1.1 What is Biomedical and Health Informatics?

What is Biomedical and Health Informatics? - http://informatics.health/
William Hersh

What is biomedical and health informatics?

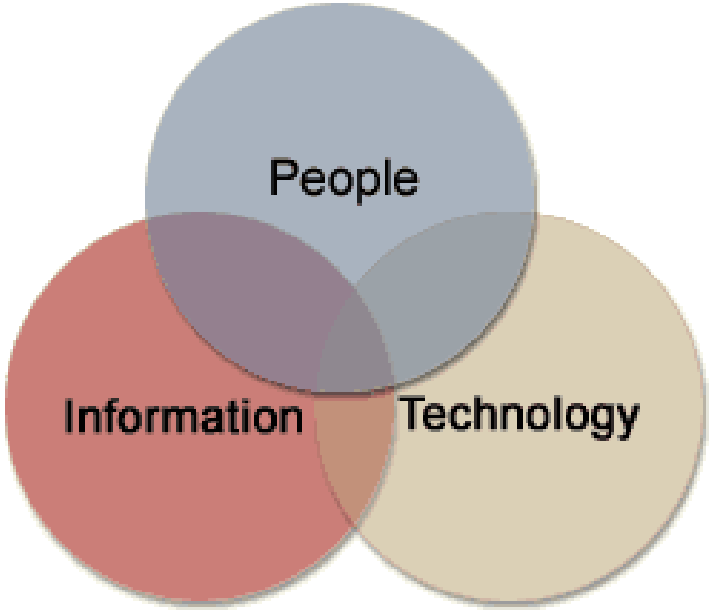
- I get asked this so often that I keep a Web site
- And a blog
- I have also written articles and chapters about it
  - Medical informatics: improving healthcare through information (Hersh, 2002)
  - But there are barriers (Hersh, 2004)
  - Characterization of and changes in the profession (Hersh, 2006)
  - Many career opportunities as well (Hersh, 2008)
  - Reconciling definitions of terms (Hersh, 2009)
  - The informatics professional workforce (Hersh, 2010)
  - Clinical informatics (Hersh, 2020)
  - Textbook (Hersh, 2022)

Other views

- Early definition: “storage, acquisition, and use of information” (Greenes, 1990)
- Other (US) perspectives
  - “The science of information applied to biomedicine … data plus meaning.” (Bernstam, 2010)
  - Paradigm shift in biomedicine from “individual brains to systems of brains” (Stead, 2010)
  - AMIA: “The interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving, decision making, motivated by efforts to improve human health” (Kulikowski, 2012)
- European and global perspectives (Haux, 2010; Hasman, 2011; Geissbuhler, 2011)

Let us start by defining “informatics”

- The discipline focused on the use of information, aided by technology, to improve individual health, healthcare, public health, and research in biomedicine and health (Hersh, 2022)
  - Is more about information than technology
- Sometimes defined as activity at the intersection of people, information, and technology
- The science of “sociotechnical systems” (Coiera, 2007)



(SUNY Buffalo)

