Health, Technology and Society:

An Introduction

Course Introduction

- This course is designed to provide students with a broad overview of the relations among health, technology and society. It helps students understand the historical, social, cultural, and ethical dimensions of healthcare technology, increase their knowledge of health issues and commitment to human rights, and sharpen their critical thinking, problem solving, and communication skills in issues associated with health.

Intended Learning Outcomes

- ILO1. describe how scientific and technological development affects health and healthcare;

- ILO2. discuss the scientific controversies and ethical concerns of issues in health and healthcare;

- ILO3. identify and analyze the historical, social, economic, cultural and ethical dimensions of healthcare technology.

Format of classes

- 1. Lectures
- 2. Seminars
- 3. Tutorials – Group Presentation

Characteristics of this course:

- Lots of examples and case studies
- Exchanges with guest speakers
- Both futuristic and historical
- Multi-disciplinary
- Lots of Bonuses*
- ...and fun (hopefully :-)

Assessment

Description		Weighting
Participation in class activities, e.g. sharing and group discussion		10%
1-hour Quiz: Multiple-choice questions or other appropriate formats which test students' understanding of health issues		30%
Group project: students will form groups of 5-6 persons, each group will give a 25-minute presentation on a given topic related to the syllabus		30%
Individual essays: each student will complete two short written assignment of around 750 words each		30%
		Total : 100%

What is "technology"?

- "Science and technology are related disciplines, but each has different goals.... Technology is the quest to solve problems in the natural world with the ultimate goal of improving humankind's control of their environment." (Balaban & Bobick, 2016, p.1)

Greatest engineering achievements of the twentieth century

- (published by National Academy of Engineering and based on the impact on society's quality of life)
- (Balaban & Bobick, 2016, p.7)

Electrification	Highways
Automobile	Spacecraft and space travel
Airplane	Internet
Water Supply and Distribution	Imaging
Electronics	Household appliances
Radio and Television	Petroleum and petrochemical technologies
Mechanization of agriculture	Laser and fiber optics
Computers	Nuclear technologies
Telephone	High-performance materials
Air conditioning and refrigeration	Health Technologies and Devices

What is "technology" ?

Technology : Johann Beckman of Gottingen first used it in 1789.

Its root, *techne*, is the ancient Greek word for "art," "craft," or "skill," derived from an earlier Indo-European root, *teks* (the root of the word *textile*) that meant "to weave" or "to fabricate".

The weaving of cloth predates the birth of agriculture to about 35,000 BCE, one of the first technologies.

A *techne* is a method, craft, or skill used in making things (*artifacts*).

What is "technology"?

The core meaning of the word technology refers to the ensembles of techniques by which humans make artifacts that serve certain useful ends.

- but too restrictive for contemporary context to describe the relationship between technology and modern society.

(Winston 2014, p.2)

- But thinking technology purely in terms of inventions and innovations, will make us neglect the technologies that are being used.

- "In the innovation-centric account, most places have no history of technology. In use-centred accounts, nearly everywhere does. It gives us a history of technology engaged with all the world's population, which is mostly poor, non-white and half female" (Edgerton, 2008:xiii).

- "**A use-based history will do much more than disturb** our tidy timelines of progress. What we take to be the most significant technologies will change. Our accounts of significance have been peculiarly **innovation-centric**, and tied to particular accounts of modernity where particular new technologies were held to be central. In the new picture, twentieth-century technology is not just a matter of electricity, mass production, aerospace, nuclear power, the internet and the contraceptive pill. It will involve the rickshaw, the condom, the horse, the sewing machine, the spinning wheel, the Haber-Bosch process, the hydrogenation of coal, cemented-carbide tools, bicycles, corrugated iron, cement, asbestos, DDT, the chain saw and the refrigerator. The horse made a greater contribution to Nazi conquest than the V2." (Edgerton, 2008: xii; emphasis by Lecturer)
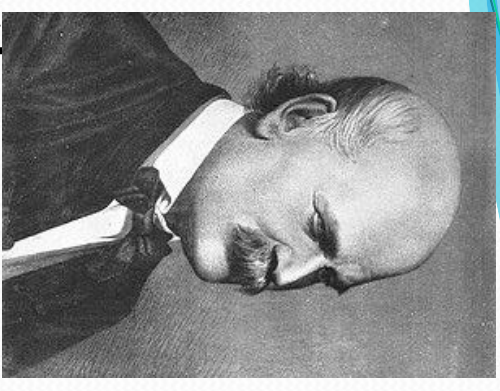
What is "technology"?

- Volti (1992, p.6) defined it as "as system based on the application of knowledge, manifested in physical objects and organizational forms for the attainment of specific goals"

What is "technology"?

