What is Biomedical and Health Informatics? (2)

What is Biomedical & Health Informatics?
William Hersh
Copyright 2023
Oregon Health & Science University

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 (a verb)
  - Organization managing HIE used to be called a *Regional Health Information Organization* (RHIO), now called an HIE (a noun)

Many are extolling virtues of EHR in healthcare

- Most prominent discussion has focused on improving healthcare through improved quality, safety, and efficiency
- However, there are many challenges
  - Mixing IT with clinical workflow has been difficult
  - Some HIT has been deleterious
  - Financial benefits of IT do not always accrue to those who pay
  - Larger problems in healthcare organization and financing make any type of change difficult

Informatics is also essential for modern biomedical research

- Embodied in the National Institutes of Health (NIH) Roadmap to accelerate biomedical research discovery (https://commonfund.nih.gov/bioinformatics/overview)
  - "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, 2019)
  - Difference between information technology (IT) and informatics very evident in this domain (Bernstam, 2009)

OHSU

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)

# Growing field related to informatics is data science

- *Data science* is "the science of learning from data; it studies the methods involved in the analysis and processing of data and proposes technology to improve methods in an evidence-based manner" (Donoho, 2017)
  - Data scientist is the "sexiest job of the 21st century?" (Davenport, 2012)
  - Or is it any different from informatics? (Hersh, 2015; Payne, 2018)
- *Data analytics* is "the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions" (Davenport, 2007)
- We are in era of *Big Data*, with four Vs (Chang, NIST, 2019)
  - Volume
  - Velocity
  - Variety
  - Variability

Related data science terms

- *Machine learning* is ability of computer programs to learn without being explicitly programmed (McCarthy, 1990)
  - Or, the use of computers to optimize a performance criterion using example data or past experience (Alpaydin, 2020)
- Current most successful approach to machine learning involves use of *neural networks*; when use deep layers, called *deep learning* (Esteva, 2019)
- *Artificial intelligence* (AI) – older term referring to information systems and algorithms capable of performing tasks associated with human intelligence (Shortliffe, 2019; Rajpurkar, 2022)

How is informatics different from data science?

- A process cycle of going from biological, social, or technical processes with afferent and efferent loops of going to and from knowledge (Payne, 2018)
- Data science and informatics focused on generating knowledge but informatics also engaged in use of that knowledge in real world of health, healthcare, research and other areas
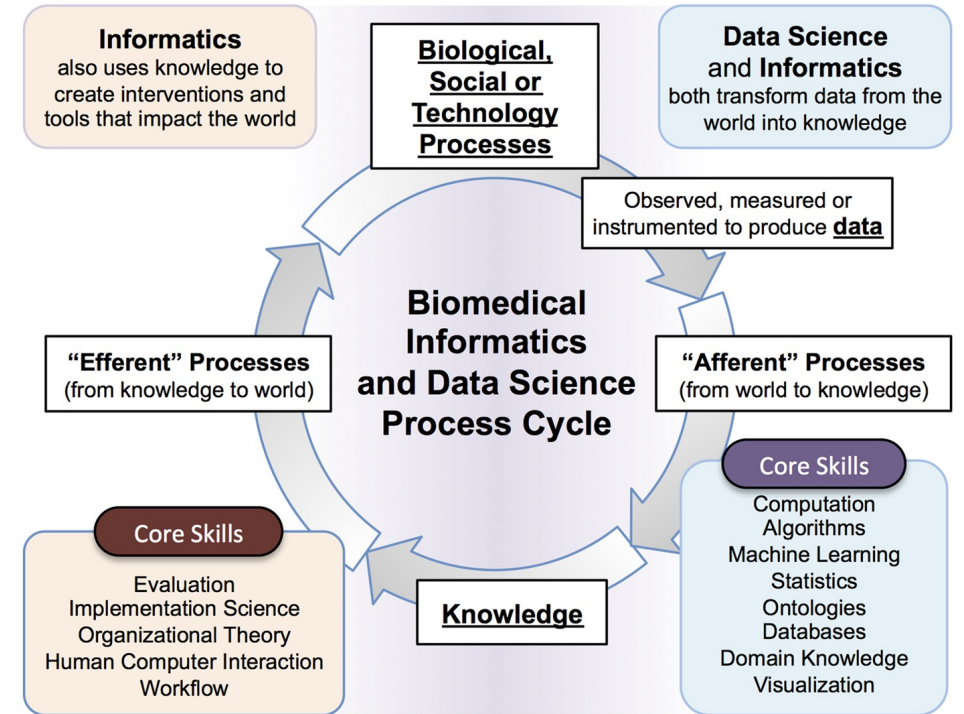
Is medicine/health an information science?

