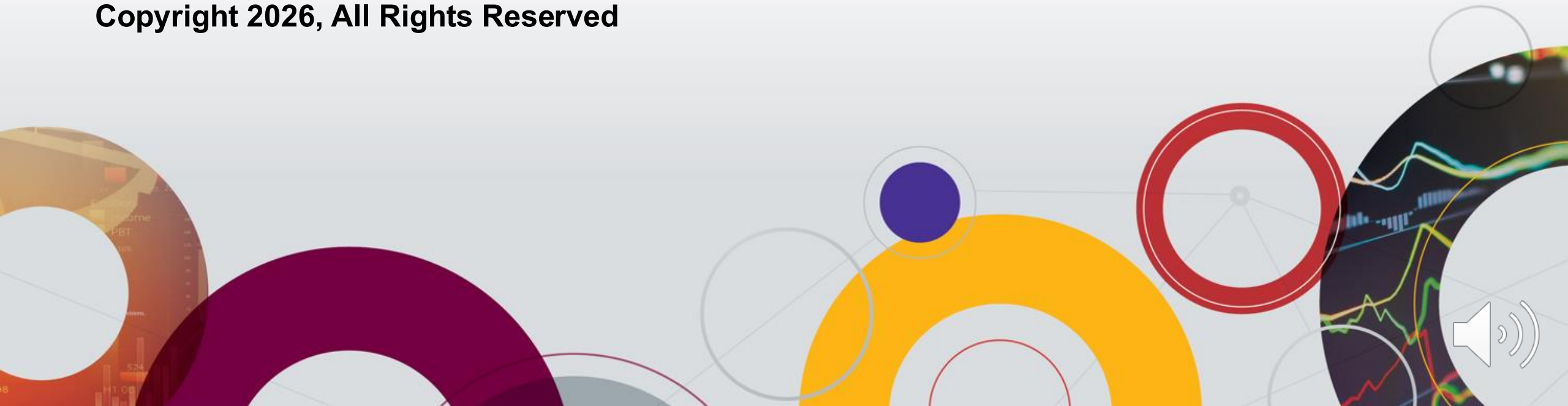


1.4a Who Does Biomedical Informatics and AI?

10x10 – Introduction to Biomedical Informatics & Artificial Intelligence
William Hersh, MD, FACMI, FAMIA, FIAHSI
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Who does biomedical informatics and AI?

Practitioners

Health IT workforce

Users

Leaders

Certification

Practitioners and users

Practitioners – develop, implement, evaluate, and lead application of informatics in biomedical and health settings

- Domain – clinical/healthcare largest in size but also research, public health, consumer health, bioinformatics, etc.
- Related disciplines – information technology (IT), health information management (HIM), data science, etc.

Users employ informatics tools to carry out their biomedical and health work

- Clinicians, patients, researchers, administrators, etc.

All require competencies to most effectively carry out work

Competencies of informatics practitioners

Core content of clinical informatics (Gardner, 2009)

Core competencies for graduate education in biomedical informatics (Kulikowski, 2012)

Foundational domains of applied health informatics (Valenta, 2018)

Domains, tasks, and knowledge for clinical informatics subspecialty practice (Silverman, 2019)

Domains, tasks, and knowledge for health informatics practice (Gadd, 2020)

UK clinical informatics core competency framework (Davies, 2022)

Digital health competencies for Canada (Monkman, 2023)

International Medical Informatics Association (IMIA) recommendations on BMHI informatics education (Bichel-Findlay, 2023)

Working in health informatics – industry, healthcare, health insurance, consulting, government, etc. (Meehan, 2023)

AMIA informatics delineation of practice (DoP) workforce analysis

Health Informatics

Domains	Task statements	KS statements
Domain 1. Foundational Knowledge and Skills	NA	31
Domain 2. Enhancing Health Decision-making, Processes, and Outcomes	11	21
Domain 3. Health Information Systems	26	36
Domain 4. Data Governance, Management, and Analytics	17	28
Domain 5. Leadership, Professionalism, Strategy, and Transformation	20	28
Total	74	144

