

Health Informatics

Lecture 2

Samantha Kleinberg
samantha.kleinberg@stevens.edu

Overview of today's class

- Where's health data collected?
- Why is it collected?
 - And why worry about why?

Meaningful use

- Incentives for not just adopting EHR, but using them to improve care
- 3 components from ARRA (2009)
 - Using EHR in meaningful way
 - Exchanging health information to improve quality of care
 - Using EHR to submit clinical quality and other measures

Stages



Stage 1: Meaningful use criteria focus on:	Stage 2: Meaningful use criteria focus on:	Stage 3: Meaningful use criteria focus on:
Electronically capturing health information in a standardized format	More rigorous health information exchange (HIE)	Improving quality, safety, and efficiency, leading to improved health outcomes
Using that information to track key clinical conditions	Increased requirements for e-prescribing and incorporating lab results	Decision support for national high-priority conditions
Communicating that information for care coordination processes	Electronic transmission of patient care summaries across multiple settings	Patient access to self-management tools
Initiating the reporting of clinical quality measures and public health information	More patient-controlled data	Access to comprehensive patient data through patient-centered HIE
Using information to engage patients and their families in their care		Improving population health

Examples of primary uses of EHR

- Order tests, medications
- Billing
- Documentation (admission, discharge, care plan, medical history, etc)

- Core objectives: must meet
- Menu: pick certain # from options

Patient Engagement Functionality	Percent of Hospitals with Capability			
	2012	2013	2014	Change (% point)
Do you currently have an electronic system that allows you to do the following?^				
Identify and provide patient-specific education resources	82.8%	90.2%	94.2%	4
Provide patients an electronic copy of their discharge instructions	82.7%	92.4%	N/A ¹	--
Provide patients an electronic copy of their health record within 3 business days	81.1%	91.7%	N/A ¹	--
Are patients able to do any of the following regarding their health/medical records?^				
View information from their health/medical record online	24%	39.8%	90.8	51
Download information from their health/medical record	14.3%	27.8%	82.2	54.4
Electronically transmit care/referral summaries to a third party	N/A ¹	11.6%	66.4	54.8
Request an amendment to change/update their health/medical record	30.9%	32.8%	72.4	39.6
Pay bills online	49.3%	55.4%	66.9	11.5
Secure Messaging*	N/A ¹	N/A ¹	51.3	--
Schedule appointments online	21.6%	29.8%	41.4	11.6
Request refills for prescriptions online	19.3%	27%	39.4	12.4
Submit patient-generated data (e.g., blood glucose, weight)	7.3%	12.5%	32.5	20

<http://dashboard.healthit.gov/quickstats/pages/FIG-Hospital-Adoption-of-Patient-Engagement-Functionalities.php>

Criteria – Stage 2

CORE OBJECTIVES (16 total)

Stage 1 Objective	Stage 1 Measure	Stage 2 Objective	Stage 2 Measure
Use CPOE for medication orders directly entered by any licensed healthcare professional who can enter orders into the medical record per state, local and professional guidelines	More than 30% of unique patients with at least one medication in their medication list admitted to the eligible hospital's or CAH's inpatient or emergency department (POS 21 or 23) have at least one medication order entered using CPOE	Use computerized provider order entry (CPOE) for medication, laboratory and radiology orders directly entered by any licensed healthcare professional who can enter orders into the medical record per state, local and professional guidelines	More than 60% of medication, 30% of laboratory, and 30% of radiology orders created by authorized providers of the eligible hospital's or CAH's inpatient or emergency department (POS 21 or 23) during the EHR reporting period are recorded using CPOE
Implement drug-drug and drug-allergy interaction checks	The eligible hospital/CAH has enabled this functionality for the entire EHR reporting period	No longer a separate objective for Stage 2	This measure is incorporated into the Stage 2 Clinical Decision Support measure
Record demographics <ul style="list-style-type: none"> Preferred language Gender Race Ethnicity Date of birth Date and preliminary cause of death in the event of mortality in the eligible hospital or CAH 	More than 50% of all unique patients admitted to the eligible hospital's or CAH's inpatient or emergency department (POS 21 or 23) have demographics recorded as structured data	Record the following demographics <ul style="list-style-type: none"> Preferred language Gender Race Ethnicity Date of birth Date and preliminary cause of death in the event of mortality in the eligible hospital or CAH 	More than 80% of all unique patients admitted to the eligible hospital's or CAH's inpatient or emergency department (POS 21 or 23) have demographics recorded as structured data

Stage 2 core

Report on all 16 Core Objectives:

