologies presented in this course have wide applicability in such policy-making labs, where retrospective and prospective data analysis can be used to evaluate 'what-if' scenarios of policies and interventions. In this topic, we will review the data and methodologies discussed throughout the course as well as other opportunities for improving the healthcare system.
Sub-Topic 4.1: Data in Healthcare
Sub-Topic 4.2: Modeling and Engineering
Sub-Topic 4.3: Case Studies

In addition to the above topics, the course will also include content about personal health and well-being, including habits, cognitive distortions, mindfulness, gratitude, etc. The students will engage in a variety of reading and exercises throughout the semester.

INSTITUTE AND OTHER COURSE POLICIES

Institute Absence Policy
While there are no formal institutional requirements regarding class attendance at Georgia Tech, we encourage and grade participation in the class. Please read the Institute Absence Policy available at: https://catalog.gatech.edu/rules/4/

Electronics Policy
The use of electronics (phones, computers, pads, etc.) are not allowed in the classroom; please turn them off and stow them away before class begins. In case you are in urgent need of electronics use, please leave the classroom, and return after you are done.

Honor Code

All course participants (instructors, teaching assistant, and students) are expected and required to abide by the policies of the Georgia Tech Academic Honor Code, and the Student Conduct expectations (http://www.policylibrary.gatech.edu/student-life). Keep in mind:

- Ethical behavior and personal integrity are extremely important in all facets of life.
- Students are responsible for completing their own original work.
- Students are expected to properly reference any external sources used to complete in their class work.
- Students are responsible to understand and abide by the Honor Code as it applies to each class activity.

The Georgia Tech Honor Code will be strictly enforced in this class. If there is any question as to whether an activity is or is not permissible (in this class) under the Honor Code, consult the instructors prior to undertaking the activity.

The Georgia Tech Honor Code is available at http://osi.gatech.edu/content/honor-code

University Policy for Students with Disabilities

Georgia Tech welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office of Disability Services. For further information regarding ODS, please visit the Office for Disability Services Web site at http://disabilityservices.gatech.edu.To receive consideration for course accommodations, you must contact ODS and provide documentation, such as academic adjustment letters, at the beginning of each semester.

Use of Generative AI Tools

Generative AI tools are now becoming a more integrative part of how we derive knowledge. However, they are a two-edged sword. While they provide opportunities for learning, they also hamper self-learning in a way that new knowledge might not be solidified for understanding new concepts and replicating rigorous analyses. Such tools may also interfere with the development of accurate knowledge since when such tools don't know the answer, they will make up an answer! Also relying on such tools for learning will particularly impact the employment of your skill set to derive knowledge – it raises the bar of knowledge as highlighted by the Professor Chris Dede. See the link below for more information:
https://www.gse.harvard.edu/ideas/edcast/23/02/educating-world-artificial-intelligence

In this course, we will treat Generative AI tools similar as collaboration with other people: you are welcome to talk about your work with other peer learners as well as with AI-based assistants. However, **all work you submit must be your own**. You should never include in your assignment anything that was not written directly by you without proper reference.

Using Generative AI tools could be useful in this course as follows:

- Inquiries about (basic) concepts in the course to complement the explanation of these concepts in the course material. You will have to thread this carefully since the information provided by such tools may not be accurate/correct/rigorous. Do not use these tools as your only approach to complement learning.
- Inquiries about the use of R and python commands that could help in speeding up the process of learning data analysis implementations.

