Informatics: What Every Clinician Needs to Know

William Hersh, MD
Professor and Chair
Department of Medical Informatics & Clinical Epidemiology
Oregon Health & Science University
Portland, OR, USA
Email: hersh@ohsu.edu
Web: www.billhersh.info
Blog: http://informaticsprofessor.blogspot.com

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VanDenBos, J, Rustagi, K, et al. (2011). The $17.1 billion problem: the annual cost of measurable medical errors. *Health Affairs*. 30: 596-603.

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William Hersh, MD
Professor and Chair
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Outline

- Problems in healthcare and their information-driven solutions
- Role of informatics science and professionals in solutions
- Interprofessional education and work to advance informatics

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Who said this and when?

- "I am fain to sum up with an urgent appeal for adopting … some uniform system of publishing the statistical records of hospitals. There is a growing conviction that in all hospitals, even in those which are best conducted, there is a great and unnecessary waste of life … In attempting to arrive at the truth, I have applied everywhere for information, but in scarcely an instance have I been able to obtain hospital records fit for any purposes of comparison … If wisely used, these improved statistics would tell us more of the relative value of particular operations and modes of treatment than we have means of ascertaining at present."

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Who and when...

- Florence Nightingale, *Notes on Hospitals*, London: Longman, Green, Roberts, Longman, and Green, 1863
  - The first informatician?
- She does have a Web site (and museum in London)
  - www.florence-nightingale.co.uk

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Some more recent wisdom

- Stead (2011)
  - Quantity and complexity of information in medicine requires a fundamental paradigm shift as the number of facts per decision rises
- Shortliffe (2010)
  - Focus of medical practice is as much on information as patients, yet we teach much less about it, including its acquisition (electronic health record [EHR], searching) and use (quality, safety)
- Blumenthal (2010)
  - Information is "the lifeblood of medicine" and health information technology (HIT) is destined to be "the circulatory system for that information"

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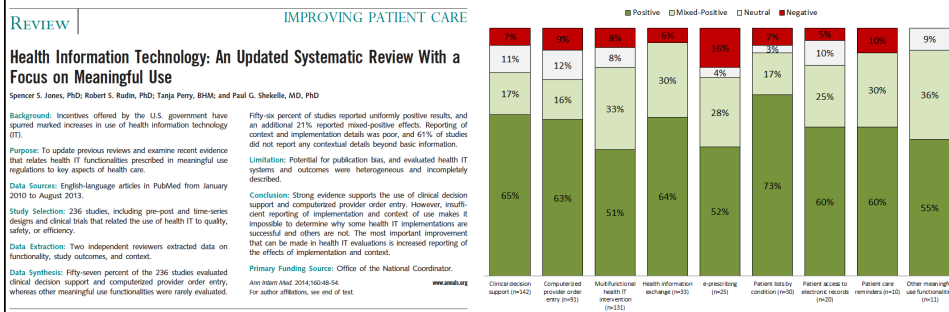## Many problems in healthcare have information-related solutions

- Quality – not as good as it could be (McGlynn, 2003; Schoen, 2009; NCQA, 2010)
- Safety – errors cause morbidity and mortality; many preventable (Kohn, 2000; Classen, 2011; van den Bos, 2011; Smith 2012)
- Cost – rising costs not sustainable; US spends more but gets less (Angrisano, 2007)
- Inaccessible information – missing information frequent in primary care (Smith, 2005)

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Growing evidence that information interventions are part of solution

- Series of systematic reviews (Chaudhry, 2006; Goldzweig, 2009; Buntin, 2011; Smith, 2014) have identified benefits in a variety of areas
  - Benefits aggregated by meaningful use categories
  - Increasingly studies using commercial systems

What are the major challenges in getting where we want? (Hersh, 2004)

- Cost
- Technical challenges
- Interoperability
- Privacy and confidentiality
- Workforce

Need to overcome challenges led to HITECH Act (Blumenthal, various)

RECOVERY.GOV

HealthIT.gov

Figure 1. Percentage of office-based physicians with EHR systems: United States, 2001–2013