1. Use computerized provider order entry (CPOE) for medication, laboratory and radiology orders
2. Record demographic information
3. Record and chart changes in vital signs
4. Record smoking status for patients 13 years old or older
5. Use clinical decision support to improve performance on high-priority health conditions
6. Provide patients the ability to view online, download and transmit their health information
7. within 36 hours after discharge.
8. Protect electronic health information created or maintained by the Certified EHR Technology
9. Incorporate clinical lab-test results into Certified EHR Technology
10. Generate lists of patients by specific conditions to use for quality improvement, reduction of
11. disparities, research, or outreach
12. Use certified EHR technology to identify patient-specific education resources and provide
13. those resources to the patient if appropriate
14. Perform medication reconciliation
15. Provide summary of care record for each transition of care or referral
16. Submit electronic data to immunization registries
17. Submit electronic data on reportable lab results to public health agencies
18. Submit electronic syndromic surveillance data to public health agencies
19. Automatically track medications with an electronic medication administration record (eMAR)

Stage 2 menu

Report on 3 of 6:

1. Record whether a patient 65 years old or older has an advance directive
2. Record electronic notes in patient records
3. Imaging results accessible through CEHRT
4. Record patient family health history
5. Generate and transmit permissible discharge prescriptions electronically (eRx)
6. Provide structured electronic lab results to ambulatory providers

Stage 3 - interoperability

- Share data
 - % of patients message provider
 - Electronic summaries for other providers
- Other
 - % of electronic prescriptions/orders
- Handle patient-generated data
 - % generated

Available data

- All providers demonstrating meaningful use and receiving payment listed publicly, updated quarterly
- <http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/DataAndReports.html>

Information exchange



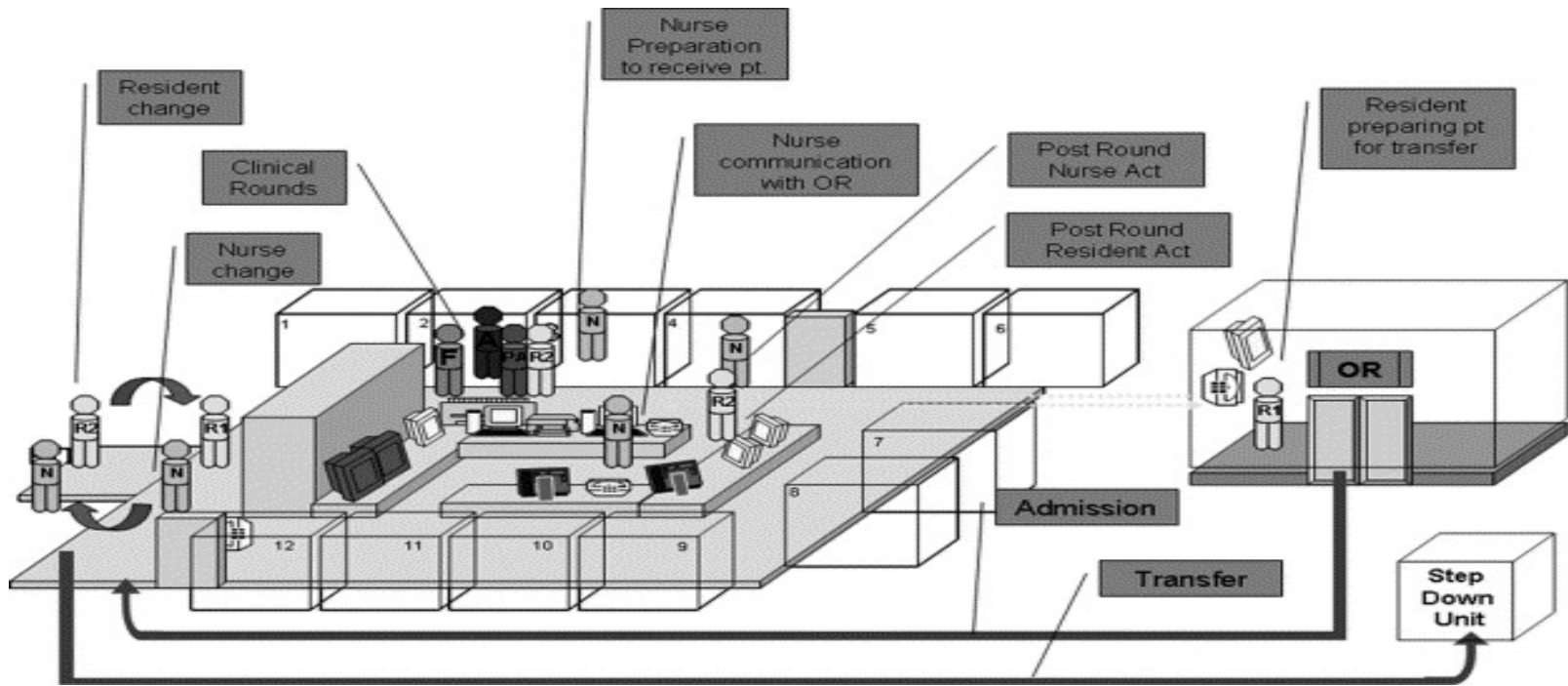
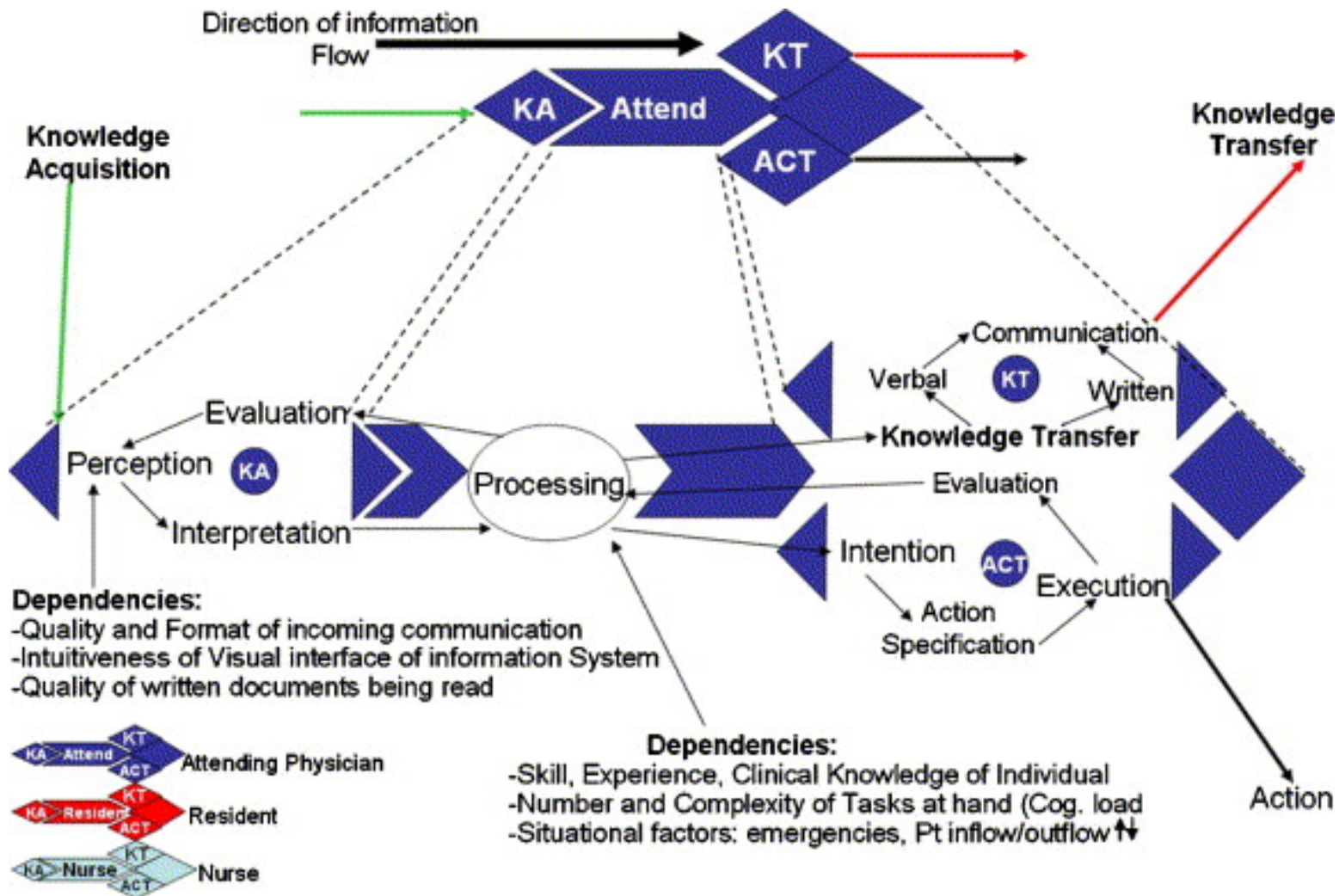