(Silverman, 2019;
Gadd, 2020)

Clinical Informatics Subspecialty (CIS)

Domains	Task statements	KS statements
Domain 1. Foundational Knowledge and Skills	NA	26
Domain 2. Improving Care Delivery and Outcomes	7	28
Domain 3. Enterprise Information Systems	16	33
Domain 4. Data Governance and Analytics	10	27
Domain 5. Leadership and Professionalism	9	28
Total	42	142

(Integrated:
Hersh, 2020)



Fundamental knowledge and skills

Fundamental knowledge and skills that provide health and clinical informaticians with a

- Common vocabulary
- Basic knowledge across all informatics domains
- Understanding of the environment in which they function, including
 - Individual health
 - Healthcare
 - Public health
 - Research

Enhance health decision-making, healthcare delivery and outcomes

Support and enhance decision-making by clinicians, patients, policy makers, researchers, and public health professionals

Analyze existing health processes and identify ways that health data and health information systems (HIS) can enable improved outcomes

Evaluate the impact of HIS on practice

Pursue discovery and innovation in HIS and informatics practice

Develop, implement, evaluate, monitor, and maintain clinical decision support

Support innovation in the health system through informatics tools and processes

Health and enterprise information systems

Plan, develop or acquire, implement, maintain, and evaluate health information systems that are integrated with existing information technology systems across the continuum of care including

- Clinical, consumer, and public health domains
- While addressing security, privacy, and safety considerations

Develop, curate, and maintain institutional knowledge repositories while addressing security, privacy, and safety considerations

Data governance, management, and analytics

Establish and maintain data governance structures, policies, and processes

Acquire and manage health-related data to ensure their quality and meaning across settings and to utilize them for analysis that supports individual and population health and drives innovation