- "Technology consists of not only useful artifacts and the tools and processes needed to produce them but also the entire social organization of people and materials that permits the acquisition of the knowledge and skills needed to design, manufacture, distribute, use, repair, and eventually dispose of these artifacts. Technology is not a collection of things but is a systematic and rational way of doing things; it is, in general, *the organization of knowledge, people, and things to accomplish specific practical goals*." (Winston, 2014, p.2)

Classical example: the case of the birth of infection control

- Ignaz Semmelweis was a Hungarian physician of ethnic-German ancestry, now known as an early pioneer of antiseptic procedures. Described as the "saviour of mothers", Semmelweis discovered that the incidence of puerperal fever (also known as "childbed fever") could be drastically cut by the use of hand disinfection in obstetrical clinics. Puerperal fever was common in mid-19th-century hospitals and often fatal. Semmelweis proposed the practice of washing hands with chlorinated lime solutions in 1847 while working in Vienna General Hospital's First Obstetrical Clinic, where doctors' wards had three times the mortality of midwives' wards. He published a book of his findings in Etiology, Concept and Prophylaxis of Childbed Fever.

- Despite various publications of results where hand washing reduced mortality to below 1%, Semmelweis's observations conflicted with the established scientific and medical opinions of the time and his ideas were rejected by the medical community. Semmelweis could offer no acceptable scientific explanation for his findings, and some doctors were offended at the suggestion that they should wash their hands and mocked him for it. In 1865, Semmelweis suffered a nervous breakdown and was committed to an asylum, where he died at age 47 of pyaemia, after being beaten by the guards, only 14 days after he was committed. Semmelweis's practice earned widespread acceptance only years after his death, when Louis Pasteur confirmed the germ theory and Joseph Lister, acting on the French microbiologist's research, practiced and operated, using hygienic methods, with great success.

What is "technology"?

Include the *invisible technologies* that control the purposeful organization of people and labour.

The entire *technosphere*—that is, the sum total of all human-created artifacts together with the enabling knowledge that created it and sustains it—as constituting one giant technological system.

The scope of technologies

- several interacting aspects:
- (1) skills, techniques, human activity-forms, or socio-technical practices;
- (2) resources, tools, and materials;
- (3) technological products, or artifacts;
- (4) ends, intentions, or functions;
- (5) background knowledge; and
- (6) the social contexts in which the technology is designed, developed, used, and disposed of.

(Winston, 2014: p.3)

Health technology

- Societies have always used and developed some form of technology to improve health and welbeing

- Health technologies are an increasing presence within health and social care (Barry & Yuill, 2016, p.284)

- "Contemporary technological healthcare is characterized by a multitude of medical devices, ranging from the bandage to the bioreactor, the thermometer to magnetic resonance imaging, from the cancer-screening test to the heart pacemaker and to human cell and tissue therapies.... Contemporary healthcare is technological healthcare" (Faulkner, 2009, p.1-13).

WHO on health technology

- A health technology is the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives (WHO, 2018).

Main Categories of Health Technology

1. Drugs: e.g., aspirin, beta-blockers, antibiotics, cancer chemotherapy

2. Biologics: e.g., vaccines, blood products, cellular and gene therapies

3. Devices, equipment and supplies: e.g., cardiac pacemaker, magnetic resonance imaging (MRI) scanner, surgical gloves, diagnostic test kits, mosquito netting

4. Medical and surgical procedures: e.g., acupuncture, nutrition counseling, psychotherapy, coronary angiography, gall bladder removal, bariatric surgery, cesarean section

Main Categories of Health Technology (continued)

5. Public health programs: e.g., water purification system, immunization program, smoking prevention program

6. Support systems: e.g., clinical laboratory, blood bank, electronic health record system, telemedicine systems, drug formulary,

7. Organizational and managerial systems: e.g., medication adherence program, prospective payment using diagnosis-related groups, alternative health care delivery configurations

- (U.S. National Library of Medicine, 2017, para. A1)

Purpose or Application of Health Technologies

1. *Prevention:* protect against disease by preventing it from occurring, reducing the risk of its occurrence, or limiting its extent or sequelae (e.g., immunization, hospital infection control program, fluoridated water supply)

2. *Screening:* detect a disease, abnormality, or associated risk factors in asymptomatic people (e.g., Pap smear, tuberculin test, screening mammography, serum cholesterol testing)

3. *Diagnosis:* identify the cause and nature or extent of disease in a person with clinical signs or symptoms (e.g., electrocardiogram, serological test for typhoid, x-ray for possible broken bone)

4. *Treatment:* intended to improve or maintain health status or avoid further deterioration (e.g., antiviral therapy, coronary artery bypass graft surgery, psychotherapy)

5. *Rehabilitation:* restore, maintain or improve a physically or mentally disabled person's function and well-being (e.g., exercise program for post-stroke patients, assistive device for severe speech impairment, incontinence aid)

6. *Palliation:* improve the quality of life of patients, particularly for relief of pain, symptoms, discomfort, and stress of serious illness, as well as psychological, social, and spiritual problems. (Although often provided for progressive, incurable disease, palliation can be provided at any point in illness and with treatment, e.g., patient-controlled analgesia, medication for depression or insomnia, caregiver support.)

