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## Metadata, Electronic Medical Records and Clinicians: *Big Data, Big Brother, Big Opportunity?*

Jon Wanderer, M.D., M. Phil  
Vanderbilt University  
Department of Anesthesiology

Society for Technology in Anesthesia  
Annual Meeting January 2014

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## Disclosure

- None

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## Learning Objectives

- Understand what constitutes metadata and recent controversy surrounding it
- Gain an understanding of the role of metadata in health care
- Review the state of the literature for health care meta data
- Learn about how metadata can provide insights into perioperative care

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## Metadata

- Data about data
  - Structural: Describes how data are put together
  - Descriptive: For data identification and discovery
  - Administrative: Helps manage data



Understanding Metadata. NISO Press. ISBN 1-880124-62-9. <http://www.niso.org/publications/press/UnderstandingMetadata.pdf>

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## Metadata: An Example

- Library metadata
  - Structural: Series organized into...
    - 3 books
      - Numerous chapters
      - » Many pages
  - Descriptive: “Fifty Shades of Grey”, E. J. James
  - Administrative:
    - How many copies are in the library
    - Who checked them out
    - Where they are located



Understanding Metadata. NISO Press. ISBN 1-880124-62-9. <http://www.niso.org/publications/press/UnderstandingMetadata.pdf>

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## Metadata: Another Example

- Malte Spitz
  - German politician
  - Obtained 6 months of his own T-Mobile metadata in May, 2010
- Cellphone metadata
  - Structural: Simple spreadsheet
  - Descriptive: Time, location, activity type, length
  - Administrative: Access history

Understanding Metadata. NISO Press. ISBN 1-880124-62-9. <http://www.niso.org/publications/press/UnderstandingMetadata.pdf>

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## Metadata New York City



"Every day, millions of people check in on Foursquare. We took a year's worth of check-ins in Istanbul, London, Chicago, Tokyo and San Francisco and plotted them on a map. Each dot represents a single check-in, while the straight lines link sequential check-ins"

<https://foursquare.com/infographics/pulse>

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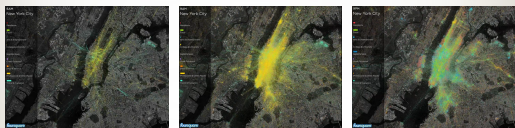
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## Metadata City



"Every day, millions of people check in on Foursquare. We took a year's worth of check-ins in Istanbul, London, Chicago, Tokyo and San Francisco and plotted them on a map. Each dot represents a single check-in, while the straight lines link sequential check-ins"

<https://foursquare.com/infographics/pulse>

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## Metadata and the US Government

- Edward Snowden
  - Analyst for the NSA
  - Downloaded 1.7 million intelligence documents
  - Released 50,000-200,000 documents to reporters
- Turns out that the NSA
  - Collects 5 billion phone records/day
  - Started after 9/11, continues
  - Future of programs uncertain




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## Metadata in Health Care

- HIPAA (164.312(b)) requires
  - “Implement hardware, software, and/or procedural mechanisms that record and examine activity in information systems that contain or use electronic protected health information.”
  - “A covered entity must keep such records and submit such compliance reports, in such time and manner and containing such information, necessary to enable the Secretary to ascertain whether the covered entity has complied or is complying with the applicable requirements of part 160 and the applicable standards, requirements, and implementation specifications of Subpart E of Part 164. Refer to § 164.530 for discussion.”
  - Basically, institutions need to keep audit logs
  - *Who did what to which data, when and why*
  - Six years of data retention required

<http://www.hhs.gov/ocr/privacy/hipaa/administrative/securityrule/pprequirements.pdf>

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## Metadata in Anesthesia

CASE REPORT  
**Failure to Recognize Loss of Incoming Data in an Anesthesia Record-Keeping System May Have Increased Medical Liability**

Michael M. Vigoda, MD, MBA, and David A. Lubarsky, MD, MBA  
 Department of Anesthesiology, Perioperative Medicine and Pain Management, Center for Informatics and Perioperative Management, University of Illinois/Jackson Memorial Medical Center, Miami, Florida

- AIMS-related liability
  - Incoming data was lost, bad outcome, case settled
  - “Finally, the entry of an untimed documentation note stating that the attending was present at emergence from anesthesia was entered shortly after surgery started. This was discovered after the plaintiff hired an expert in AIMS who demanded the computerized audit trail. We believe this is the first report of a plaintiff doing so; we do not expect it will be the last.”