Fig. 2 Schematic layout of the CTICU and key activities during which observations were conducted. Patient cubicles surround the Nursing station where most of the clinical information systems lie. The letters on the human representations signify the followi...

Malhotra, S., Jordan, D., Shortliffe, E. & Patel, V.L., 2007, Workflow modeling in critical care: piecing together your own puzzle, *Journal of biomedical informatics*, 40(2), pp. 81-92

Critical zone (CZ)	Examples of activities	Description
Re-orientation	Resident change	Morning sign-out by (night) nurses and residents to their in-coming
Admissions	OR to Nurse information transfer	Information of patients due to be admitted from the operating room (OR) or emergency department (ED) is received
	Receipt of patient by resident	Based on the information preparations to received the patient are made
		Patient handover and determination of preliminary management (or continuation of the management as communicated by the personal handing over the patient)
Re-assessment	Evening clinical round	New admissions are assessed and initial management determined
		Next days step down/transfer/discharge plan for existing patients discussed
Evening sign-out	Resident change (handoff)	Information of patients handed off to the incoming night team (residents and nurses)
	Nurse change (handoff)	Overnight patient care activities carried out based on the information provided
		Documentation of overnight activities and preparation for morning sign-out (handoff to incoming team) are made
	Transfer of existing patient in ICU to floors (wards)	Transfer summary, continued management plan documented, initiated and communicated to the clinical unit receiving the patient



