

Biomedical and Health Informatics: Careers and Opportunities at the Intersection of Computer Science and Biomedicine

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Outline

- Terms and definitions
- Recent growth and change
- Career and educational opportunities

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What is biomedical and health informatics (Hersh, 2009)?

- I get asked this so often that I keep a Web site
 - <http://www.billhersh.info/whatis/>
- And a blog
 - <http://informaticsprofessor.blogspot.com>
- *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
- Practitioners of BMHI are usually called *informaticians* (sometimes *informaticists*)

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Other views

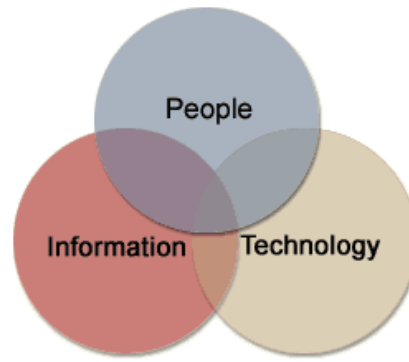
- Early definition: “storage, acquisition, and use of information” (Greenes, 1990)
- Other (US) perspectives
 - Paradigm shift in biomedicine from “individual brains to systems of brains” (Stead, 2011)
 - AMIA: “The interdisciplinary field that studies and pursues the effective uses of biomedical data, 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)

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Let us start by defining “informatics”

- The discipline focused on the acquisition, storage, and use of information in a specific setting or domain (Hersh, 2009)
 - 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)



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

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

Golden Rule
(Kuperman, personal
communication, 2013):

Goal of informatics is

$$\left(\text{brain icon} + \text{computer icon} \right) > \text{brain icon}$$

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

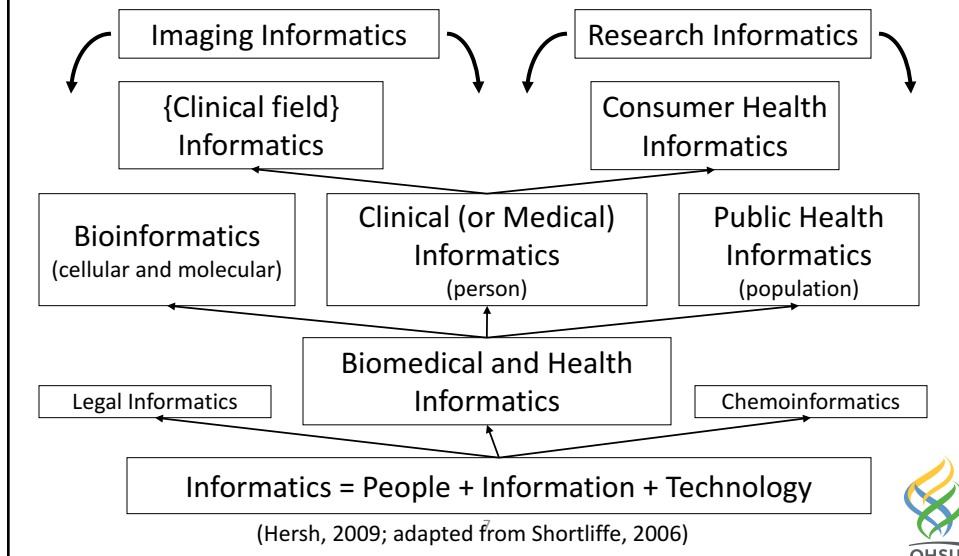
Goal is not

$$\text{computer icon} > \text{brain icon}$$

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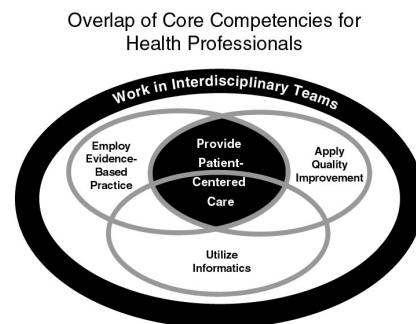


Informatics terminology (and our “adjective problem”)



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 (CIBER, 2008)
- Informatics is a core component of the “learning health system” (Friedman, 2010; Smith, 2012)



Some related terms

- *Health information technology* (HIT or *health IT*) – health-related application of IT
- *Information and communications technology* (ICT) – same as IT with added emphasis on telecommunications
- *eHealth* – use of ICT for health
- *Telemedicine* – provision of healthcare when participants separated by time and/or distance
 - *Telehealth* – pursuit of health when separated by time and/or distance
- *mHealth* – use of mobile devices for health

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Terms related to medical/clinical records

- *Electronic health record* (EHR) – patient's health record in digital form
 - Has mostly supplanted *electronic medical record* (EMR)
- *Meaningful use* – program of incentives for EHR adoption in US requiring that they be used in ways that achieve healthcare goals
- *Personal health record* (PHR) – personally controlled health record
- *Health information exchange* (HIE) – exchange of health information across traditional business and other boundaries

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Programming an EHR is simple, right?

