

Digital Health, Robotics & AI for Personalized Medicine: Economic Analysis

Summer seminar

Location: [Stanford Center at Peking University](#) (SCP KU), Beijing, China

Arrival Date in Beijing, China: Saturday, August 24, 2024 (course begins August 26, 2024)

Departure Date from Beijing, China: Saturday, September 14, 2024 (course ends by evening September 13, 2024)

Class meetings: Weekdays 9:00 - 11:45am, SCP KU G02 John Leighton Stuart Room
September 13: SCP KU M11

Instructor: Karen Eggleston (翁笙和), Ph.D., Senior Fellow, Stanford University Freeman Spogli Institute for International Studies; Director, Asia Health Policy Program, Shorenstein Asia-Pacific Research Center
<https://aparc.fsi.stanford.edu/asiahealthpolicy/>

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Teaching Assistant: Victoria Liu, liucx@stanford.edu

Piazza: <http://piazza.com/stanford/summer2024/scpku2024>
The access code is **scpku_health**

Useful resources:

Crisis24 hotline: +1(443)716-2305 – download app.

<https://crisis24horizon.com/Stanford/login>

<https://www.youtube.com/watch?v=xesDRkU9zzM>

<https://internationaltravel.stanford.edu/>

Course description

Globally, health systems struggle to provide affordable access to high-quality care for all their citizens. As potential solutions, digital health, robotics and AI for precision health and personalized medicine hold both promise and peril. Digital health tools can provide affordable access for remote and vulnerable populations, and some applications of AI can enhance precision health strategies to address social determinants of health and promote cost-effective screening (e.g. for diabetic retinopathy) for healthy aging. Yet algorithms can be biased, tech can complicate life for busy health professionals, and personalized medicine can be very expensive, exacerbating rather than mitigating disparities. This seminar provides students with a glimpse of health economics concepts and research about the trade-offs involved in integrating health technology and AI health applications into healthcare system workflows.

This seminar combines fieldtrips within China with guest speakers to help students think through economic analysis of digital health innovations, including the following questions:

1. What is the evidence about how digital health initiatives and applications of deep learning to health services work in practice, in high- and in low-resource settings?
2. How do government agencies and health tech assessment bodies determine a new digital health or AI-enabled technology can be marketed and if it can be covered by insurance? How have health systems attempted to address concerns about data privacy and security?
3. What are incentive structures and provider skillsets needed to harness these technologies to improve health equity, health service quality, and health system resilience at an affordable cost?

In our short 3 weeks together, 2 weeks will involve classes at SCPKU and one week (9/4-9/10) will be a fieldtrip to Zhejiang and Shandong. We will provide more information about the fieldtrip during the first few classes.

The class format while at SCPKU will generally be an introductory lecture on the topic(s) for that day, followed by *student-led discussion* and *group project brainstorming*. Each student will choose one reading or podcast from those listed below on the syllabus to lead seminar discussion about the main points of that reading. To avoid overlap, please email Victoria (liucx@stanford.edu) your top 2 choices of a single reading or podcast to summarize by August 28th, and we will confirm with you whether your top choice is available and which day you should be ready to summarize it (from 9/2 through 9/12).

Student teams of Stanford students and Chinese students will choose a case study of health tech in practice in a high-income setting and/or a low-income setting. Each team will analyze evidence about the social value of their chosen technology and propose adapting it to a different setting in East, Southeast, or South Asia. So please think ahead of time about the arena of health or medicine in which you would like to develop ideas for an innovative or adapted digital application, assistive robotics or AI-enabled intervention or medical device (e.g., health screening, mental health, physician support, elderly care, etc), and search for information about what has “worked” in that arena.

Students will gain

- A working knowledge of basic health economics concepts;
- Experience analyzing incentives and trade-offs when apply those concepts to a series of case studies of digital health technologies, AI applications and personalized medicine;
- An understanding of the strengths and limitations of an economics perspective for assessing new technologies;
- Exposure to a variety of Chinese experts and policymakers and their informed views about the potential of such new technologies to improve health and make health systems more resilient;
- Practice in teamwork across disciplines and cultures.

Overview of the seminar schedule

[subject to change]

Week 1 (8/26-8/30) will provide the students with analytic tools for their case studies by introducing and illustrating **basic concepts of health economics**. Concepts include public goods, externalities, moral hazard, adverse selection, and behavioral hazard.