Malhotra, S., Jordan, D., Shortliffe, E. & Patel, V.L., 2007, Workflow modeling in critical care: piecing together your own puzzle, *Journal of biomedical informatics*, 40(2), pp. 81-92

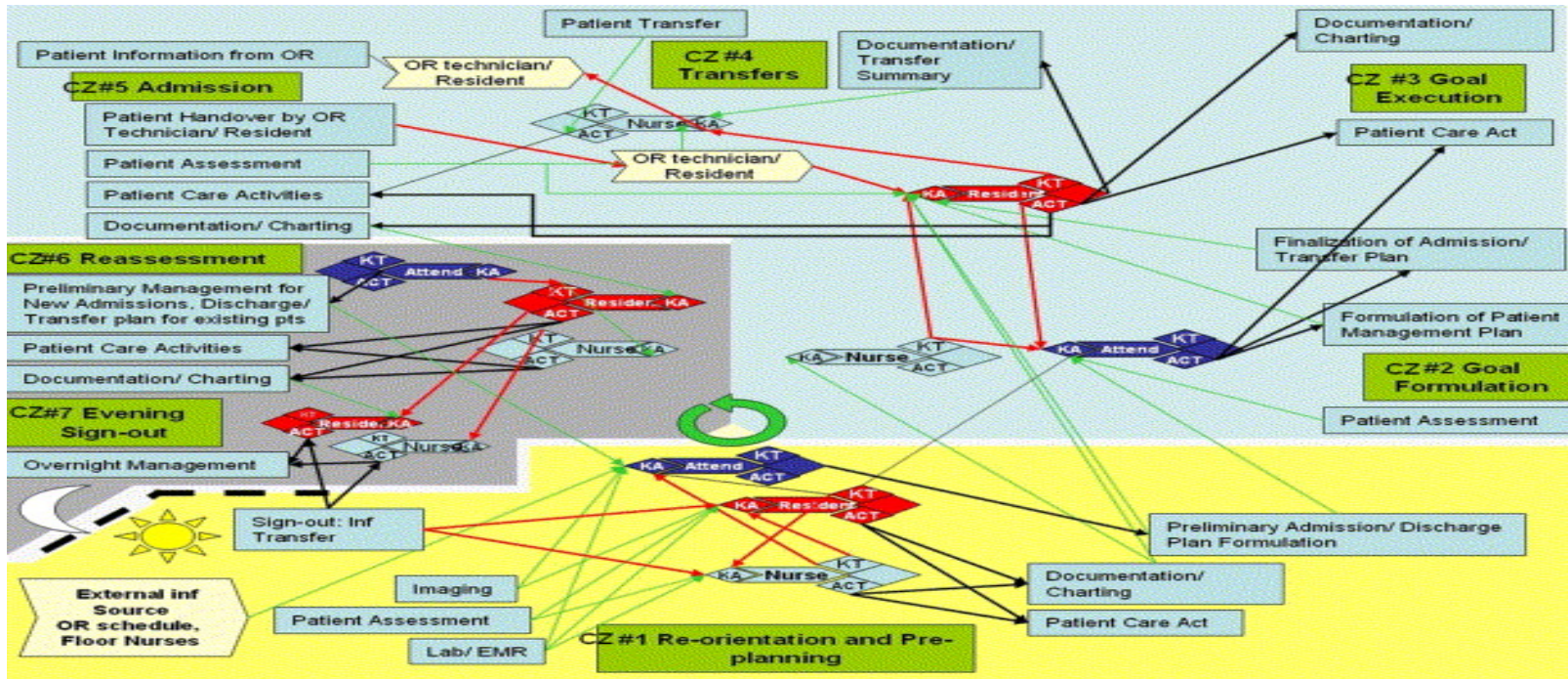


Fig. 6 The cognitive workflow model for inpatient care. The workflow flows in an anti-clockwise fashion. Although this being a continuous cycle with no start or finish, the symbol of the sun (morning) can be used as the starting point. Please note the three levels of abstraction (see text for details): (a) the complete workflow model as top level, (b) the grouped CZs shown with different background colors—1 through 3, (c) the