Incorporate information from emerging data sources

Ensure data quality and meaning across settings

Derive insights to optimize clinical and business decision making

Identify and minimize biases in data and mitigate their impact

Implement and evaluate machine learning and artificial intelligence applications

Leadership, professionalism, and transformation

Facilitate leadership and change management among people and organizations

Build support and create alignment for informatics best practices

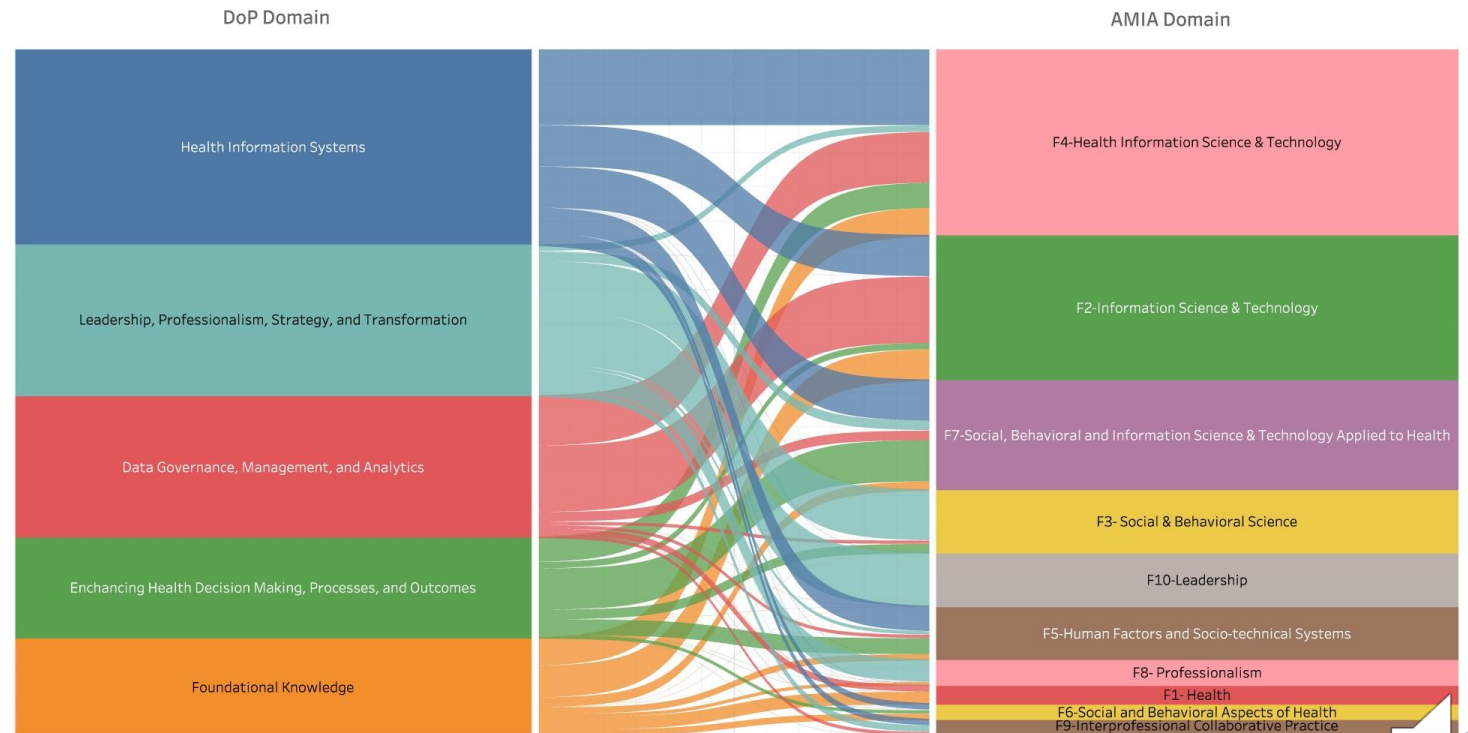
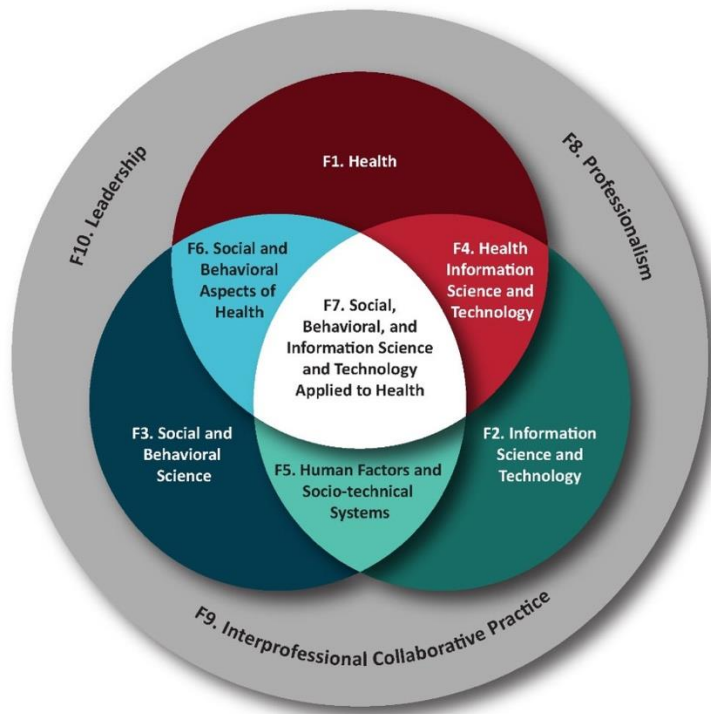
Lead health informatics initiatives and innovation through collaboration and stakeholder engagement across organizations and systems

Mapping DoP to foundational domains of practice

Foundational domains (Valenta, 2018) used for applied master's program accreditation

Mapped to elements of DoP (Johnson, 2023)

Also used to develop competencies for undergraduate education (Khairat, 2023)



Health IT workforce

Traditional groupings in healthcare settings (Hersh, 2010)

- Information technology (IT) – usually with computer science or information systems background
- Health information management (HIM) – historical focus on medical records
- Clinical informatics (CI) – often from healthcare backgrounds, performing implementation, analysis, training, etc.
- Others – librarians, managers, administrators, etc.