Percent

80

60

40

20

0

Any EHR system

Basic system

18.2 17.3 17.3 20.8 23.9 29.2 34.8 42.0 48.3 51.0 57.0 71.8 78.4

10.5 11.8 16.9 21.8 27.9 33.9 39.6 48.1

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
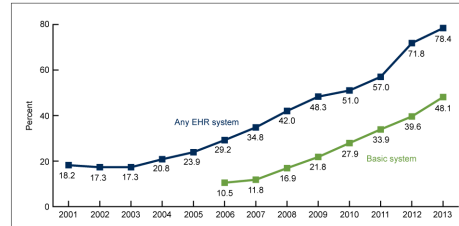
NOTES: EHR is electronic health record. "Any EHR system" is a medical or health record system that is either all or partially electronic (excluding systems solely for billing). Data for 2001–2007 are from in-person National Ambulatory Medical Care Survey (NAMCS) interviews. Data for 2008–2010 are from combined files (in-person NAMCS and mail survey). Estimates for 2011–2013 data are based on the mail survey only. Estimates for a basic system prior to 2006 could not be computed because some items were not collected in the survey. Data include nonfederal, office-based physicians and exclude radiologists, anesthesiologists, and pathologists.
SOURCE: CDC/NCHS, National Ambulatory Medical Care Survey and National Ambulatory Medical Care Survey, Electronic Health Records Survey.

(Hsaio, 2014)

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Toward a "continuously learning healthcare system" (Smith, 2012)

- Records immediately updated and available for use by patients
- Care delivered the has been proven "reliable at the core and tailored at the margins"
- Patient and family needs and preferences are a central part of the decision process
- All healthcare team members are fully informed about each other's activities in real time
- Prices and total costs are fully transparent to all participants in the care process
- Incentives for payment are structured to "reward outcomes and value, not volume"
- Errors are promptly identified and corrected
- Outcomes are routinely captured and used for continuous improvement

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# The currency of 21st century clinicians will be data (Safran, 2007)

- In addition to documentation using the electronic health record (EHR), will need competency in "secondary" uses of data, including
  - Health information exchange
  - Personal health records
  - Quality measurement and improvement
  - Predictive analytics to identify and act upon outliers
  - Clinical and translational research
  - Public health surveillance

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Clinicians will need to recognize the limitations of such data

- Caveats (Hersh, 2013)
  - Inaccurate
  - Incomplete
  - Transformed in ways that undermine meaning
  - Unrecoverable for secondary uses
  - Unknown provenance
  - Insufficient granularity

- Recommendations (Hersh, 2013)
  - Adaptation of "best evidence" approaches
  - Processes to evaluate availability, completeness, quality, and transformability
  - Creation of tools to manage data and their attributes
  - Development of methods for comparative validation of data
  - Standardized reporting methods for data and their attributes
  - Appropriate use of informatics expertise

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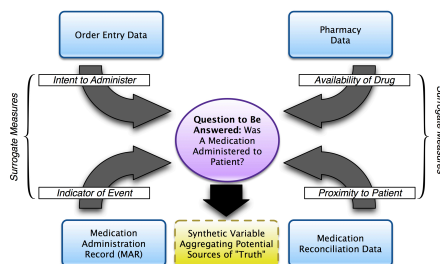
This will require new competencies

- In addition to being able to use the EHR and other HIT for patient care, clinicians will need to work in teams to
  - Find and apply the most recent information and best evidence
  - Provide population-based health management
  - Engage patients in their care, including via electronic means
  - Identify patients at risk for complications and/or higher resource use
  - Participate in quality measurement and improvement efforts

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Biomedical and health informatics underlies the solutions

- *Biomedical and health informatics* (BMHI) is the science of using data and information, often aided by technology, to improve individual health, health care, public health, and biomedical research (Hersh, 2009)
  - It is about information, not technology
  - http://www.billhersh.info/whatis
- Practitioners are BMHI are usually called *informaticians* (sometimes *informaticists*)
- Overview textbooks: Shortliffe, 2014; Hoyt, 2014

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BMHI has many sub-areas

Imaging Informatics

Research Informatics

{Clinical field} Informatics

Consumer Health Informatics

Bioinformatics (cellular and molecular)

Medical or Clinical Informatics (person)

Public Health Informatics (population)