Vigoda MM and Lubarsky DA. Anesth Analg 2006;102:1798-802.

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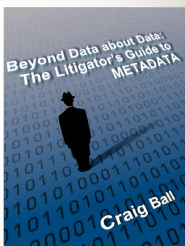
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## Liability

- Electronic medical records
  - Make it impossible to hide who did what, when and where
  - Need to adapt and alter practice
  - Need systems that force you to do the right thing
- As of 12/31/06, all electronically stored information must be turned over to the opposing party, even if not requested.



<http://www.craigball.com/metadata.pdf>  
 McLean et al. EMR Metadata: Uses and Liability. J Am Coll Surg 2008;206:405-411.

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## Metadata is here to stay

- We have to record it
- We have to keep it
- Uses discussed so far
  - Tracking down PHI breaches
  - Providing medicolegal ammunition
- Can anything good come of these data?




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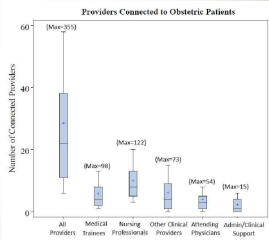
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## Understanding Workflow

- Who takes care of obstetric patients?
  - Beth Israel Deaconess, 2010, 4500 mothers
  - Interactions identified via audit log



Gray et al. Using Digital Crumbs from an Electronic Health Record to Identify, Study and Improve Health Care Teams. AMIA Annu Symp Proc 2011:491-500.

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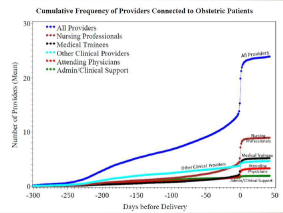
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## Understanding Workflow

- Can we see the health care system from the patients' point of view?



Gray et al. Using Digital Crumbs from an Electronic Health Record to Identify, Study and Improve Health Care Teams. AMIA Annu Symp Proc 2011:491-500.

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## Understanding Workflow

Figure 5. In this patient centered NPI provider network, the patient is represented by red squares in center of figure. Providers are represented by other colors (see key). Providers with largest number of ties to patient in this program were listed in patient.

Gray et al. Using Digital Crumbs from an Electronic Health Record to Identify, Study and Improve Health Care Teams. AMIA Annu Symp Proc 2011:491-500.

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## Trainee Insight

- VA Eastern Kansas Health Care System
- 5 month study of radiology imaging audit logs
- Team: Surgical trainees (PGY1-3), MS3, family practice resident
- Expectation: Look at the images prior to presenting patients to attending surgeon

McLean et al. EMR Metadata: Uses and Liability. J Am Coll Surg 2008;206:405-411.

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## Trainee Insight

- Surgical residents look at CT scans but ignore other images.
- FPR don't look at images.
- Attendings look over the shoulders of trainees.
- "It was somewhat disconcerting to learn that physicians in training seem to be interested in viewing only CT scans. (For this reason we are now giving surgery residents feedback on their viewing habits.)"

McLean et al. EMR Metadata: Uses and Liability. J Am Coll Surg 2008;206:405-411.

**Table 1. Profile of Physician-in-Training Use of Vista Imaging**

Variable	Mean logins ± SD
Logins per level of training	
PGY III	191.0 ± 18.3
PGY II	164.0 ± 34.3
PGY I	92.0 ± 14.8
FPR	21.0 ± 4.6*
MS	32.0 ± 5.7**
Log-ins per training level per number of days on service	
PGY III	1.4 ± 0.3
PGY II	1.1 ± 0.4
PGY I	0.7 ± 0.6
FPR	0.2 ± 0.3*
MS	0.3 ± 0.1*

**Table 3. Number of CT Scan Images Viewed by Physicians in Training per Session**

Training level	Images/session, n	Range of images viewed
PGY III	73.1 ± 18.7	1 to 867
PGY II	64.1 ± 21.5	1 to 795
PGY I	39.2 ± 53.7	1 to 456
FPR	19.3 ± 22.8	1 to 112
MS	24.4 ± 6.3	1 to 71

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## Note Usage

- EMR audit logs analysis at Columbia
- Analysis of inpatient area
- Rationale for research
  - May help improve EMR
  - Understand individual clinicians
  - Reveal team information, help improve communication

Hripcsak et al. Use of electronic clinical documentation: time spent and team interactions. J Am Med Inform Assoc 2011; 18:112-117.