- (U.S. National Library of Medicine, 2017, para. A2)

- Why should we study the relations among the relations among health, technology and the society?

- "Whether in health care or other sectors, technological innovation can challenge certain ethical, religious, cultural, and legal norms" (U.S. National Library of Medicine, 2017, section C).

- And the applications of health technologies have other social consequences as well.

Earlier controversial health technology

- In-vitro fertilization
- Predetermination of the sex of children
- Retardation of ageing
- Modifying human behavior by neurosurgical, electrical or pharmaceutical means
- Contraceptives
- Organ transplantation

(National Research Council, 1975)

More recent health technologies that arouse concerns

- Artificial organs
- Life-sustaining technologies for critically or terminally ill patients
- Genetic testing
- Genetic therapy
- Ultrasonography for fetal sex selection
- Stem cell research (U.S. National Library of Medicine, 2017b, section B)

Emerging Health Technologies

"that'll improve and/or ruin *everything"*

- Robotic construction
- Augmented reality
- Synthetic biology
- Precision Medicine
- Bioprinting
- Brain-Computer interfaces

among others

(Weinersmith & Weinersmith, 2017)

- Examples of Unintended Consequences of Health Technology (U.S. National Library of Medicine, 2017a, box II-3)

Technology	Intended or Original Uses	Unintended Consequences or Unanticipated Uses
Antibiotics (antibacterials)	Kill or inhibit growth of bacteria that cause infectious diseases	Overuse and improper use leading to multi-drug resistant bacterial strains[1]
Antiretroviral therapy (ART)	Treatment of HIV/AIDS	Return to risky sexual behaviors in some patient groups[2,3,4]
Aspirin	Relieve pain, fever, inflammation	Antiplatelet to prevent blood clots[5]
Bariatric surgery	Weight loss in obese patients	Cure or remission of type 2 diabetes in many of the obese patients[6]
Medical ultrasonography	Visualizing structures and blood flow in the body in real time	Fetal sex selection[7,8,9]
Prostate cancer screening with PSA test	Identify men with prostate cancer early enough to cure	Invasive testing, therapies, and adverse effects for men with slow-growing/low-risk cases that will never cause symptoms[10,11]
Sildenafil	Cardiovascular disorders, especially hypertension (used today for pulmonary arterial hypertension)	Treat male sexual dysfunction[12]

Sources:

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8. Nie JB. Non-medical sex-selective abortion in China: ethical and public policy issues in the context of 40 million missing females. Br Med Bull. 2011;98:7-20.

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10. Hayes JH, Barry MJ. Screening for prostate cancer with the prostate-specific antigen test: a review of current evidence. JAMA. 2014;311(11):1143-9.

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12. Kling J. From hypertension to angina to Viagra. Mod Drug Discov. 1998;1(2):31-8.

Guideline for ethical decision making

1. Identify all stakeholders—that is, all individuals whose interests might be affected by a decision.

2. Identify all possible courses of action that one might follow.

3. Review all arguments for each option, developing pros and cons in terms of their potential risks and rewards for all stakeholders.

4. Then, after having carefully worked through such deliberations, make a rational choice about which of the available options has the strongest set of moral reasons behind it. (Winston, 2014, p.17)

In later lectures we will learn:

- the different perspectives on technology in general, and health technology in particular.
- how technology affects the experience of illness
- how health technology has altered the relations between the medical profession and patients,
- the for-profit health-care sector and patients/consumers,
- or the government and its people.

This Week's required reading:

- Winston, M. (2014). "Introduction: Children of Invention Revisited". (pp.1-26 in your textbook)

References

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health technologies that may arouse ethical concerns

- **Genetics-related developments** (especially the advent of new technologies for genetic diagnosis, testing and screening; gene therapy; pharmacogenetics and pharmacogenomics; and nutrigenomics)

    1. the diagnosis and treatment of both single and multifactoral disease

    2. The development of target disorders

    3. The targeting of drug-based treatments

- **Informatics-based systems and e-health used for monitoring the individual,** such as biosensors or telecare; **telemedicine deployed for diagnostic** (thorough imaging/ultrasound) **and therapeutic purposes; and information systems used to manage clinical data about patients**

- **tissue-related, such as tissue engineering and (adult or embryonic) stem cells research and therapy**
- (U.S. National Library of Medicine, 2017a; Webster, 2007, p.6-15)