Biomedical and Health Informatics

Legal Informatics

Chemoinformatics

Informatics = People + Information + Technology

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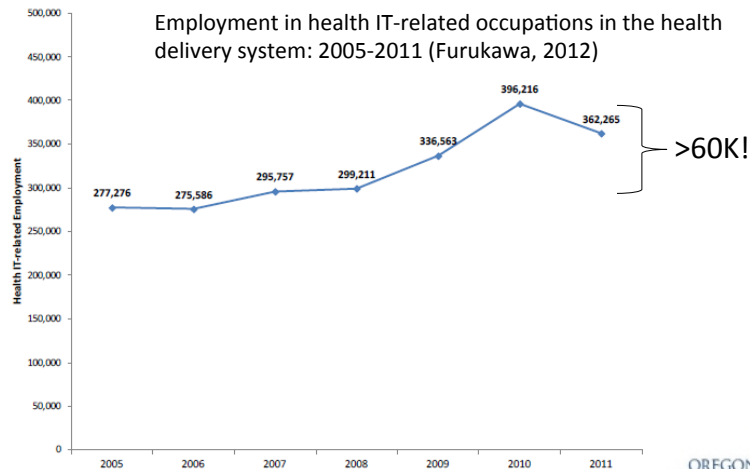OREGON HEALTH &SCIENCE UNIVERSITY

Growth of field has led to increased job opportunities

- Analysis of HIMSS Analytics Database™ estimated need for 41,000 additional HIT professionals as we moved to more advanced clinical systems (Hersh, 2008)

- ONC increased estimate of need to 50,000, leading to Workforce Development Program being part of HITECH Program (Hersh, 2012)

- Actual numbers hired have been even higher (Furukawa, 2012; Schwartz, 2013) – see next slide

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Although we all underestimated the growth

Employment in health IT-related occupations in the health delivery system: 2005-2011 (Furukawa, 2012)

>60K!

Job postings in health IT

- Percent change in online health IT job postings per month increased much more relative to healthcare jobs and all jobs (Furukawa, 2012)
- Between 2007-2011, 226,356 health IT jobs posted (Schwartz, 2013)
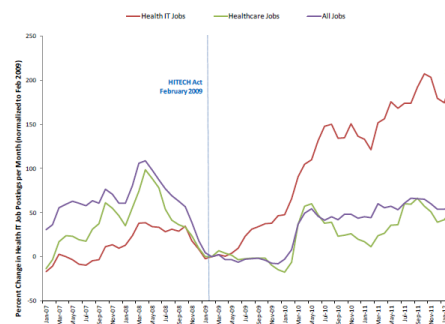
Still, shortages persist for experienced health IT workforce

- Survey of healthcare CIOs (CHIME, 2012)
  - 71% said IT staff shortages could jeopardize an enterprise IT project, while 58% said they would definitely or possibly affect meeting meaningful use criteria for incentive funding
  - 85% also expressed concerns about being able to retain current staff
- Survey of health IT leaders (HIMSS, 2013)
  - Found comparable picture in both healthcare organizations and vendors having challenges recruiting and maintaining staff

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Clinical informatics subspecialty for physicians

- History
  - 2009 – American Medical Informatics Association (AMIA) develops and publishes plans for curriculum and training requirements
  - 2011 – American Board of Medical Specialties (ABMS) approves; American Board of Preventive Medicine (ABPM) becomes administrative home
  - 2013 – First certification exam offered by ABPM; 455 physicians pass (91%)
  - 2014 – ACGME fellowship rules released
- Subspecialty open to physicians of all primary specialties
  - But not those without a specialty or whose specialty certification has lapsed

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Definition of clinical informatics (ACGME)

- Clinical informatics is the subspecialty of all medical specialties that transforms health care by analyzing, designing, implementing, and evaluating information and communication systems to improve patient care, enhance access to care, advance individual and population health outcomes, and strengthen the clinician-patient relationship

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A better (re-)definition of clinical informatics

- Clinical informatics is the health profession that transforms health care by analyzing, designing, implementing, and evaluating information and communication systems to improve patient care, enhance access to care, advance individual and population health outcomes, and strengthen the clinician-patient relationship

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Competencies of clinical informaticians (Safran, 2009)

- Search and appraise the literature relevant to clinical informatics
- Demonstrate fundamental programming, database design, and user interface design skills
- Develop and evaluate evidence-based clinical guidelines and represent them in an actionable way
- Identify changes needed in organizational processes and clinician practices to optimize health system operational effectiveness
- Analyze patient care workflow and processes to identify information system features that would support improved quality, efficiency, effectiveness, and safety of clinical services
- Assess user needs for a clinical information or telecommunication system or application and produce a requirements specification document
- Design or develop a clinical or telecommunication application or system
- Evaluate vendor proposals from the perspectives of meeting clinical needs and the costs of the proposed information solutions
- Develop an implementation plan that addresses the sociotechnical components of system adoption for a clinical or telecommunication system or application
- Evaluate the impact of information system implementation and use on patient care and users
- Develop, analyze, and report effectively (verbally and in writing) about key informatics processes

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Core content for clinical informatics (Gardner, 2009)

