Addressing the Unintended Consequences of Information Technology in Health Care

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In Portland, Oregon, we live in the shadow of Mount St. Helen's

- We have experience with unintended consequences!
- If you cannot prevent them, you can at least try to manage them

Clinical systems implementation has its upsides and downsides

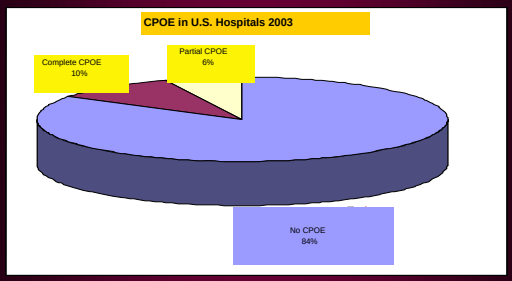
Outline
- Background
- Methods
- Results
  - Unintended adverse consequences
  - Prevention of them

We studied computerized provider order entry (CPOE)

Process which allows a physician to use a computer to directly enter medical orders

Usually part of a suite of clinical applications and impacts the entire health care team

Our two surveys showed that adoption of CPOE is low



We turned to qualitative methods

- To find out why CPOE has not diffused
- To identify success factors for implementing computerized physician order entry
- To describe unintended consequences

There are frightening stories about the unintended consequences of CPOE

- Story 1: University of Virginia
- Story 2: Pediatric mortality
- Story 3: Viagra

The Virginia story had a happy ending

The University of Virginia story told by Massaro

Interns look and feel like this, and they revolted

It ended with collaboration

- The administration, clinical leaders, and house officers met weekly
- Developed time saving order sets

The story about one pediatric hospital made headlines

- Han et al. paper about increased pediatric mortality
- Han et al. Unexpected increased mortality after implementation of a commercially sold CPOE system. Pediatrics 2005.

The story of another pediatric hospital did not make headlines

- Study by Del Beccaro et al. showed no increased mortality
- Listened to users and implemented with care
- Del Beccaro et al. Pediatrics 2006

- Another unintended consequence of an EHR

The latest smoking cure: Viagra

Every smoker needs a little encouragement to give up, but some in Glasgow received more than they expected when they registered for a drug to help them.

In a development unlikely to reduce cigarette consumption but almost certain to produce other benefits — at least for male patients — a "computer glitch" led to smokers being mistakenly prescribed Viagra instead of the anti-smoking drug Zyban.

The problem is thought to have become apparent several weeks ago. About 900 family doctors at 200 surgeries have been sent an e-mail giving warning about a malfunction in its "e-Formulary" IT system, which automatically lists the most popular drugs when doctors fill out prescriptions. When GPs tried to select Zyban, a drug that suppresses the part of the brain that experiences nicotine cravings, the computer instead selected sildenafil, the generic name for Viagra, which is used to treat impotence.

In a statement yesterday, Greater Glasgow NHS said that patient care had not been impaired by the blunder because prescriptions were "subject to stringent double-checking by both prescribing doctors and pharmacy staff".

A spokeswoman for the health authority said that no patients had complained of having been given Viagra in error. Although all surgeries in the area had been warned as a precaution, only two had reported the problem.

Family doctors, however, said last night it was unlikely that all prescription mistakes would have been noticed. One Glasgow doctor said: "In some cases, it's possible that GPs will have spotted the problem after printing out a prescription. But some will not, and unsuspecting patients will have gone to the chemist's and unknowingly ordered Viagra.

The POE team (POET) is multidisciplinary

- Joan S. Ash, Ph.D., M.L.S., M.B.A.
- Dean F. Sittig, Ph.D.
- Richard H. Dykstra, M.D., M.S.
- Emily M. Campbell, R.N., M.S.
- Josh Richardson, M.L.I.S., M.S.
- Ken P. Guappone, M.D., Ph.D.
- James Carpenter, R.Ph., M.S.
- Carmit McMullen, Ph.D.