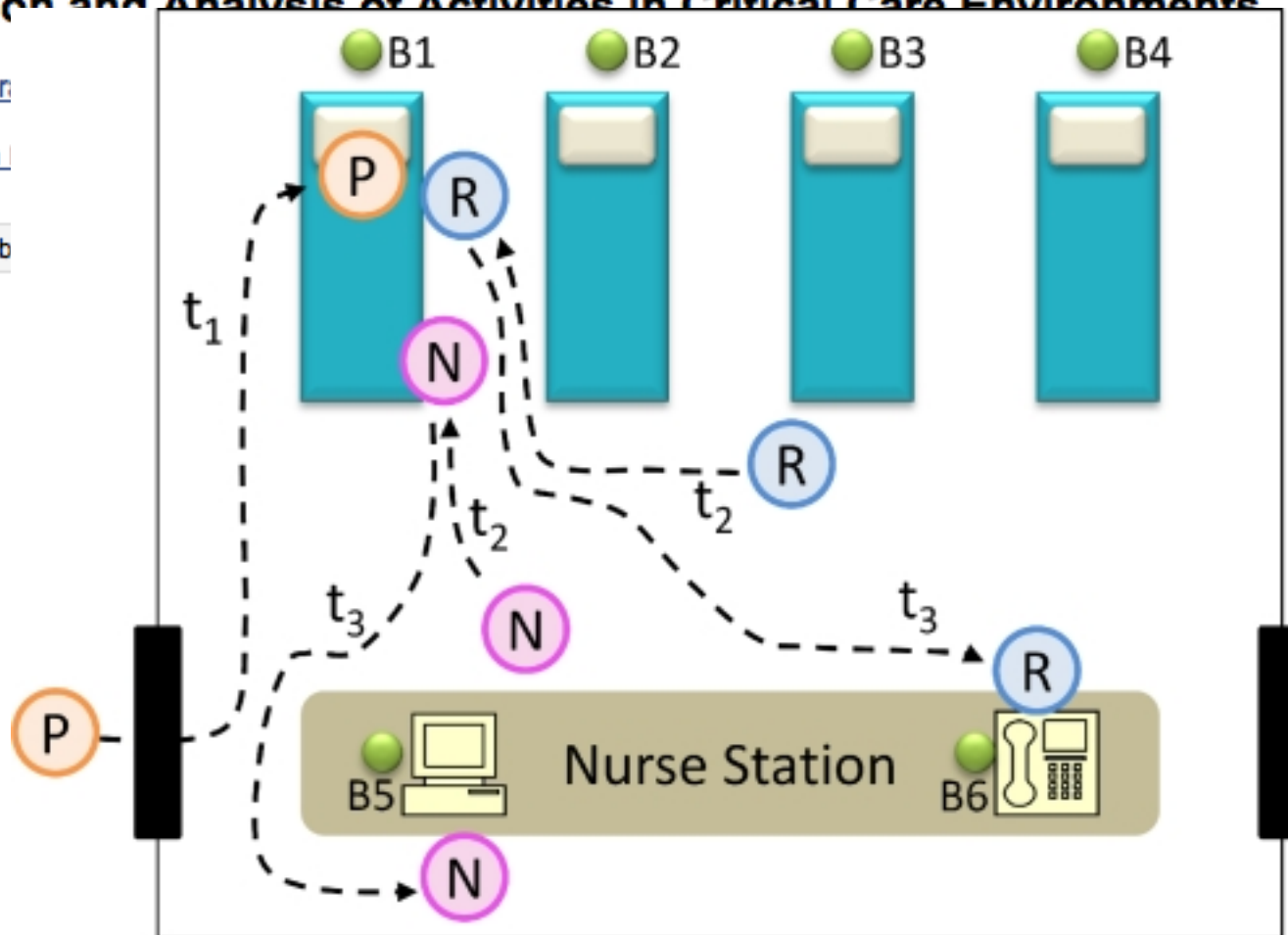
Malhotra, S., Jordan, D., Shortliffe, E. & Patel, V.L., 2007, Workflow modeling in critical care: piecing together your own puzzle, *Journal of biomedical informatics*, 40(2), pp. 81-92

Visualization and Analysis of Activities in Critical Care Environments

[Mithra Vankipur](#)

[Author information](#)

This article has b



Information exchange

- Within hospital
 - Between units, people with different roles, etc
- Between multiple organizations
 - Primary care + specialist, etc

Why is information exchange important?

- Reduce duplicate tests
- Improve diagnosis and treatment
 - E.g. Medication interactions, allergies
 - Results of prior testing/diagnoses ruled out
- Reduce errors/improve efficiency
 - Eg. Asking for family history repeatedly
- Research! Feedback loop, missing data

Why is information exchange hard?