1. Fundamentals
1.1. Clinical Informatics
1.1.1. The discipline of informatics
1.1.2. Key informatics concepts, models, theories
1.1.3. Clinical informatics literature
1.1.4. International clinical informatics practices
1.1.5. Ethics and professionalism
1.1.6. Legal and regulatory issues
1.2. The Health System
1.2.1. Determinants of individual and population health
1.2.2. Primary domains, organizational structures, cultures, and processes
1.2.3. The flow of data, information, and knowledge within the health system
1.2.4. Policy & regulatory framework
1.2.5. Health economics and financing
1.2.6. Forces shaping health care delivery
1.2.7. Institute of Medicine quality components

2. Clinical Decision Making and Care Process Improvement
2.1. Clinical Decision Support
2.1.1. The nature and cognitive aspects of human decision making
2.1.2. Decision science
2.1.3. Application of clinical decision support
2.1.4. Transformation of knowledge into clinical decision support tools
2.1.5. Legal, ethical, and regulatory issues
2.1.6. Quality and safety issues
2.1.7. Supporting decisions for populations of patients
2.2. Evidence-based Patient Care
2.2.1. Evidence sources
2.2.2. Evidence grading
2.2.3. Clinical guidelines
2.2.4. Implementation of guidelines as clinical algorithms
2.2.5. Information retrieval and analysis
2.3. Clinical Workflow Analysis, Process Redesign, and Quality Improvement
2.3.1. Methods of workflow analysis
2.3.2. Principles of workflow re-engineering
2.3.3. Quality improvement principles and practices

3. Health Information Systems
3.1. Information Technology Systems
3.1.1. Computer Systems
3.1.2. Architecture
3.1.3. Networks
3.1.4. Security
3.1.5. Data
3.1.6. Technical approaches that enable sharing data
3.2. Human Factors Engineering
3.2.1. Models, theories, and practices of human-computer (machine) interaction (HCI)
3.2.2. HCI Evaluation, usability testing, study design and methods
3.2.3. Interface design standards and design principles
3.2.4. Usability engineering
3.3. Health Information Systems and Applications
3.3.1. Types of functions offered by systems
3.3.2. Types of settings where systems are used
3.3.3. Electronic health/medical records systems as the foundational tool
3.3.4. Telemedicine
3.4. Clinical Data Standards
3.4.1. Standards development history and current process
3.4.2. Data standards and data sharing
3.4.3. Transaction standards
3.4.4. Messaging standards
3.4.5. Nomenclatures, vocabularies, and terminologies
3.4.6. Ontologies and taxonomies
3.4.7. Interoperability standards
3.5. Information System Lifecycle
3.5.1. Institutional governance of clinical information systems
3.5.2. Clinical information needs analysis and system selection
3.5.3. Clinical information system implementation
3.5.4. Clinical information system testing, before, during and after implementation
3.5.5. Clinical information system maintenance
3.5.6. Clinical information system evaluation

4. Leading and Managing Change
4.1. Leadership Models, Processes, and Practices
4.1.1. Dimensions of effective leadership
4.1.2. Governance
4.1.3. Negotiation
4.1.4. Conflict management
4.1.5. Collaboration
4.1.6. Motivation
4.1.7. Decision making
4.2. Effective Interdisciplinary Teams
4.2.1. Human resources management
4.2.2. Team productivity and effectiveness
4.2.3. Group management processes
4.2.4. Managing meetings
4.2.5. Managing group deliberations
4.3. Effective Communications
4.3.1. Effective presentations to groups
4.3.2. Effective one-on-one communication
4.3.3. Writing effectively for various audiences and goals
4.3.4. Developing effective communications program to support system implementation
4.4. Project Management
4.4.1. Basic principles
4.4.2. Identifying resources
4.4.3. Resource allocation
4.4.4. Project management tools (non-software specific)
4.4.5. Informatics project challenges
4.5. Strategic and Financial Planning for Clinical Information Systems
4.5.1. Establishing mission and objectives
4.5.2. Environmental scanning
4.5.3. Strategy formulation
4.5.4. Action planning and strategy implementation
4.5.5. Capital and operating budgeting
4.5.6. Principles of managerial accounting
4.5.7. Evaluation of planning process
4.6. Change Management
4.6.1. Assessment of organizational culture and behavior
4.6.2. Change theories
4.6.3. Change management strategies
4.6.4. Strategies for promoting adoption and effective use of clinical information systems

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Clinical informatics subspecialty (cont.)