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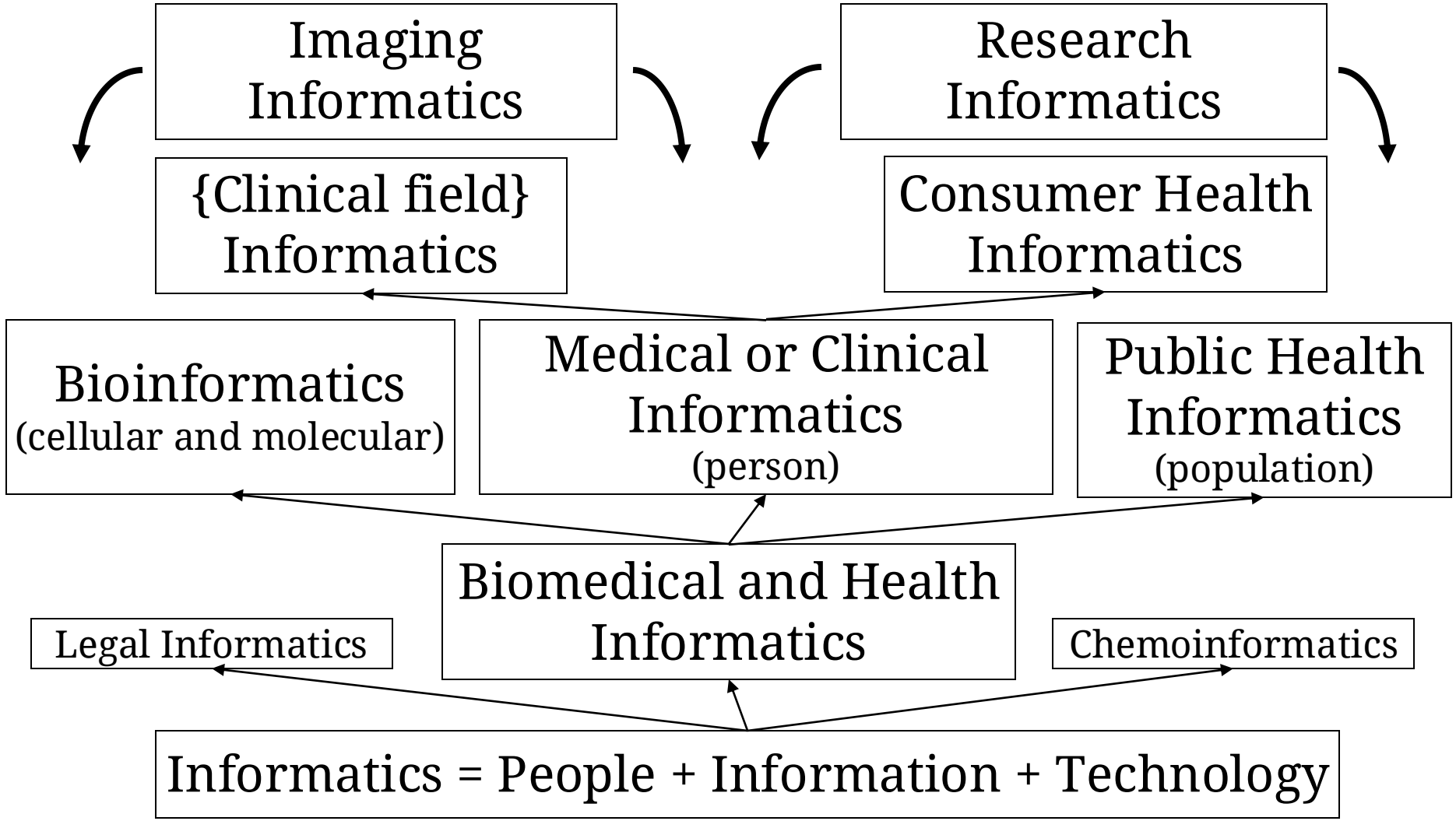
It also has an “adjective problem”



(Hersh, 2009; adapted from Shortliffe textbook)

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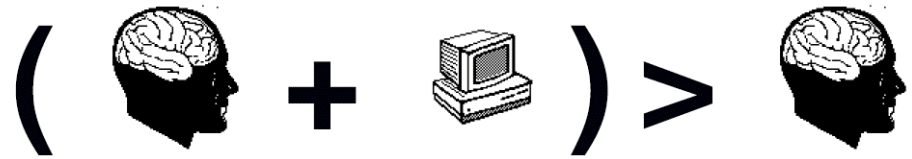
What informatics “is and isn’t” (Friedman, 2013)

- Is
  - Cross-training where basic informational sciences meet a biomedical application domain
  - Relentless pursuit of assisting people
  - Tower of achievement
    - Model formulation
    - System development
    - System implementation
    - Study of effects
- Isn’t
  - Scientists or clinicians tinkering with computers
  - Analysis of large data sets per se
  - Circumscribed roles related to deployment of electronic health records (*point of disagreement)
  - Profession of health information management
  - Anything done using a computer

It has a “fundamental theorem” and a “golden rule”

Fundamental Theorem (Friedman, 2009) – based on “relentless pursuit of assisting people”

Goal of informatics is



Goal is not

Golden Rule (Kuperman, personal communication, 2013):

“Never implement unto others that which you would not implement unto yourself”

My current preferred terminology

- *Biomedical and health informatics* (BMHI) is the field concerned with the optimal use of information, often aided by technology, to improve individual health, healthcare, public health, and biomedical research
  - Informatics applied in a more focused domain is {X} informatics, e.g., nursing, dental, pathology, primary care, etc.
  - Can be classified by "level" of domain but also has some overarching areas, e.g., imaging and research
- Practitioners of BMHI are usually called *informaticians* (sometimes *informaticists*) – there is controversy over this as well! (Bain, 2024)