- Many studies over the years, even from pre-computer era, found physicians spend great deal of time with information
- For outpatient physicians
  - Physicians in a general medicine clinic found to spend 37.8% of time charting, 5.3% consulting, 1.7% in other activities, and remaining 55.2% of time with patients (Mamlin, 1973)
  - 14-39% of work took place outside the exam room (Gilchrist, 2005; Gottschalk, 2005)
  - Work related to patient when physician not present consumed 15-23% of work day (Gottschalk, 2005; Farber, 2007; Chen, 2011)
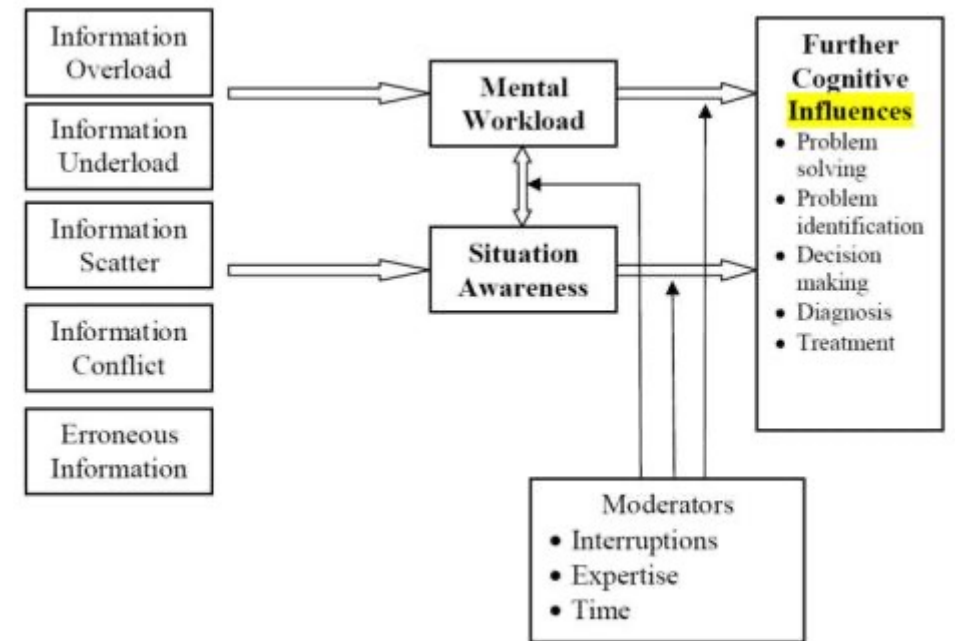
Time studies in hospital and emergency departments

- Time studies of hospital (Ammenwerth, 2009; Tipping, 2010; Tipping, 2010; Victores, 2014) and emergency (Chisholm, 2011) physicians show physicians spent about
  - 15-38% of their time in direct patient care
  - 50-67% of their time in indirect patient care, divided between reviewing results, performing documentation, and engaging in communication

