

Humanities Seminars Program

Transformative advances in science and healthcare: 1950-2024+

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In this seminar I will put into context the many amazing scientific discoveries since the 1950's that have impacted our healthcare. Medical "Discoveries" often have a history of unknowing use, at times 100's if not 1000's of years behind them, that I will describe. Transforming discoveries into useful methods, much less actual therapy, can take many years, as I will describe.

Session 1: First uses without knowing how things worked, identifying how things worked, then exploiting to identify new drugs: The way things were in 1950 and beginnings of transformative changes

Required readings: Desborough 2017 The aspirin story from willow to wonder drugs; Hutchings 2019 History of Antibiotics and sulfa drugs; History of Vaccines (the links are live and might be interesting but not required reading); Beyrer 2021 The Long History of mRNA Vaccines (the links are live and might be interesting but not required reading)

Optional readings: From 1900 to today harnessing-natures-matchmakers

- Animals, animals, animals, Petrie dishes, few drugs.
 - 18th and 19th century vintage vaccines
 - Sulfa drugs and antibiotics (penicillin)
- Beginnings of transformation targeting proteins in a test tube
 - Enzymes, used from early times to first class of modern drugs

Session 2: The 1950's, 1960s, and 1970's

Required readings: The History of Cell Lines and Culture (interesting live links); Genetics vs Genomics and Structure of DNA

Optional readings: Flower 2002 receptors, a long engagement

- Cells and cell lines grown in the lab
- Discovery of the double helix of DNA
- Modern medicinal chemistry
- First block-buster drug from testing in test tubes
- Culture of cells in the lab actually becomes practical early '70's
- Receptors, not just enzymes, as targets
- First mammalian DNA isolated

- DNA code of first simple organism “sequenced”

Session 3: The rolling stone gains momentum in the ‘80’s and ‘90’s

Required readings: PCR and Sequencing

Optional readings: None

- First drugs from testing cells in the lab
- Beginnings of molecular biology and biotechnology
- Computers impact medicinal chemistry
- Excitement that single “magic bullet” genes could be identified for many diseases as the cause that drugs could target
- Human genome project to identify the DNA code of humans (sequence the human genome) begins 1990, completed 2003
- First experiment leading to mRNA vaccines (e.g. think, COVID vaccine) in 1987

Session 4: The turn of the century

Required readings: None

Optional readings: None

- “Next generation sequencers” make determining the DNA code of different people with different diseases affordable, fast, practical
 - First paper 2008
 - The “Tesla” of sequencers launched 2014
- Limits of the “magic bullet” concept both revealed by molecular biology/biotechnology then exploited

Session 5: The first quarter of the 21st century

Required readings: Farrell, 2023 Role of Big Data in Drug Discovery; A simple guide to CRISPR; Sheridan 2023 First approved CRISPR Therapy; Ikarashi 2023 Human Ancestors Nearly Went Extinct 900,000 Years Ago; Pennisi 2023 Human ancestors may have survived a brush with extinction (includes another viewpoint);

Optional readings: Mallappallil 2020 Big Data and Medical research (detailed)

- Discovery from databases of “big data”
- Mutations – lots of information ranging from basis for some diseases, to risk of complex disease, and evidence for near extinction of the human lineage 900,000 years ago during the Pleistocene climate change extinction
- First use of AI and imaging for diagnosis
- Single-Cell analysis
- Methods to discover drugs targeting genes
 - First testing of gene editing therapy in people, cutting and inactivating genes

- Drugs targeting gene activity

Session 6: Transformative changes foreshadowing the future

Required readings: None

Optional readings: Zhang 2023 single-cell analysis and diagnostics (somewhat technical, can ignore the different platforms)

- Reduced use of animals
- Predicting risk from spills
- Diagnosis of Alzheimer's and other dementias from a finger-stick
- Diagnosis by profiling rare single-cells
- Drugs targeting genes