- Patient matching
- Preserving privacy
- Differing data formats

What's the practical impact

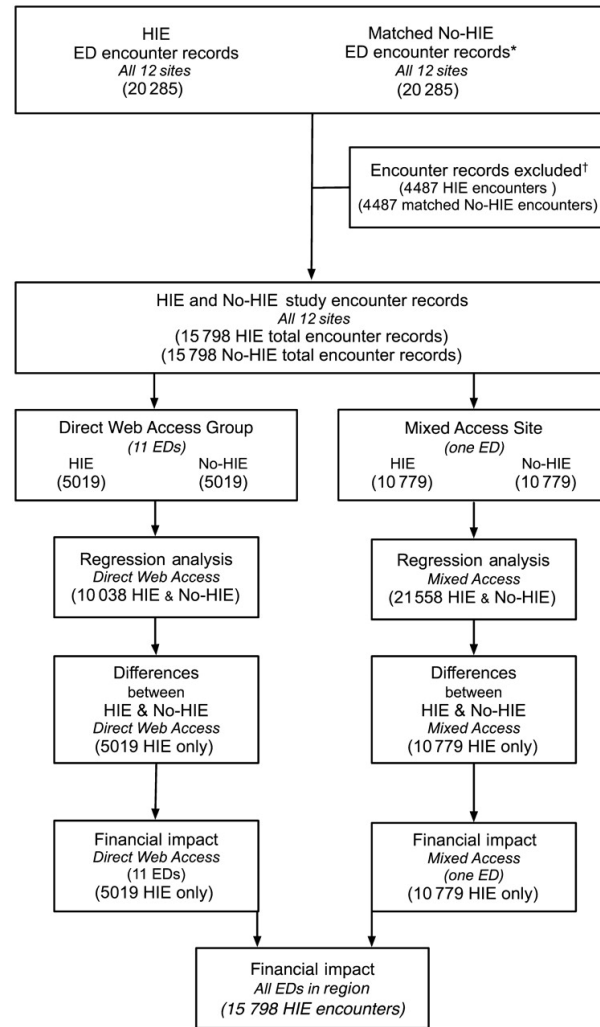
- Study took all major emergency departments in Memphis, compared outcomes with HIE and without
- Access: 6.8% of ED visits (12 EDs), associated with decreased hospital admissions
- Cost: estimate HIE reduced overall cost by \$1.07 million (primarily due to reduced admissions)

The financial impact of health information exchange on emergency department care

Mark E Frisse, Kevin B Johnson, Hui Nian, Coda L Davison, Cynthia S Gadd, Kim M Unertl, Pat A Turri, Qingxia Chen

J Am Med Inform Assoc amiajnl-2011-000394 Published Online First: 4 November 2011 doi:10.1136/amiajnl-2011-000394

Study design.



Frise M E et al. J Am Med Inform Assoc doi:10.1136/ amiajnl-2011-000394

HIE Models

- Direct exchange between care providers
 - Ex: Doctor refers patient to specialist for follow-up, and sends brief history
- Central organization
 - many-to-many
- Patient mediated
 - EX: PHR, bringing paper records to appointment

Direct exchange

- Pushing info to public health registries, sending orders and results to clinicians
- Challenges?
- Different data formats
- Depends on individuals requesting/matching patients

Patient exchange

(consumer mediated exchange)

- Patients share access with their providers
- In some cases, can correct errors, add information

e-Patient Dave

- <https://www.youtube.com/watch?v=cxZy-Vnu0c0>

However...

People hide information

- Lab tests under assumed name
- Seeking an out of state provider rather than primary care
- Giving false information
- Simply not giving information when requested

13-17% of consumers in recent surveys say they've engaged in information hiding in their record

Query model

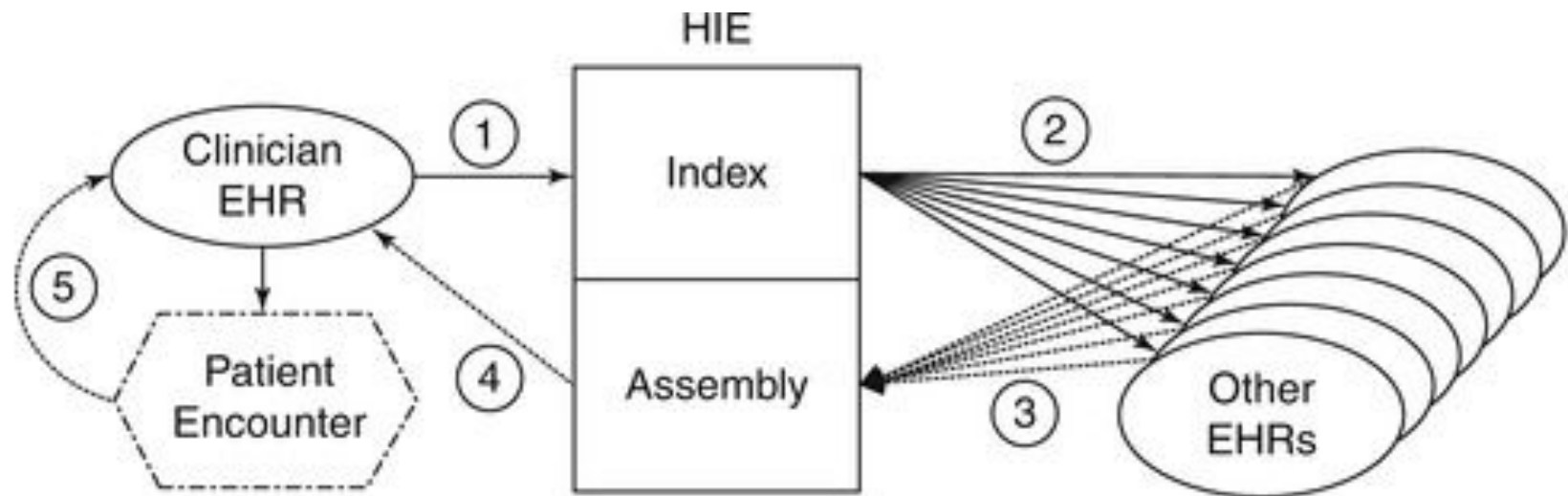
- Alice comes to emergency room, physician wants to get all of Alice's records from all of her providers