For each study, qualitative data gathering started with an expert consensus panel

Then we did fieldwork

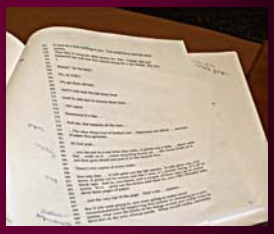
- Five sites for success factors study
- Five hospitals for unintended consequences study

We used multiple researchers, methods, sites, and types of subjects to assure trustworthiness

- Observation: 784 person-hours
- Interviews, focus groups: 87
- Over 2000 pages of data

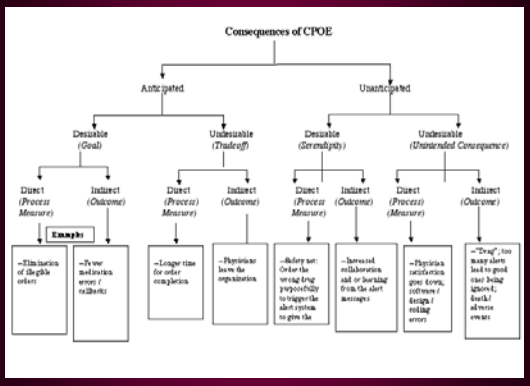
We analyzed the data iteratively, individually

- Coding the transcripts
- Use of software
- Building themes



We met to conduct team analysis

- 2,173 pages of data
- 86 analysis meetings
- Agreement on patterns and themes
- Found 380 unintended consequences



What does "unintended" mean?

- Unanticipated and not specifically a goal of the project
- "Unintended" most often connotes consequences that are unanticipated and undesirable
- They are not uniformly errors or mistakes: they are simply surprises

Positive consequences can be happy surprises

"he turns the patient instructions on the screen to the patient and they go over it line by line, clarifying any questions. Patient finds error"

We discovered there are "two sided" consequences

- Sometimes positive and sometimes negative
- "I am glad the computer goes down sometimes. Otherwise, I will forget how to use it [paper]"

Types of unintended adverse consequences we identified

- More/new work for clinicians
- Workflow issues
- Never ending system demands
- Paper persistence
- Changes in communication patterns
- Emotions
- New kinds of errors
- Changes in the power structure
- Overdependence on the technology

We developed a telephone survey

- Five questions about hospital use of CPOE to measure "infusion," or sophistication
- Eight questions about unintended consequences (UCs)
- For each type of UC we asked (neutrally) if they experienced it and how important it is

We surveyed all U.S. hospitals with CPOE

- HIMSS Analytics database identified 448 hospitals as "having implemented CPOE" from over 4500 hospitals
- Added all 113 Veterans' Affairs (VA) hospitals to this list
- Attempted to contact all 561 hospitals

We interviewed 176 hospital representatives

- Talked to staff at 299 of the 561 acute care hospitals
- Discovered that 89 listed as having CPOE did not
- 34 hospitals had policies against doing surveys
- Response rate (based on 176 valid interviews) was 47% (using ISER calculation)

We found that CPOE is heavily infused

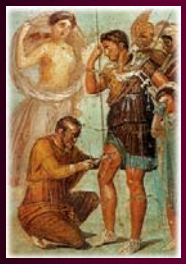
- Length of time that CPOE had been in place: median = 5 years
- % of orders entered electronically: median = 90.5%
- Greater than 96% of the sites used CPOE to enter pharmacy, laboratory and imaging orders
- 86% of the respondents had at least 3 types of decision support (order sets, drug-drug interaction warnings, and pop-up alerts)
- 90% had a CPOE committee in place

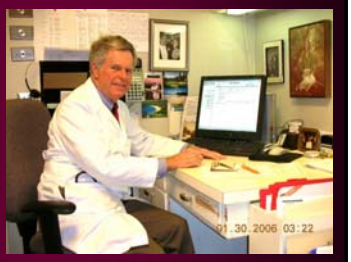
We also found that most hospitals had experienced unintended consequences