Diverse array of titles, job descriptions, and required backgrounds (HIMSS, 2024)

Health information and technology job descriptions (HIMSS, 2024)

Analytics Specialist
Analytics/Report Writer
Application Analyst
Applied Data Scientist
Artificial Intelligence (AI)
Developer
Artificial Intelligence (AI)
Practitioner
Associate Physician
Informaticist
Business Analyst
Business Development
Officer
Business Intelligence
Analyst
Chief Artificial
Intelligence Officer
Chief Business
Development Officer
Chief Clinical Information
Officer
Chief Data Officer
Chief Digital Officer
Chief Experience Officer
(Chief Patient
Experience Officer)
Chief Information
Security Officer
Chief Intelligence
Systems Officer
Chief Medical Information
Officer
Chief Medical Officer
Chief Nursing Informatics
Officer

Chief Privacy Officer
Chief Risk Officer
Chief Technology Officer
Client Executive
Clinical Data Scientist
Clinical Information
Specialist
Clinical Systems Analyst
Clinical
Terminologist/Mapping
Specialist
Clinical Transformation
Analyst
Coding Specialist
Compliance Professional
Consultant
Cyber Architect
Cyber Security Architect
Data Analyst
Data Analyst – Health
Plan
Data Architect
Data Governance
Advisor/Coordinator
Data Manager
Data Privacy Analyst
Data Security Analyst
Database Administrator
Database Developer
Desktop/Field Services
Technician
Director of Clinical
Information Systems
Director of Informatics

Director of Registries and
Data Science
Document Integrity
Specialist
FHIR Developer
Health System Sales
Executive
Informatics and Training
Analyst
Information Security
Manager
Integration Analyst
IT Auditor and Risk
Analyst
IT Business Relationship
Manager
Nurse Informaticist
Pharmacist Informaticist
Pharmacy Technician
Informaticist
Physician Informaticist
Population Health Analyst
Privacy Manager
Privacy Specialist
Process Improvement
Consultant
Process Improvement
Specialist
Process Improvement
Technician
Product Manager
Program Director
Program Manager
Project Management
Officer

Project Manager
Quality Analyst
Revenue Cycle Analyst
Risk Professional Sales,
Solutions Specialist
Security Analyst
Senior Application
Analyst
Senior Director of
Business Intelligence
Senior Process
Improvement
Specialist
Senior Manager, HIS
Operations
Senior Privacy Specialist
Senior Project Director
Senior Project Manager
Senior Solutions Architect
Senior System
Administrator
Service/Help Desk
Analyst
Software Developer
Systems Architect
Telemedicine/Telehealth
Nurse Practitioner
Vice President of
Software Engineering
Vice President, Chief
Information Officer
Vice President, IT
Operations

IT

Early work focused on data collected as part of HIMSS Analytics Database (Hersh, 2008; Hersh, 2018)

- Self-reported jobs data; no longer collected
- ~1 IT staff per 60 non-IT staff
- Staffing rose with higher stages of EHR and other IT adoption – ~40K more required for full (Stage 7) adoption
- Motivated workforce development programs as part of HITECH Act
- Workforce needs maintained 4 years into HITECH Act

Small but growing use of outsourcing (Lieberman, 2022)

More recent data tends to come from industry surveys, e.g., (Bloomforce, 2024)

Health IT salaries (Bloomforce, 2024)

➡	Project Manager	Principal Trainer	Credentialed Trainer	Clinical Informatics Specialist
Low	\$90,000	\$65,000	\$55,000	\$65,000
High	\$145,000	\$117,000	\$90,000	\$113,500
Average	\$112,000	\$83,250	\$74,900	\$78,900