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## Who looks at notes by author

Author	attending	resident	nurse	social work	med student
attending	~60	~45	~15	~10	~5
resident	~85	~75	~15	~10	~5
nurse	~15	~15	~40	~10	~5
social work	~20	~25	~30	~45	~10
med student	~40	~70	~50	~15	~10

- Note views within 3 months
- Author is excluded
- Billing/IT excluded

Hripcsak et al. Use of electronic clinical documentation: time spent and team interactions. J Am Med Inform Assoc 2011; 18:112-117.

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## Which notes are viewed by user

Author	attending	resident	nurse	social work	med student
attending	~75	~25	~20	~10	~5
resident	~80	~40	~35	~10	~5
nurse	~45	~65	~65	~10	~5
social work	~30	~35	~40	~70	~10
med student	~70	~80	~35	~10	~10

- Author is excluded

Hripcsak et al. Use of electronic clinical documentation: time spent and team interactions. J Am Med Inform Assoc 2011; 18:112-117.

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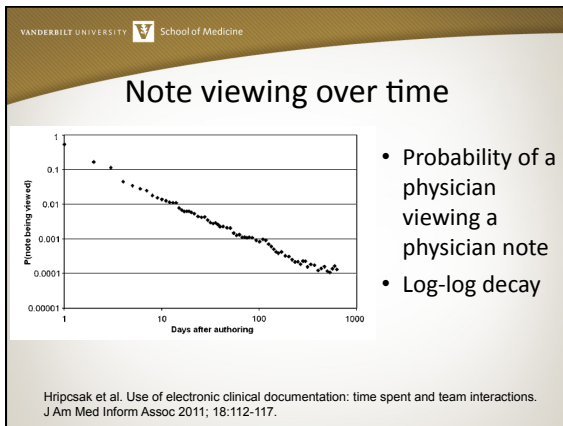
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### Most viewed notes

**Table 3** Most frequently viewed physician (attending or resident) notes  
Notes viewed after 1 day\*

No viewed (1 day)	No authored (1 day)	Per-day probability of being viewed	Note type
168	176	0.95	Infectious disease consult note
378	418	0.90	Heart-failure free text note
121	135	0.90	Pulmonary fellow consult note
91	102	0.89	Hematology/oncology attending consult note
100	113	0.88	Rheumatology attending consult note
1397	1586	0.88	Medical intensive care unit attending miscellaneous note
1254	1460	0.86	Medical intensive care unit resident miscellaneous note
131	153	0.86	Nephrology attending admission note
107	125	0.86	Neurology resident admission note
965	1132	0.85	Pediatric critical care attending note

Hripcsak et al. Use of electronic clinical documentation: time spent and team interactions. J Am Med Inform Assoc 2011; 18:112-117.

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### Note Usage: Key Points

- Not all notes are equal
- Users look at notes written by users like themselves
- 16% of notes are never viewed by anyone
- Time spent writing notes: 20-103 min/day
- Time spent viewing notes: 7-56 min/day

Hripcsak et al. Use of electronic clinical documentation: time spent and team interactions. J Am Med Inform Assoc 2011; 18:112-117.

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### What about anesthesia notes?