Even more work with data and information more recently

- Studies in era of widespread EHR adoption
  - Interns spent about 40% of time spent interacting with computers (Block, 2013)
  - About 60% of internists reported "loss" of around 48 minutes per day due to EHR use (McDonald, 2014)
  - Residents in an academic teaching hospital found to spend 50% of time with computers vs. 10% time directly with patients (Mamykina, 2016)
  - Physicians found to spend two hours of time doing EHR and desk time for every hour of direct patient time, plus additional 1-2 hours per night (Sinsky, 2016)
  - Two studies of primary care physicians found spending 50% (Tai-Seale, 2017) and 60% (Arndt, 2017) of workday with EHR and other desktop medicine tasks
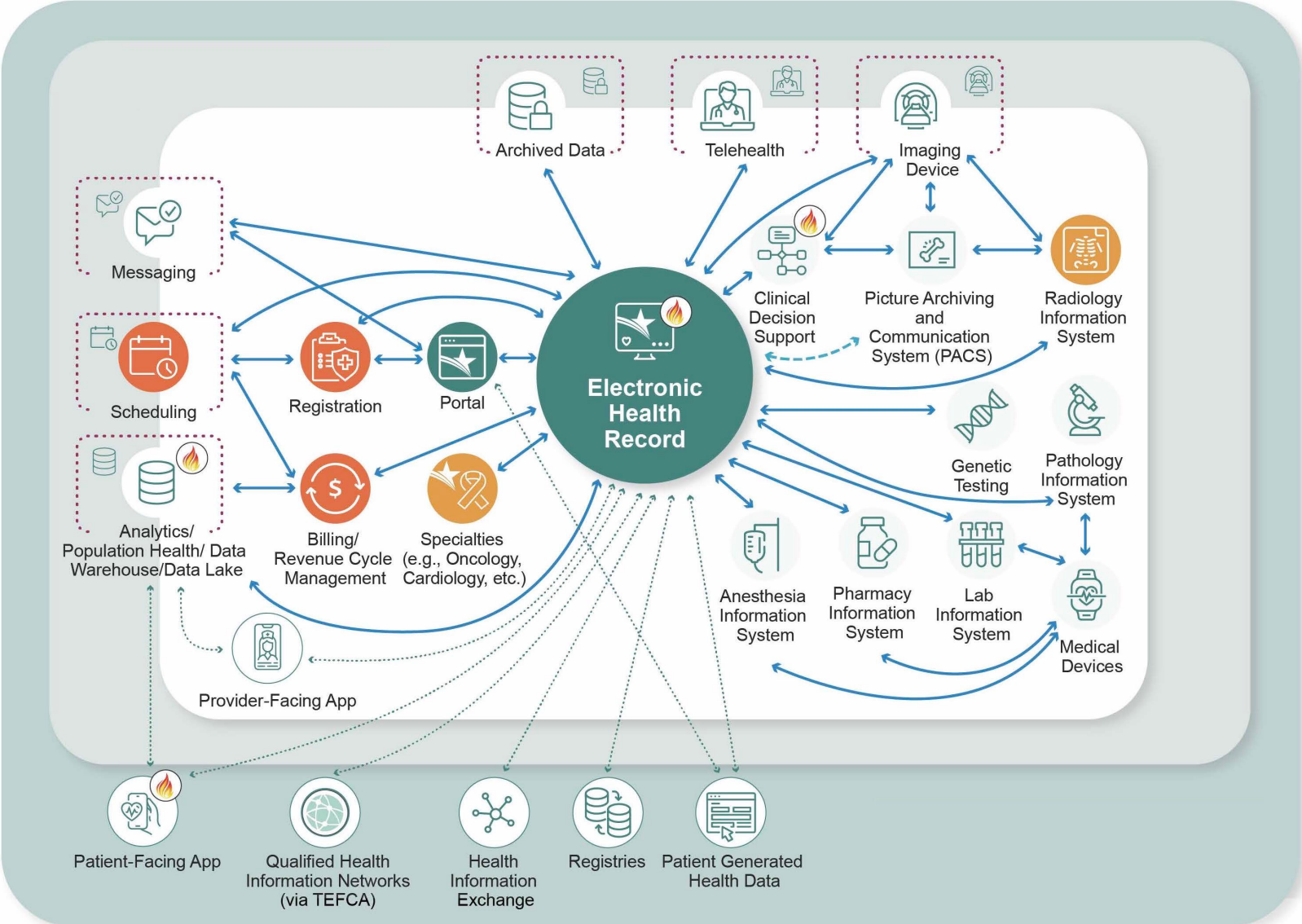- These studies don't answer what is right amount of time (Hersh, 2017)

Information chaos and complexity

- Physician performance and safety impacted by "information chaos" (Beasley, 2011)
- Epidemiology and all of healthcare system are "complex adaptive systems" where small changes can be unpredictable and lead to new states of equilibrium (Pearce, 2006)

Big-picture view of clinical information systems

https://sequoiaproject.org/interoperability-matters/information-blocking-compliance-workgroup/ibwg-resources-lp/

More focused view of information supporting healthcare quality improvement

https://build.fhir.org/ig/HL7/davinci-deqm/index.html#quality-improvement-ecosystem