➡	Team Lead	Manager	Senior Manager	Director	Senior Director
Salary	\$121,000	\$138,650	\$165,300	\$179,250	\$245,800
Bonus	\$0-8k	\$5-10k	\$10-20k	\$15-25k	\$20-40k

Salary of All Application Analysts

10th %	25th %	Median	75th %	90th %	Avg
\$75,000	\$82,900	\$100,000	\$120,000	\$140,000	\$103,250

HIM

HIM is a field in transition, with leadership promoting advanced skills, degrees, and work (Davis, 2019; Kiel, 2022)

- [Career map](#)
- Call to “adapt or disappear” (Butler, 2014)

Historical levels/roles/training

- Registered Health Information Administrator (RHIA)
- Registered Health Information Technician (RHIT)
- Certified Coding Specialist (CCS)

Historically large workforce (BLS, 2025)

- Medical Records and Health Information Technicians (RHIT and CCS) – about 194,800 employed in 2024, estimated to increase by 13,800 by 2034 (~7% growth)
- RHIAs and other roles not counted in these numbers



CI (or health and clinical informatics – HCIN)

Individuals who bring skills at intersection of healthcare and IT (Hersh, 2010)

Becoming harder to distinguish from IT (HealthITJobs.com, 2015) – “The primary skill gap in healthcare IT -- specifically Clinical Systems (EMR/EHR) -- is that most leaders are looking for employees with both hands-on clinical experience and technical expertise. Historically, these have been two very separate skillsets.”

Early estimate of need – one physician and nurse in each US hospital (~10,000) (Safran, 2005)

Many healthcare organizations have CI departments distinct from IT and may include HIM

New need for which CI experts well-trained: algorithmic consultant (Marwaha, 2025)

Analysis of informatics job postings (McLane, 2021)

	n	Overall (%)	RN require (%)
Organization type			
Health system	103	50.0	43.7
Hospital	34	16.5	50.0
Consulting	18	8.7	33.3
Vendor	15	7.3	46.7
Payer/insurance company	8	3.9	25.0
Home care	5	2.5	20.0
Clinic	4	1.9	50.0
Government	4	1.9	50.0
Physician group	4	1.9	25.0
Other	11	5.4	9.1
Total	206	100	
Degree required			
Associate degree	42	20.4	59.5
Bachelor's and above	126	61.2	37.3
Master's and above	6	2.9	66.7
Doctoral degree	2	1.0	
Not listed	30	15.3	26.7
Total	206	100	
Degree preferred			
Associate degree	1	0.5	
Bachelor's and above	52	25.1	44.4
Master's and above	50	23.7	25.5
Doctoral degree	3	2.3	
Not listed	100	48.4	10.6
Total	206	100	
Experience			
<y	28	13.6	
1-2 y	48	23.3	
3-4 y	69	33.5	
5-6 y	45	21.8	
7-8 y	13	6.3	
9-10 y	3	1.5	
Total	206	100	
Specific EHR experience			
Epic	45	21.8	
Cerner	24	11.7	
MEDITECH	6	2.9	
Other	15	7.3	
Not listed	116	56.3	
Total	206	100	