- Following usual path of five years of "grandfathering" training requirements to take certification exam before formal fellowships required
- Two paths to eligibility for exam in first five years
  - Practice pathway – practicing 25% time for at least three years within last five years (education counts at half time of practice)
  - Non-traditional fellowships – qualifying educational or training experience, e.g., NLM fellowship, or educational program (master's degree)
- After 2018, only pathway to certification will be ACGME-accredited fellowship

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Clinical informatics is not just for physicians

- Informatics is the ultimate interprofessional area of healthcare
  - Very little in clinical informatics core competencies and curricular content specific to medicine
- AMIA has established Advanced Interprofessional Informatics Task Force to explore certification for non-physicians
  - Most likely initial efforts at doctoral (research and professional) level, with focus on professional roles
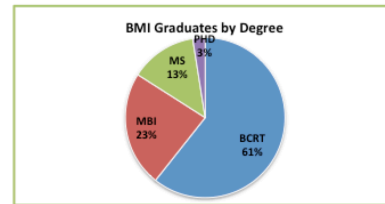
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OHSU informatics education – only 30 of enrollment is physicians

BMI Graduates to Date by Degree & Track				
	BCB	CI	HIM	Total	%
BCRT	2	291	45	338	61%
MBI	5	124	1	130	23%
MS	8	67	0	75	13%
PHD	5	9	0	14	3%
	20	491	46	557	100%

BMI Graduates by Degree

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

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What are key interprofessional areas ahead?

- Optimizing the electronic health record (EHR)
  - Analytics of EHR and other clinical data for increasing quality, efficiency, and coordination of healthcare
  - Standards, interoperability, and health information exchange (HIE)
  - Will expand to "big data" when we add in data from genomics, imaging, personal health devices, etc.
- Patient engagement
  - Use of personal health record (PHR) for engaging consumers and patients in their health and healthcare
- Precision/personalized medicine
  - Based in part on bioinformatics and computational biology, with potential to revolutionize diagnosis and treatment of disease

- I am sure you can add more …

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Important for research too

- Clinical & Translational Science Award (CTSA) Program
  - Has galvanized related area of clinical research informatics (Richesson, 2013)
- Patient-Centered Outcomes Research Institute (PCORI)
  - Comparative effectiveness research
  - Clinical Data Research Networks – www.pcornet.org
- NIH Big Data to Knowledge (BD2K)
  - Training the next generation of scientists in data and related techniques

- I am sure you can add more more …

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Informatics is also fundamental to clinician education

- OHSU medical school curriculum being revised
  - Provides opportunity to introduce more informatics into curriculum
  - Process also aided by AMA Accelerating Change in Medical Education grant
- Driven by competencies focused on uses for informatics and not just technology itself
- Each competency built out with
  - Learning objectives
  - Timing in curriculum
  - Mapping to six ACGME core competency domains
- Will also play role in larger efforts at OHSU in interprofessional education

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Current working list of competencies (1/2)

- Find, search, and apply knowledge-based information to patient care and other clinical tasks
- Effectively read and write from the electronic health record for patient care and other clinical activities
- Use and guide implementation of clinical decision support (CDS)
- Provide care using population health management approaches
- Protect patient privacy and security
- Use information technology to improve patient safety
- Engage in quality measurement selection and improvement

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Current working list of competencies (2/2)

- Use health information exchange (HIE) to identify and access patient information across clinical settings
- Engage patients to improve their health and care delivery though personal health records and patient portals
- Maintain professionalism through use of information technology tools
- Provide clinical care via telemedicine and refer those for whom it is necessary
- Apply personalized/ precision medicine
- Participate in practice-based clinical and translational research

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Toward the future

- Patient-centered, population-oriented learning health system
- Healthcare system held accountable for outcomes and resource use, driven by data
- Interprofessional education in informatics for all clinicians, with competency in its varied applications

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For more information

- Bill Hersh
  - http://www.billhersh.info
- Informatics Professor blog
  - http://informaticsprofessor.blogspot.com
- OHSU Department of Medical Informatics & Clinical Epidemiology (DMICE)
  - http://www.ohsu.edu/informatics
  - http://www.youtube.com/watch?v=T-74duDDvwU
  - http://oninformatics.com
- What is Biomedical and Health Informatics?
  - http://www.billhersh.info/whatis
- Office of the National Coordinator for Health IT (ONC)
  - http://healthit.hhs.gov
- American Medical Informatics Association (AMIA)
  - http://www.amia.org
- National Library of Medicine (NLM)
  - http://www.nlm.nih.gov

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