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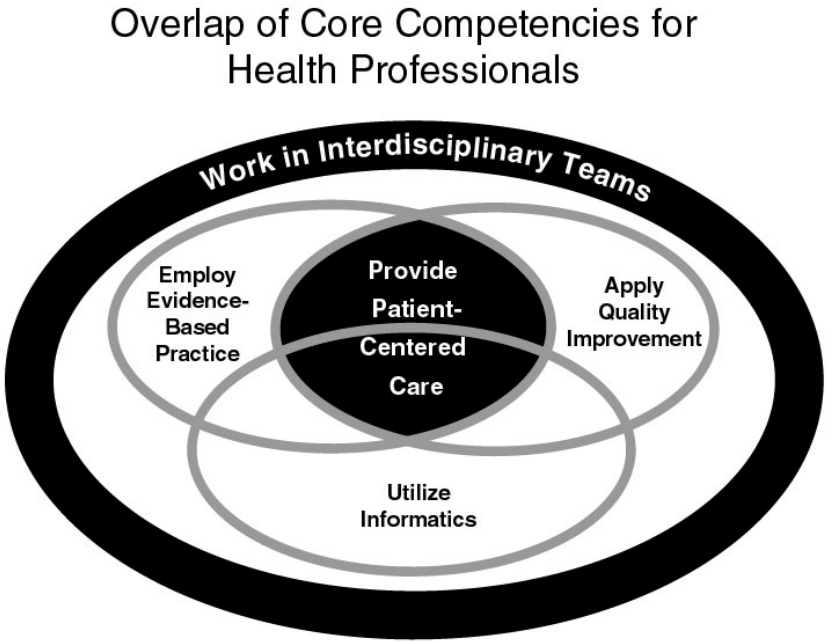
Informatics now viewed as a core competency for health professionals

- According to Institute of Medicine report, the modern healthcare professional must have competency in informatics as part of larger goal to provide patient-centered care (Greiner, 2003)
- Informatics competency is not just computer literacy!
  - The "Google generation" does not necessarily have good information skills (Rowlands, 2008)



Evolution of “informatics”

- Origin of term attributed to Dreyfus in 1962 (Fourman, 2002)
- Achieved widespread use in France (*informatique*), Russia, and later rest of Europe in 1960s to denote computing issues related to information use
- “Medical informatics” first used in 1974 (Collen, 1994)
  - More European history from Moehr (2004)
  - History of field documented by Collen (2015)
- At present, most significant use is in biomedical arena, but it is used by other domains, such as law, chemistry, social sciences, etc.

How is informatics distinguished from related terms?

- *Information technology* (IT) – computer and related technology
- *Computer science* is academic discipline that underlies IT (and other technologies)
- *Management information systems* is another field underlying IT (usually in business schools)
- *Health information technology* (HIT or health IT) – health-related application of IT

Related terms – health information management (HIM)

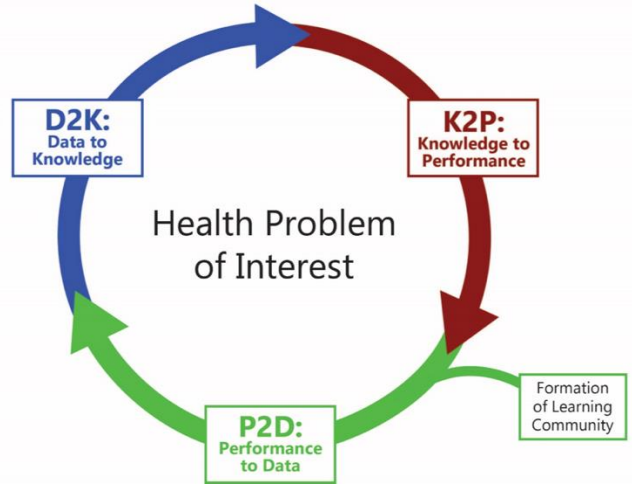
- Discipline historically focused on management of (paper) medical records (changing in current environment), with three main levels of practice
  - *Registered Health Information Administrator* (RHIA) – highest level, baccalaureate degree
  - *Registered Health Information Technologist* (RHIT) – associate degree
  - *Certified Coding Specialist* (CCS) – usually less then associate degree