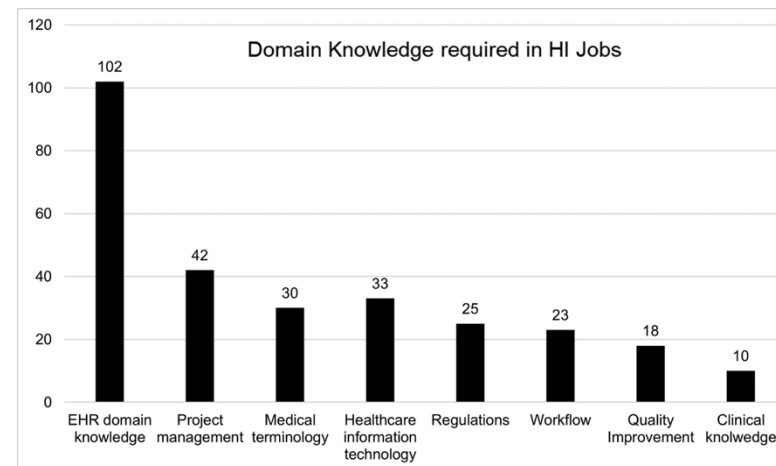
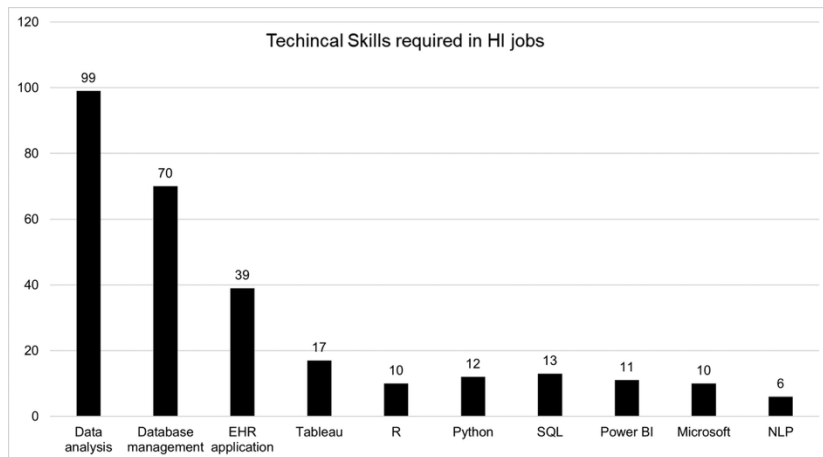
	Overall (%)	RN required (%)
Hard skills		
EHR support	50.5	61.9
Change management	23.8	32.1
Programming	12.1	20.0
Training	49.0	43.6
Other clinical systems	44.2	45.2
Computer skills	40.8	42.9
Data analysis	39.3	32.1
Project management	35.9	39.3
Workflow analysis	35.4	39.3
Process improvement	33.5	33.3
Health policy/standards	22.8	26.2
Administration and leadership	16.5	10.7
Soft skills		
Communication	55.8	59.5
Problem solving	34.5	35.7
Critical thinking	18.4	23.8

Informatics educational programs vs. job postings (Patel, 2022)

In US, 94 universities offer BMHI graduate programs

- Almost all offer Master of Science degrees (92)
- Also offer doctoral (43) and certificate programs (54)
- Diversity of names: health, clinical, biomedical, etc.

Gaps between curricular content and skills required



Lack of informatics workforce data: inadequate labor statistics

US [Standard Occupational Classification \(SOC\)](#) has codes for

- 29-1000+ Health Diagnosing and Treating Practitioners
- 29-2071 Medical Records Specialists
 - Non-RHIA HIM: RHIT, CCS, and other coders
- 29-9021 Health Information Technologists and Medical Registrars
 - “Health informatics specialist” one of several examples
- 11-9111 Medical and Health Services Managers
 - “Chief Medical Information Officer” an example
- 15-1000+ Computer Specialists

But no unique code for “informatics” – despite AMIA proposal to establish SOC code for “health informatics practitioner”

Same for [International Standard Classification of Occupations \(ISCO\)](#)

- Not updated since 2008; no codes for “informatics”

Related growing area for jobs: data science

Strong outlook for jobs – requiring not only quantitative skills but for some, expertise in subject domains (e.g., biomedicine) and good communications skills (Magnet, 2025)

- Includes need for “light quants” and “analytical translators” (Davenport, 2015)

According to BLS (2025)

- Average salary \$112,590
- 245,900 jobs in 2024, expected to grow by 82,500 (34%) by 2034

Some notable roles for data scientists in healthcare, with focus on (Meyer, 2019)

- Performance improvement
- Innovation
- Product development
- Broad organizational-specific needs

Contrasting jobs in data science vs. health informatics (Hoffman, 2021)