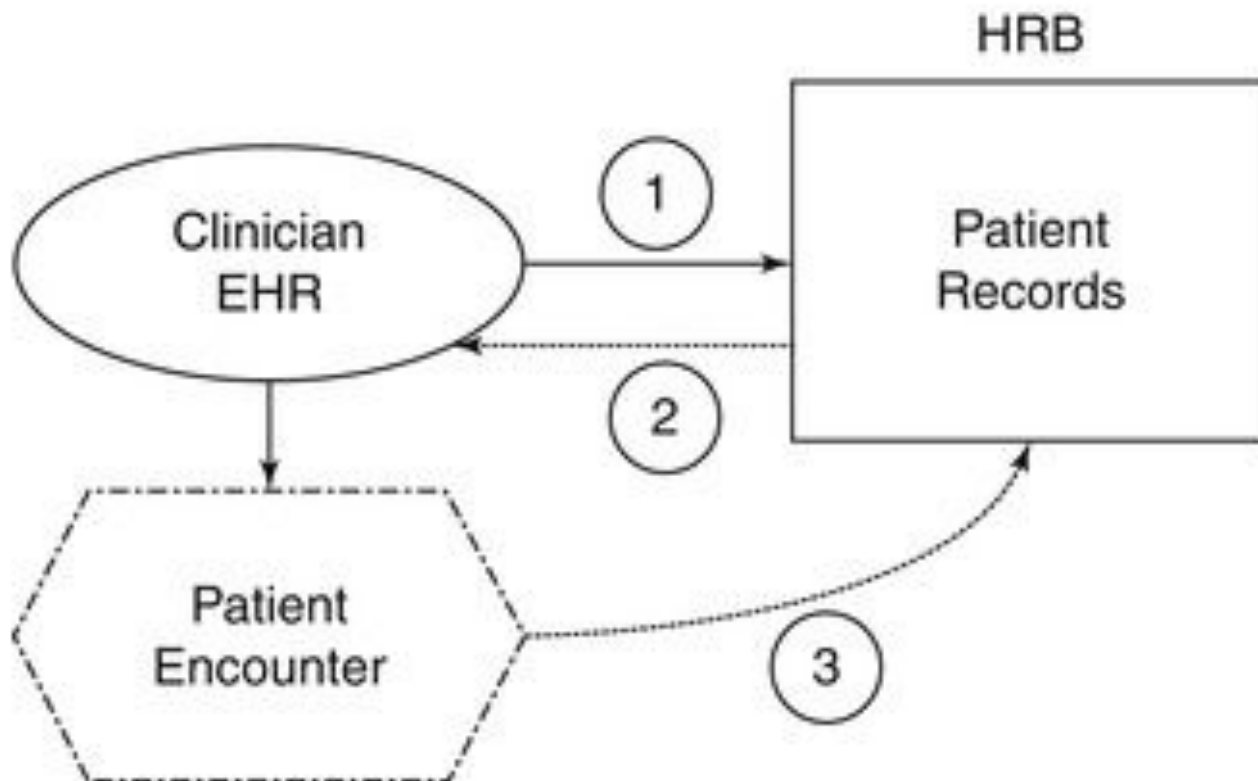
HIOs

- Health Information organizations
- Regional HIO
 - Serves a specific geographic area
- HII (health information infrastructure)
- NHII = national HII, e.g. connected RHIOs

Why NHII?

- Biosurveillance
- Full sharing of records
- Integration with public health
- Clinical trials





What data will be sent to the HSCIC for Care.data?

The data that will be extracted from GP systems includes: referrals, NHS prescriptions, your family

Will anything be left at my GP?

Free text notes -- conditions are all coded and it's these codes that are extracted -- and "sensitive data", which includes details of infertility and assisted conception, sexually transmitted infections, abortions, gender identity matters and abuse. However, this list "might be reconsidered" at a later date.

data, and the identifiers will be stored separately. Critics believe that HSCIC retains, at the very least, a look-up table for these identifiers.

Case studies

1. Take a few minutes, read over case studies
2. Pair up, choose 2 to discuss.
3. Discuss how these would be different under direct exchange, a central HIO, and consumer-mediated exchange.
4. Is there one approach overall that you would argue is better?