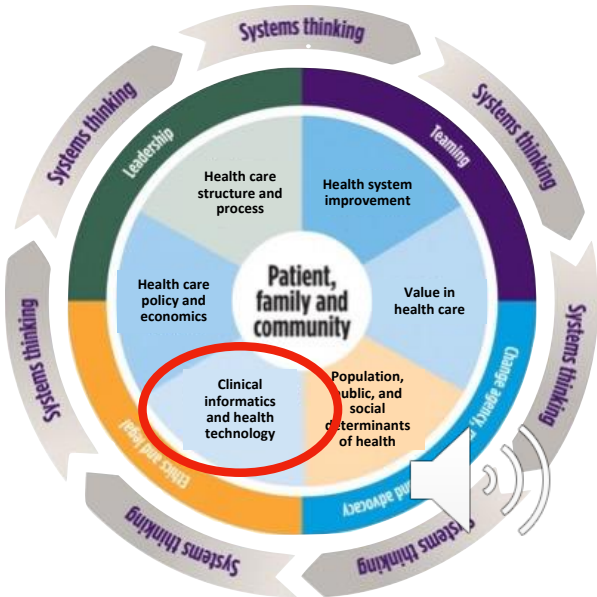
Related terms – digital health

- Broad term for digital, i.e., IT-related, aspects of health and healthcare (Rivas, 2018; Snowden, 2020; D'Anza, 2022; Abernethy, 2022) – emanates from
  - *Information and communications technology* (ICT) – same as IT with added emphasis on telecommunications
  - *eHealth* – use of ICT for health
  - *mHealth* – use of mobile devices for health
- Preferred term to informatics (Car, 2025)?
- Related terms include
  - *Telemedicine* – provision of healthcare when participants separated by time and/or distance
  - *Telehealth* – pursuit of health when separated by time and/or distance

Related terms focusing on health systems and use of informatics within them

- *Learning health system* (LHS) – health systems that learn from data, practice, and improvement (Smith, 2012; Lim, 2022; Friedman, 2022)
- Health systems science (HSS) – different from basic and clinical sciences (Gonzalo, 2019)
  - Textbook (Skochelak, 2020) includes chapter on clinical informatics (Hersh, 2020)
- *Implementation science* – planning, executing, and evaluating implementation efforts to improve health outcomes (Weiner, 2022)
- All based on *evidence-based medicine* (EBM) – application of best scientific evidence in medical decision-making (Straus, 2018; Hersh, 2022)





Terms related to medical/clinical records

- *Electronic health record* (EHR) – patient's health record in digital form
  - Has mostly supplanted electronic medical record (EMR)
  - Key function is *clinical decision support* (CDS) – applying knowledge and recommendations within EHR and other systems
- *Personal health record* (PHR) – personally controlled health record
- *Health information exchange* (HIE) – exchange of health information across traditional business and other boundaries

Informatics is also essential for modern biomedical research

- Embodied in the National Institutes of Health (NIH) Common Fund to accelerate biomedical research discovery
  - "Today's biomedical researcher routinely generates … billions of bytes of data. … What researchers need are computer programs and other tools to evaluate, combine, and visualize these data. In some cases, these tools will greatly benefit from the awesome strength of supercomputers or the combined power of many smaller machines in a coordinated way but, in other cases, these tools will be used on modern personal computers and workstations."

Informatics terms for biomedical research

- *Translational research* – classically, the translation of basic research into clinical applicability ("bench to bedside"), but also from controlled settings to community and population (Woolf, 2008)
  - Increasing recognition that research findings must "translate" into clinical care more quickly and efficiently, leading to US government investment in *clinical and translational research* through the NIH Clinical & Translational Science Award (CTSA) program (Leshner, 2013)
  - *Translational bioinformatics* – bioinformatics applied to health-related problems (Tenenbaum, 2016)
- *Precision medicine* (IOM, 2011; Collins, 2015) – clinical care tailored to an individual's characteristics, including their genome
  - Previously called *personalized medicine* (Schleidgen, 2013)
- *Clinical research informatics* (CRI) is area of informatics applied to clinical research (Richesson, 2023)
  - Difference between information technology (IT) and informatics very evident in this domain (Bernstam, 2009)

A final perspective of informatics

- Data ➔ Information ➔ Knowledge
  - Used in many fields but introduced in informatics by Blum (1984)
- Data are the raw material collected and stored
- Information gives meaning and organization to the data
- Knowledge provides understanding and applicability to new situations
- Some add wisdom, as knowing how to apply knowledge (Rowley, 2007)