- At least 72% of respondents ranked more work/new work, workflow, system demands, communication, emotions, and dependence on the technology as moderately to very important
- Shifts in the power structure and CPOE as a new source of errors ranked lower

Types of Unintended Adverse Consequences of CPOE

CPOE creates new work for clinicians and changes their workflow

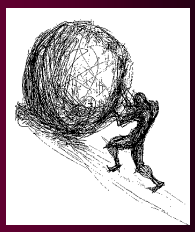




- Enter new data; re-entry of data; double checks
- Respond to alerts
- Expend extra time in completing non-routine, complex orders

CPOE causes never ending system demands for information technology organization

- Demand for hardware & software purchase, implementation, and maintenance
- Personal order sets are difficult to standardize, update, or maintain over time
- Users demand more sophisticated functionality



Paper persistence means hospitals are not "going paperless"

Paper used as temporary, handwritten data storage system

Paper used as portable, disposable, computer display interface

" We produce 1.6 million pieces of paper per month - printed or copied –half is related to clinical care…we destroy 40% of that paper"

Your hospital will be paperless, the same day my bathroom is…

Michael Shabot, M.D.

CPOE alters communication among providers, ancillary services, and clinical departments

- Causes reductions in face-to-face communication
- Causes "illusion of "communication, " belief that the proper people will see it and act upon it
- Causes depersonalization

Emotions run high

- CPOE evokes strong emotional responses
  - strongly negative
  - highly positive emotions
- Strong positive correlation between time system is in place and positive emotions

CPOE can cause insidious silent errors

Pick lists for data entry promote juxtaposition errors

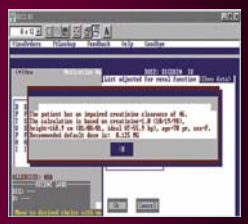
- ***"I ordered the test that was right next to the one I thought I ordered, you know, right below it. My little thingie [cursor] had come down and I clicked and I'm lookin' at this one but in fact I clicked on the thing before. By that time I turned my head and I'm hitting return and typing my signature and not seeing it"***

CPOE causes changes in the power structure

- Loss of clinician autonomy
- Administration and I.T. gain power
- Clinical decision support can “tell doctors how to practice”
- Coalitions

Clinical care becomes over dependent on the computing infrastructure

- System failures wreak havoc unless good downtime procedures exist
- Reliance on clinical decision support may reduce learning
- *“If it’s in the computer it must be right!”*



How can we prevent, manage, or overcome these unintended consequences?

Prevention is related to time issues

- Speed of order entry
- Speed of full order process
- Life cycle of implementation
- Address workflow and emotions

Prevention is related to multidimensional integration

- Systems integration
- Integration into workflow
- Fit with integrated health care delivery system
- THE HUB
- These address workflow, communication, more work, and emotions

Prevention of all unintended consequences categories is related to adequate financial resources

Prevention is related to meeting information needs

- Technical aspects: quality of application, customizability
  - Entering dot in required field
- These address workflow, power, communication, emotions

Prevention is related to value to users and tradeoffs

- Value: remote entry, legibility, decision support
- Tradeoffs: time, rigidity, adapting to upgrades
- These address workflow, power, communication, more work, overdependence, emotions

Prevention is related to the existence of special people

- Administrative leaders
- Clinical leaders, champions, curmudgeons
- Bridgers / support staff, help at the elbow
- Trainers
- Vendor
- These address all of the types of unintended consequences

Bridgers are bilingual superheroes

Prevention is related to organizational culture

- Organizational culture
  - Administrative commitment, vision
  - Trust
- Leadership open to feedback, collaboration
- Collaborative project management-- CIS
- These can address all types of unintended consequences

Prevention is related to continuous improvement through evaluation and learning

- Careful planned evaluation
- Continuous modification
- Involvement and feedback
- Address all types of unintended consequences

Our conclusion is that it is possible to address many unintended consequences

- The goal is to better understand them
- To learn more about them through evaluation research
- Realize how complex CPOE is

Questions?

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