Patient matching

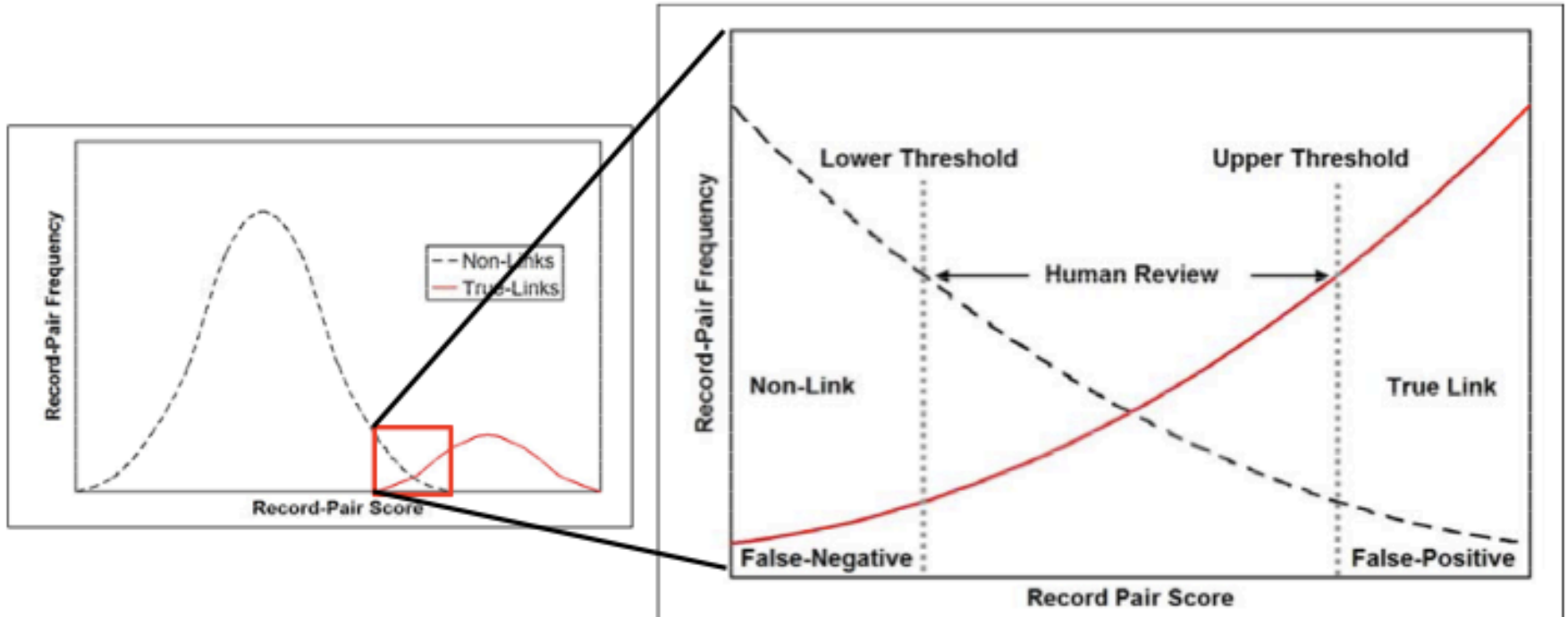
- Basic problem: How do we know Joe Smith at Hospital A is the same Joe Smith at Hospital B?
- Effects of incorrect match
 - Medical errors: e.g. missing allergy/incorrect allergy
 - Loss of privacy: disclosing another patient's info
- Challenges
 - Missing data, highly scattered records, common characteristics

UPI

- Everyone gets a “unique patient identifier” (UPI)
- SSN often used, this would replace that
- What’s are pros/cons? Is it a bigger security risk?
- Note: congress has banned funding HHS to investigate UPIs

Other approaches

Figure 5-1. Illustration of the Intermediate Score Range Where Both True Matches and Non-Matches Are Present



NOTE: To disambiguate these linkages, human review is often necessary.

Table 6-1. Summary of HIO Matching Approaches

Attribute	Results
Number of unique patients in HIO	■ 225,000 to 9.4 million
Software type	■ Use commercial product: 5 HIOs ■ HIOs using commercial software that make some adjustments to the system: 3 HIOs ■ Use own matching solution: 2 HIOs
Type of matching	■ Probabilistic: 4 HIOs ■ Deterministic: 1 HIO ■ Combination of probabilistic and deterministic: 1 HIO ■ Fuzzy match based on heuristics: 1 HIO
Manual review component	■ 0 FTEs (full-time equivalents): 2 HIOs ■ 0.5 to 1.0 FTEs: 3 HIOs ■ Will use manual review, but number of FTEs TBD: 2 HIOs
Summary of all variables used by the HIOs for matching (note: not all HIOs use all of these methods)	■ Medical record number ■ First name ■ Middle name ■ Last name ■ Maiden or alias names ■ Gender ■ Date of birth (as single value or separate fields for month, day, and year) ■ Social security number (whole number or last four digits) ■ Phone numbers ■ Street address ■ City ■ County ■ State ■ Zip code ■ Driver's license number ■ Race ■ Marital status ■ Date of encounter

Challenges

- Data may be...
 - Missing
 - Incorrect
 - Outdated

Data from outside hospital?

<http://vimeo.com/81272562>

Today's paper

For next week

- Read
 - S. Abhyankar, D. Demner-Fushman, F. M. Callaghan, and C. J. McDonald. Combining structured and unstructured data to identify a cohort of icu patients who received dialysis. Journal of the American Medical Informatics Association