Vista CPS in use by: DoctorOne (BROKERSERVER)

File Edit View Tools Help

SEVEN, INPATIENT **3E S 3E-100-4** Primary Care Team Unassigned
 666-00-0807 Mar 09, 1945 (65) Provider: DOCTOR.ONE Attending: Doctor.Two

Flag VistaWeb Postings
 Remote Data

Active Problems	Allergies / Adverse Reactions	Postings
Depression *Tachycardia Hypertrophy (BENIGN) OF PROSTATE WITHOUT URINARY OBSTRUCTION *Phlebitis And Thrombophlebitis Of Femoral Vein (DEEP) Graves' Disease	Pet Hair Keflex	Allergies

Active Medications	Clinical Reminders	Due Date
No Active Medications Found	Depression Screening	Dec 07, 08
	PC Nutritional Screening	DUE NOW
	Influenza Vaccine	DUE NOW
	Pneumococcal vaccine (Pneumovax)	DUE NOW

Recent Lab Results	Vitals	Appointments/Visits/Admissions
No Orders Found	T 98.6 F Aug 20, 2010 11:30 (87.0 C) P 68 Aug 20, 2010 11:30 R 24 Aug 20, 2010 11:30 BP 194/88 Aug 20, 2010 11:30 HT 70 in Aug 20, 2010 11:30 (177.8 cm) WT 199 lb Aug 20, 2010 11:30 (90.3 kg) PN 0 Aug 20, 2010 11:30 POX 98 Aug 20, 2010 11:30 BMI 28.61 Aug 20, 2010 11:30	Aug 03, 10 09:00 Endocrine Inpatient Appointment Jul 23, 10 08:00 Inpatient Stay 3e North Jul 15, 10 13:00 General Medicine Action Required Jul 01, 10 14:00 General Medicine Action Required Jun 20, 10 13:00 General Medicine Action Required Jun 10, 10 10:00 General Medicine Action Required May 24, 10 13:00 Inpatient Stay 3e North May 20, 10 08:00 General Medicine Action Required May 18, 10 08:00 General Medicine Action Required May 10, 10 15:00 General Medicine Action Required

Cover Sheet | Problems | Meds | Orders | Notes | Consults | Surgery | DIC Summ | Labs | Reports

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But programming is actually the easy part

- Mixing IT with clinical workflow has been difficult
- Some HIT has had safety issues
- Financial benefits of HIT do not always accrue to those who pay
- Many issues with privacy and security, who go beyond healthcare
- Larger problems in healthcare organization and financing make change difficult

Informatics is also essential for modern biomedical research

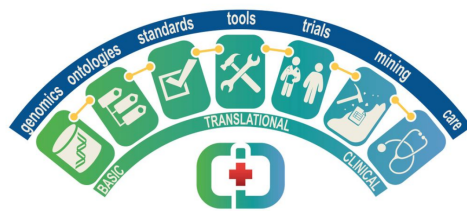
- Embodied in the National Institutes of Health (NIH) Roadmap to accelerate biomedical research discovery (<http://commonfund.nih.gov>)
 - *Today's biomedical researcher routinely generates ... billions of bytes of data. ... What researchers need are computer programs and other tools to evaluate, combine, 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.*

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OHSU to pioneer digital health innovation for the benefit of patients nationwide

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OHSU has been awarded two grants totaling \$62 million from the National Center for Advancing Translational Sciences, part of the National Institutes of Health, to support the use of health data, algorithms and information systems to bridge basic science and clinical research.

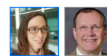
The newly awarded grant provides OHSU with \$25 million over five years to establish and lead the new National Center for Data to Health, or CD2H, which aims to foster collaboration across more than 50 premier medical research institutions within the prestigious Clinical and Translational Science Awards, or CTSA, network.

Downloads



Melissa Haendel, Ph.D.