- Useful for us
  - Communication
  - Clinical care
  - Research
- Necessary for billing
- But are they used by anyone else?
- Surgeons: "We never look at them"

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### Our Principles of Audit Log Research

1. All questions vetted by IRB
2. All questions vetted by privacy office
3. Input from data privacy expert
4. Data de-identified prior to analysis
5. Results reported in aggregate

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### Preoperative Note Views

- VUMC audit logs x 5 months
- Removed employees from
  - Preop
  - Department of Anesthesiology
  - Holding rooms
  - PACUs

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## Non-Anes Preop Note Views

- 41,036 observations of 14,234 notes
- 3,916 unique viewers from 412 work areas
- Average note views
  - From preop clinic: 3.58 per note
  - Day of surgery preop: 1.98 per note

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## Non-Anes Preop Note Views

- Most notes are viewed the day of surgery
- Similar power law distribution as observed with EMR notes in general

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## Individual views for top job and departmental users, relative to surgery

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## "We never look at them"

- Preop clinic notes viewed...
  - 2,654 times by 380 non-anesthesia faculty
  - including 129 surgical faculty in 13 departments
  - 5,954 times by 389 non-anesthesia residents
  - including 203 surgical residents in 12 departments
- Informed preop redesign process

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## Performance Evaluation

- Performance assessment is critical
  - Low: Remediate, remove
  - High: Replicate, retain
- Evaluation data is noisy, requires work
- Is it feasible to find EMR metadata markers of high performing clinicians?

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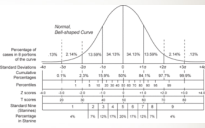
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## ZScore: Definition

$$z = \frac{x - \mu}{\sigma}$$

$\mu$  = Mean  
 $\sigma$  = Standard Deviation



Raw evaluation scores are normalized to correct for faculty grade inflation and idiosyncratic grade range usage. Basically, a de-Lake Wobegon-izer.

Lower = Worse

- 0.5 = In need of intervention
- 0.6 = Presenting a challenge
- 0.8 = Serious performance issues

Baker. Determining resident clinical performance: getting beyond the noise. *Anesthesiology*. 2011 Oct;115(4):862-78.

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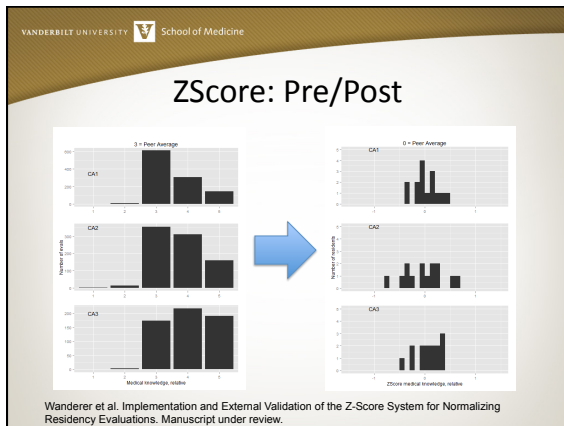
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### Anesthesia Residents

- 1,205,554 EMR views from 44 residents
  - 68.7% unrelated to OR cases they performed
  - 31% related to OR cases
  - 0.05% with multiple OR cases/pt
- Emergency and weekend cases removed (20%)
- EMR views classified temporally
  - Day before (38%), day of (46%), day after (16%)
  - Preop (58%), intraop (20%), postop (22%)

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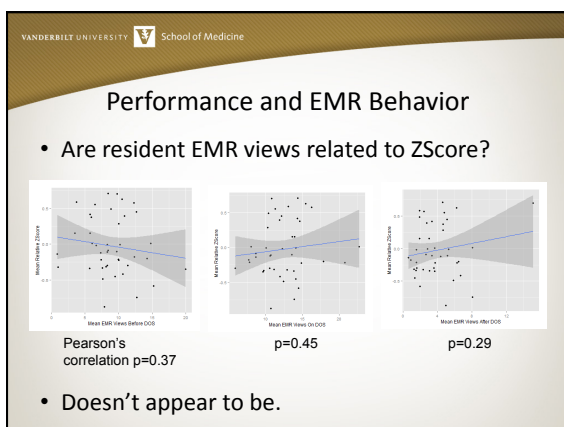
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Conclusions

- Metadata is everywhere, beware
- Audit logs are mandatory big data
- Can provide insight into health care workflows
- Does not appear to be useful for performance evals
  - Not correlated with performance metrics
  - Privacy concerns
  - Potentially game-able

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Thanks!

jon.wanderer@vanderbilt.edu

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