Students will view a documentary video about government and private roles in delivering publicly-financed services, available at <https://www.youtube.com/watch?v=g9JRhGpXC2Y>, commemorating the 25th anniversary of a classic paper on “The Proper Scope of Government” by Hart, Shleifer, and Vishny (NBER 1996, *Quarterly Journal of Economics* 1997). Interviewees featured on the video discuss and compare health insurance, medical care, and long-term care to other taxpayer-financed services (transportation, education, prisons) across multiple settings. After viewing the video, students will discuss the role of public and private sectors in regulating and integrating digital health, AI and robotics into health systems. Students will get to know their classmates through group discussions, working toward forming their teams of 2-4 (Stanford and PKU or Tsinghua students) for designing a novel digital health application.

Readings:

- Fuchs VR. “Major Concepts of Health Care Economics.” *Ann Intern Med*. 2015; 162:380-383. Doi:10.7326/M14-1183. <http://annals.org/article.aspx?articleid=2173507>
- “Characteristics of the Health Sector,” chapter from János Kornai and Karen Eggleston, *Welfare, Choice and Solidarity in Transition: Reforming the Health Sector in Eastern Europe*, Cambridge, UK: Cambridge University Press, 2001.
- Cutler, David, Angus Deaton, and Adriana Lleras-Muney. “The Determinants of Mortality.” *The Journal of Economic Perspectives* 20.3 (2006): 97-120.
- Warraich, Haider J., Hilary D. Marston, and Robert M. Califf. “Addressing the challenge of common chronic diseases-a view from the FDA.” *The New England Journal of Medicine* 390, no. 6 (2024): 490-492.
- Baicker, Katherine, and Ziad Obermeyer. “Overuse and underuse of health care: new insights from economics and machine learning.” In *JAMA Health Forum*, vol. 3, no. 2, pp. e220428-e220428. American Medical Association, 2022.
- Meng, Qingyue, et al, 2019. “China’s health system reforms: review of 10 years of progress.” *The BMJ*. Doi: 10.1136/bmj.14178

Optional/Supplemental:

- Fuchs and Eggleston, 2023. *Who Shall Live? 3rd Edition*, especially pp.1-27 (Introduction and Chapter 1) and Part 3 (pp.231-257).
- Einav, Liran, Amy Finkelstein, Raymond Fisman, and Ray Fisman. *Risky Business: Why Insurance Markets Fail and What to Do About It*. Yale University Press, 2023.
- **OECD/health-at-a-glance**: Look at Japan & Korea (ROK), Asia’s 2 OECD countries: <https://www.oecd.org/health/health-at-a-glance/>
- Health outcomes v expenditures: <https://www.oecd-ilibrary.org/sites/7a7afb35-en/1/3/1/index.html?itemId=/content/publication/7a7afb35-en&csp=6cf33e24b6584414b81774026d82a571&itemIGO=oecd&itemContentType=book#figure-d1e11447-3c7a7758e7>
- Global Burden of Disease estimates & visualizations, The Institute for Health Metrics and Evaluation (IHME) -- <https://vizhub.healthdata.org/subnational/china>

August 30: Guest lecture introducing China’s healthcare system from faculty of Peking Union Medical College, including Dean Liu Yuanli (刘远立), loosely based on the following readings:

Geng F, Liu Z, Yan R, Zhi M, Grabowski DC, Hu L. Post-Acute Care in China: Development, Challenges, and Path Forward. *J Am Med Dir Assoc*. 2024 Jan;25(1):61-68. doi: 10.1016/j.jamda.2023.09.034. Epub 2023 Nov 4.

Chinese Books: 刘远立, 健康中国蓝皮书 (2023) Liu Yuanli, *Annual Report on Healthy China Construction* (2023). 胡琳琳, 医养结合——老年整合照护的理论与实践 (2022) Hu Linlin, *Theory and Practice of Integrated Care for the Elderly*.

Week 2 (9/2 – 9/6) focuses on applications of technology in high-income settings: digital accessibility and innovations for healthy aging in urban China, OECD economies like Japan and South Korea, and Singapore. Cases including telemedicine in China, the US, Israel and Sweden, and subsidized elderly care robots in Japanese nursing homes. We will depart 9/4 for our visit to Zhejiang and then Shandong.