Melissa Haendel, Ph.D., co-director of the NCATS-funded Biomedical Data Translator. (OHSU)



Related



Translational research institute at OHSU receives \$37 million



Informatics is increasingly becoming a “data science”

- EHR (and probably all informatics) work changing from “implementation” to “analytics” (Hersh, 2012)
- Data science is the “sexiest job of the 21st century?” (Davenport, 2012)
- Growing importance of role for *analytics* in healthcare (Adams, 2011; O’Reilly, 2012; Hersh, 2014)
 - But we must use caution to make sure that clinical data is complete, correct, and otherwise sound (the role of informatics?) (Hersh, 2013)

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Informatics has gone from “dot-com” to “dot-gov”(Kleinke, 2007)

- Bush Administration
 - Recognized value of health information technology (HIT)
 - Actions: Office of the National Coordinator for Health IT (ONC), American Health Information Community (AHIC), etc.
- Obama Administration
 - The American Recovery & Reinvestment Act (ARRA) of 2009 provided incentives for “meaningful use” of electronic health records (EHRs) and the infrastructure to achieve it through provisions of the Health Information Technology for Economic and Clinical Health (HITECH) Act (Washington, 2017; Halamka, 2017)

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Bush Administration started promotion of field

- President Bush State of the Union – mentioned every year from 2004 to 2008
 - January, 2004 – “Computerizing health records [can] reduce costs, improve care, and lower the risk of medical mistakes.”
 - January, 2007 – “We need to reduce costs and medical errors with better information technology.”
- Set goal of electronic health records (EHRs) for half of all Americans by 2014 (White House, 2005)
- Established the Office of the National Coordinator for Health IT (ONC)
 - www.healthit.gov

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Obama Administration upped the ante

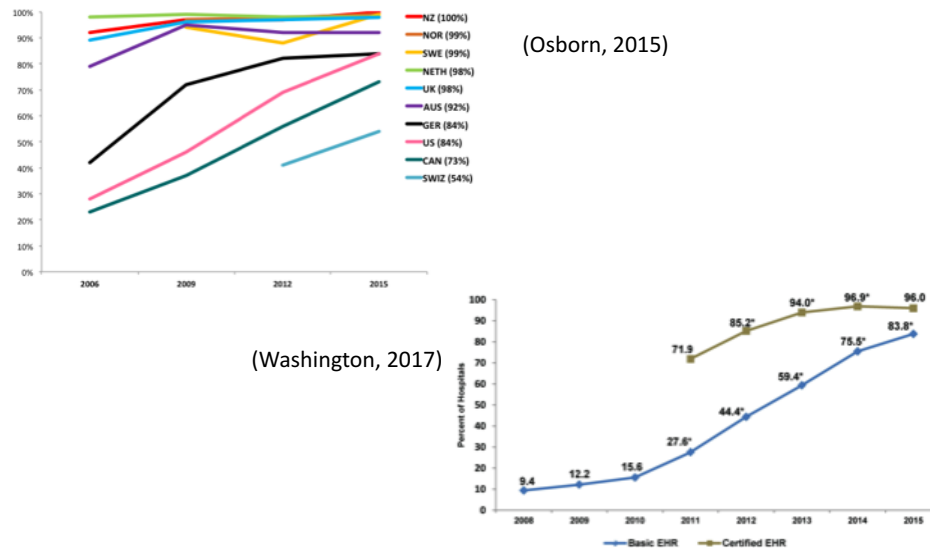


“To improve the quality of our health care while lowering its cost, we will make the immediate investments necessary to ensure that within five years, all of America’s medical records are computerized ... It just won’t save billions of dollars and thousands of jobs – it will save lives.”

January, 2009



US has been a laggard in EHR adoption but now catching up

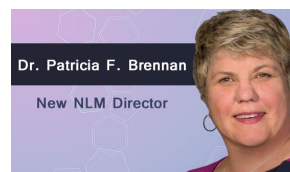


Other US government agencies and entities involved in health IT

- National Library of Medicine (NLM, www.nlm.nih.gov) and other institutes of the National Institutes of Health (NIH)
 - NLM leader in funding research and training in informatics
 - Reaffirmed with appointment of new leader and incorporation of NIH data science activities (Brennan, 2016; Brennan, 2016)
- Agency for Healthcare Research & Quality (AHRQ, www.ahrq.gov)
 - Funds research and policy development, produces health IT information resources
- Centers for Medicare and Medicaid Services (CMS, www.cms.hhs.gov)
 - Payor for Medicare and Medicaid, including HITECH incentives
- National Committee for Vital & Health Statistics (NCVHS, www.ncvhs.hhs.gov)
 - Government advisory board, including issues related to health IT



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Informatics also requires us to address harms and limitations

- IOM HIT safety report documented concerns about dangers (2012)
- Key issues to address are workflow (Carayon, 2010) and usability (Lowry, 2012)
- EHR must move from being a monolithic, transaction-based application to a platform (Glaser, 2012; Mandl, 2012)
 - Emerging SMART on FHIR standard the answer (Mandel, 2016)?
- Has EHR undermined medicine or are we in “transitional chaos” (Rosenbaum, 2015; Martin, 2016)?