It is unavoidable that such tools will be part of the learners' learning hence it is expected that you will consult Generative AI in some instances that could enhance your learning. It is however **the learners' responsibility** to assume that the information from AI tools will not always be accurate thus you will

need to check with your instructor team and/or other resources. Learners need to be aware of the potential harm to their learning as follows:

- Inquiries on developing answers to homework assignment questions ad-litteram. It is thus important **NOT** to use Generative AI tools to respond to the homework assignment without being involved in the process of deriving knowledge from your own reading. Submitting the assignment questions to such tools is also not compliant with Georgia Tech policies on sharing the course material beyond the classroom learning. *Thus, we will consider an honor code violation if the responses to assignment questions are generated by such tools.*
- Inquiries on developing presentations or writing brief reports (when needed) will NOT be allowed. Your presentations need to be your team's work alone. It is important to develop your own presentation skills your own words. *Thus, we will consider an honor code violation if your presentation uses Generative AI tools to be developed.*
- Inquiries on any aspect related to learners or instructors, and other individual-level information are considered violations of the Georgia Tech Guidelines on Generative AI for Privacy and Security. Please read carefully the Georgia Tech Guidelines: https://gatech.service-now.com/home?id=kb_article_view&sysparm_article=KB0043472

For further reading on use of Gen AI tools in learning, please read about some heuristics and recommendations at: https://www.cc.gatech.edu/news/new-policies-navigate-role-ai-assistants-cs-courses.

Statement of Intent for Classroom Inclusivity

As members of the Georgia Tech community, we, the instructors of this course, are committed to creating a learning environment in which all of our students feel safe and included. Because we are individuals with varying needs, we rely on your feedback to achieve this goal. To that end, we invite you to enter into dialogue with us about the things we can stop, start, and continue doing to make our classroom an environment in which every student feels valued and can engage actively in our learning community.

Campus Resources for Students

In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

Academic support

- Center for Academic Success http://success.gatech.edu
  - 1-to-1 tutoring http://success.gatech.edu/1-1-tutoring
  - Peer-Led Undergraduate Study (PLUS) http://success.gatech.edu/tutoring/plus
  - Academic coaching http://success.gatech.edu/coaching
- Residence Life's Learning Assistance Program https://housing.gatech.edu/learning-assistance-program
  - Drop-in tutoring for many 1000 level courses
- OMED: Educational Services (http://omed.gatech.edu/programs/academic-support)
  - Group study sessions and tutoring programs
- Communication Center (http://www.communicationcenter.gatech.edu)
  - Individualized help with writing and multimedia projects

- Academic advisors for your major
  http://advising.gatech.edu/

Personal Support

Georgia Tech Resources

- The Office of the Dean of Students:
  http://studentlife.gatech.edu/content/services; **404-894-6367**; Smithgall Student Services Building 2nd floor
  - You also may request assistance at
    https://gatech-advocate.symplicity.com/care_report/index.php/pid383662?
- Counseling Center:
  http://counseling.gatech.edu; **404-894-2575**; Smithgall Student Services Building 2nd floor
  - Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources.
  - *Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at **404-894-2204**.*
- Students' Temporary Assistance and Resources (STAR):
  http://studentlife.gatech.edu/content/need-help
  - Can assist with interview clothing, food, and housing needs.
- Stamps Health Services: https://health.gatech.edu; **404-894-1420**
  - Primary care, pharmacy, women's health, psychiatry, immunization and allergy, health promotion, and nutrition
- OMED: Educational Services: http://www.omed.gatech.edu
- **Women's Resource Center: http://www.womenscenter.gatech.edu; 404-385-0230**
- **LGBTQIA Resource Center: http://lgbtqia.gatech.edu/; 404-385-2679**
- **Veteran's Resource Center: http://veterans.gatech.edu/; 404-385-2067**
- **Georgia Tech Police: 404-894-2500**

National Resources:

- The National Suicide Prevention Lifeline provides free and confidential support 24/7 to those in suicidal or emotional distress at **1-800-273-8255**
- The Trevor Project provides crisis intervention and suicide prevention support to members of the LGBTQ+ community and their friends. They are available 24/7 by telephone (**1-866-488-7386**), chat (http://www.thetrevorproject.org; 3-10pm Eastern, 7 days a week), and text (Text "Trevor" to **1-202-304-1200**; available 3-10pm, M-F).