Guest lectures

Anthony Vasquez – guest lecture on digital accessibility

- Goldstein, D. and Care, G. (2012). [Disability Rights and Access to the Digital World](#): An Advocate's Analysis of an Emerging Field. Disability Rights Education & Defense Fund.

Hongqiao Fu (傅虹桥), Peking University School of Public Health: **10-11:30am Monday, September 2, 2024**

- Jiajia Zhan, Xu Zhang, and Fu Hongqiao, “[Information Disclosure via Platform Endorsement in Online Healthcare](#),” presented at <https://www.nber.org/conferences/si-2024-digital-economics-and-artificial-intelligence>

Dr. Kevin Schulman of Stanford Clinical Excellence Research Center

- Schulman KA, Nielsen PK, Patel K. AI Alone Will Not Reduce the Administrative Burden of Health Care. *JAMA*. 2023;330(22):2159–2160. doi:10.1001/jama.2023.23809

CK Cheruvettolil, Senior Strategy Officer for Digital Health and Artificial Intelligence at the Bill & Melinda Gates Foundation – **9:15-10:00am Tuesday, September 3, 2024**

Other Peking University experts through Week 3 [Julie Shi on telemedicine, Jianan Yang on tech-enabled nudges, Gordon Liu on surgical robotics]

Readings:

- Liu, Gordon, Eric Q. Wu, Jeonghoon Ahn, Isao Kamae, Jipan Xie, and Hongbo Yang. “The development of health technology assessment in Asia: current status and future trends.” *Value in Health--Regional Issues* 21 (2020): 39-44. <https://doi.org/10.1016/j.vhri.2019.08.472>
- Dan Zeltzer, “The Impacts of Telemedicine: An Initial Assessment,” International Health Economics Association IHEA Digital Health Tech Special Interest Group Webinar, April 2024
- <https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices>
- Mello, Michelle M., and Sherri Rose. “Denial—Artificial Intelligence Tools and Health Insurance Coverage Decisions.” In *JAMA Health Forum*, vol. 5, no. 3, pp. e240622-e240622. American Medical Association, 2024.
- [2024 AI Index Report](#), Chapter 5 Science and Medicine.

- Ong, Jasmine Chiat Ling, Shelley Yin-Hsi Chang, Wasswa William, Atul J. Butte, Nigam H. Shah, Lita Sui Tjien Chew, Nan Liu et al. “[Medical Ethics of Large Language Models in Medicine.](#)” *NEJM AI* (2024): AIra2400038.

Individual or small group presentations: – **email Victoria your choice**

- Lin, Chin, Wei-Ting Liu, Chiao-Hsiang Chang, Chiao-Chin Lee, Shi-Chue Hsing, Wen-Hui Fang, Dung-Jang Tsai et al. “Artificial Intelligence–Powered Rapid Identification of ST-Elevation Myocardial Infarction via Electrocardiogram (ARISE)—A Pragmatic Randomized Controlled Trial.” *NEJM AI* 1, no. 7 (2024): AIoa2400190.
- Natesan, Divya, Eric L. Eisenstein, Samantha M. Thomas, Neville CW Eclov, Nicole H. Dalal, Sarah J. Stephens, Mary Malicki et al. "Health Care Cost Reductions with Machine Learning–Directed Evaluations during Radiation Therapy—An Economic Analysis of a Randomized Controlled Study." *NEJM AI* 1, no. 4 (2024): AIoa2300118.
- AI Grand Rounds podcasts – <https://ai-podcast.nejm.org/>
 - Choose any episode to summarize and lead discussion

Optional/Supplemental:

- Duo Xu, Jiajia Zhan, Terence Cheng, Hongqiao Fu, Winnie Yip, “Understanding online dual practice of public hospital doctors in China: a mixed-methods study,” *Health Policy and Planning*, Volume 37, Issue 4, April 2022, Pages 440–451, <https://doi.org/10.1093/heapol/czac017>
- The Digital Future of Health, Stanford Online webinar [US-focused], Dr. Bryant Lin and Dr. Oliver Aalami, <https://youtu.be/Vx0q0q1KXb8?si=XmzGZol4WETTpWZM>
- Erik Brynjolfsson and Danielle Li, “The Economics of Generative AI,” NBER Reporter 2004 No. 1, pp. 16-18.
- Jenelle Jindal, Suhana Bedi, Akshay Swaminathan, Michael Wornow, Jason Fries, Akash Chaurasia, Nigam Shah, “[Large Language Models in Healthcare: Are We There Yet?](#)” May 8, 2024.
- He, Daixin, Fangwen Lu, and Jianan Yang. “Impact of Self- or Social-Regarding Health Messages: Experimental Evidence Based on Antibiotics Purchases.” *Journal of Development Economics* 163 (June 1, 2023): 103056. <https://doi.org/10.1016/j.jdeveco.2023.103056>.
- Karen Eggleston, Toshiaki Iizuka and Yong Suk Lee, “Robots in Nursing Homes” or “Robots and Labor in the Service Sector: Firm-level Evidence from Nursing Homes,” (2021). <https://freakonomics.com/podcast/cobots/>
- Agrawal, Ajay, Joshua Gans, Avi Goldfarb, and Catherine E. Tucker, eds. *The Economics of Artificial Intelligence: Health Care Challenges*. University of Chicago Press, 2024.

Week 3 (9/9 – 9/13) completes the fieldtrip and then challenges students to analyze how to adapt or tailor their tech for application in a low-resource settings (rural China, low-income southeast and south Asia). In addition to presented case studies and guest lectures, student teams will refine their cases/applications & conclude by presenting them to a panel of “judges” (Chinese health economists with relevant expertise) on Friday.

Guest lecturers [may be in week 2 to help prepare students for final project]

CK Cheruvettolil, Senior Strategy Officer for Digital Health and Artificial Intelligence at the Bill & Melinda Gates Foundation – **9:15-10:00am Tuesday, September 3, 2024**

Lijing L. Yan (阎丽静), Professor and Head, NCD Research, Global Health Research Center, Duke Kunshan University

Siyan Yi, Cambodia expert, National University of Singapore

Phyu Phyu Thin Zaw, Myanmar expert, Hong Kong University

Readings:

- Ruamviboonsuk, Paisan, Richa Tiwari, Rory Sayres, Variya Nganthavee, Kornwipa Hemarat, Apinpat Kongprayoon, Rajiv Raman et al. “Real-time diabetic retinopathy screening by deep learning in a multisite national screening programme: a prospective interventional cohort study.” *The Lancet Digital Health* 4, no. 4 (2022): e235-e244.
 - AHPP webinar “Bringing AI from Code to Clinic: Perspectives from a Google Health Cross-Functional Team,” https://youtu.be/HmlQM5UzPlg?si=mV2beZy5_07OkoC4
 - [Some background concepts: <https://www.future-diagnostics.com/blog/sensitivity-and-specificity/>]
- Siyan Yi, Esabelle Lo Yan Yam, Kochukoshy Cheruvettolil, Eleni Linos, Anshika Gupta, Latha Palaniappan, Nitya Rajeshuni, Kiran Gopal Vaska, Kevin Schulman, Karen Eggleston, “Digital Health Innovations in Low- and Middle-Income Healthcare Systems: Perspectives from South and Southeast Asia,” Stanford AHPP working paper.

Project teams: work on final proposal, class presentation & feedback, prep for final presentation to “judge panel” Friday

Optional/Supplemental:

<https://www.who.int/news/item/16-05-2022-almost-one-billion-children-and-adults-with-disabilities-and-older-persons-in-need-of-assistive-technology-denied-access--according-to-new-report>

Asia Health Policy Program [AHPP] webinars: [see the website](#) and recordings of recent webinars at the Shorenstein APARC YouTube channel, [Asia health policy playlist](#), such as

- Ziad Obermeyer, (Machine) Learning About Sudden Cardiac Death
- Asia-Pacific Digital Health Innovation (with Kiran Gopal Vaska, Director of the National Health Authority of India)
- Pharmaceutical economics, biomedical innovation & global health beyond COVID
- Global health economics, China & the science of healthcare delivery in the digital age

Friday, September 13: SCPKU M11

9:00 – 10:30am Final panel discussion and webinar with Peking University [Institute for Global Health and Development](#) Dr. Gordon Liu and Dr. Jianan Yang, Director Min Yu of the Zhejiang Provincial CDC, and other guest speakers

11:00 – 12:30 **Student presentations to panel of Chinese experts**, feedback

Final program lunch and farewell