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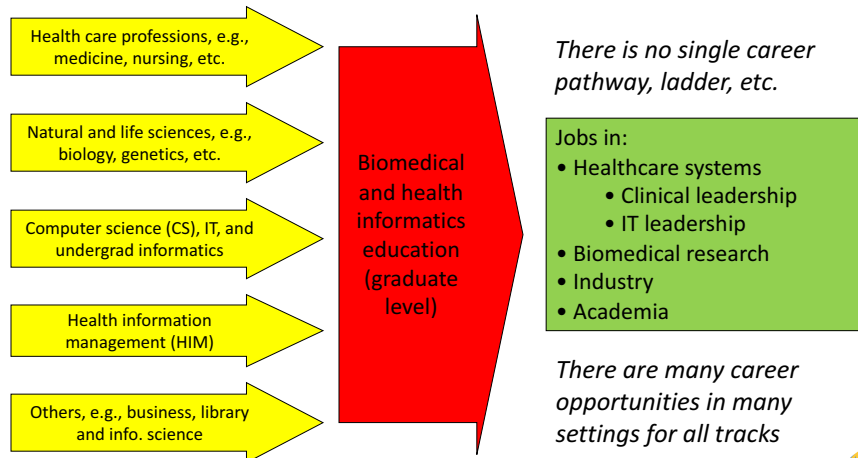
Opportunities for informatics careers

- Most prevalent in clinical informatics (in healthcare settings), but plenty of other opportunity in other areas of informatics
 - Bioinformatics – leading and assisting computational analysis of genomics and related technologies
 - Clinical and translational research – using informatics to aid biomedical research
 - Public health – using information to protect the public and promote health
 - Consumer health – helping the general population maintain and improve health
 - Imaging informatics – using images for biomedical research, clinical care, etc.



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Career pathways have diverse inputs and outputs (Hersh, 2009)

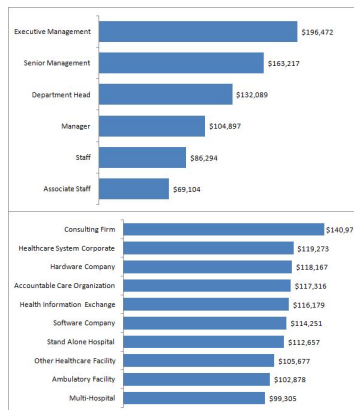


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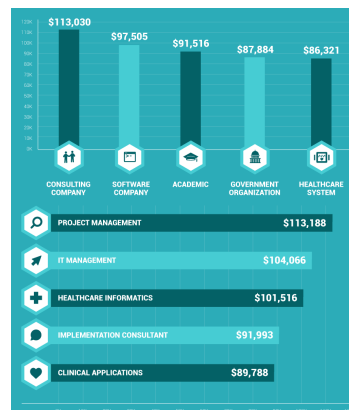


Show me the money: how much do HIT professionals make?

- HIMSS compensation survey (2015) and HealthITJobs.com (2016)
- Salaries vary by level, region, experience, organizational size, and organizational type
- Even higher for some: physicians, advanced data science/analytics



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Example: OHSU informatics

<http://www.ohsu.edu/informatics>



Degrees Awarded 1998-2016 (653 people)			
Track	CI	BCB	Total
Certificate	406	0	406
MBI/MMI	190	8	198
MS	72	16	88
PhD	18	6	24
Total	686	30	716

International students from: Argentina, Singapore, Egypt, Israel, Saudi Arabia, Zimbabwe, Thailand, China, and other countries

Track	Degree/Certificate	PhD	MS	MBI	Grad Cert
Clinical Informatics		On-campus	On-campus	On-campus	On-campus
			On-line	On-line	On-line
Bioinformatics and Computational Biology		On-campus	On-campus		

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How have OHSU students and graduates done?

- About 25 years of experience...
- General observation: What people do when they graduate is partially dependent on what they did when they entered, e.g.,
 - Physicians, nurses, public health, etc. draw on their clinical/professional background
 - Information technology professionals draw on their unique background and experience
- Graduates have obtained jobs in a variety of settings, e.g., clinical, academic, and industry
- Growing number of opportunities in data science/analytics

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Conclusions

- These are exciting times for biomedical and health informatics, with many opportunities in a wide variety of settings
- Attention must also be paid to the professional practice and education of informaticians
- But the main focus of the field must be how to optimally use information and technology properly to advance human health and improve delivery of healthcare

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