The Benefit and Burden of Electronic Reminders for Optimizing Patient Care

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Motivation

- Health information technology (HIT) is becoming increasingly important
  - $35 billion in annual investments
  - Significant policy attention, including incentives in the Affordable Care Act
- Increasingly viewed as key to getting doctors to provide quality, population-based medicine
Motivation

- Conflicting evidence on the overall effect of HIT on outcomes
- Fundamental difficulty in that most of empirical literature treats HIT as unitary black box
- In practice, effect of HIT on outcomes is fundamentally behavioral and involves tradeoff
  - Providing useful information to clinicians that would otherwise be overlooked
  - Distracting clinicians with too much (or irrelevant) information ("information overload," "alert fatigue")
  - Need to take a closer look at this tradeoff to optimize HIT
Outline

1. Research problem, literature, institutional setting
2. Natural experiment in VA: variation in electronic reminders
3. Research in progress: diabetes / health factors
4. Results
5. Future work
Large literature in psychology on cognitive limitations, but general, often lab-based

- E.g., Miller’s (1958) famous seven digits

Despite huge policy attention, no consensus on effect of HIT

Case studies on how HIT improved outcomes, left outcomes unchanged, or worsened outcomes

Natural experiments

- Fundamental problem: how do you describe or compare systems of HIT?
- Literature has sidestepped this by estimating effect of a single HIT intervention or average effect of any HIT
- Does not inform how to best implement health IT
Medical care is primarily an informational task

- Arrow (1963): “I will hold that virtually all the special features of this [medical care] industry, in fact, stem from the prevalence of uncertainty”

- Increasingly more information to process in less time, proliferation of performance measures in name of “quality improvement”

- HIT as tool to deal with this
  - But often designed as if physicians can process information effortlessly in first place
  - Numerous commentators (most of the physicians) on “alert fatigue,” etc.
Veterans Health Information and Technology Architecture (VistA) one of the earliest, most widely used, and acclaimed HIT system in the US

- Reached stable form in 1994
- Over 60% of all US physicians have trained in the VA
- VA hospitals with VistA comprised nearly half of US hospitals with enterprise-wide HIT
Electronic reminders a very common way to communicate potential patient issues to physicians, however, relatively primitive

Examples:

- Reminder to screen for smoking
- If smoker, reminder to counsel against smoking
- If diabetic, reminder to do yearly foot exam and eye exam
Empirical advantage at the VA: hold HIT platform fixed, but significant variation in electronic reminders across locations and time

- National reminders relatively few
  - E.g., hypertension assessment, screen for traumatic brain injury, colon cancer screening
- Regional reminders (21 regions or VISNs)
  - E.g., in VISN 21, herpes zoster vaccine, amiodarone monitoring
- Local reminders, the vast majority
The VA Natural Experiment

- Cross-sectional variation
  - 20-fold variation in reminder-related information ("health factors") across VA health care systems
  - Unrelated to number of patients or visits at health care systems
The VA Natural Experiment

- Time series variation by station

![Graph showing time series variation by station for Palo Alto, LA, and Seattle.]

- This paper: Use within station-time variation (by individual patient visit)
- Occupy central part of screen when opening each patient's facesheet
Electronic Reminders in the VA: Clinical Interface

- Clinician must click on a reminder to address it (may ignore it)

- Clicking on it shows description, underlying logic, and collects reminder-relevant information (health factors) from drop-downs and radio buttons
Diabetes and Hemoglobin A1c

- Diabetes: Common condition with high burden of disease
  - Increasing evidence and guidelines for chronic disease management
- HbA1c a laboratory test to follow clinical control of the disease
  - Unique in its clinical relevance, correlation to outcomes, measure of therapeutic efficacy
  - Based on glycosylation of red blood cells (will use red blood cell 6-month lifespan later)
- Idea for this current project:
  - Does the burden of non-diabetic electronic reminders negatively impact diabetic control?
Health factors (HFs): reminder-related pieces of information populated by clinicians responding to reminders

Complication [in this current project]:
- HFs might not be observed if (1) reminder was not displayed, or (2) clinician did not respond to a displayed reminder

So for now HFs are potentially endogenous
- But will show evidence of balance and robustness
- Also will use clinical evidence linked to timing of HbA1c
Cohort

- Select the 25 VA locations ("stations"), out of 130 stations, associated with the 18 largest VistA systems
- Follow patients with diabetes in primary care office visits over 6 year period
- 5,500,000 primary care office visits within a 6-month window of a HbA1c lab
- 10,000 providers associated with these visits

Data

- Patient demographics (age, gender, ethnicity)
- Diagnoses to create Elixhauser indices
- History of HbA1c values
Substantial raw variation in HF counts across visits within station-month
Specification

- Regress HbA1c on non-DM HF counts in visits in prior months

\[ Y_{ijst} = \sum_{s=t-6}^{t-1} \sum_{q=0}^{4} \alpha_s^q Q(HF_{ijst}) = q + \beta X_{it} + \eta_{st} + \zeta_j + \varepsilon_{ijst}, \]

or

\[ Y_{ijst} = \sum_{s=t-6}^{t-1} \alpha_s HF_{ijst} + \beta X_{it} + \eta_{st} + \zeta_j + \varepsilon_{ijst} \]

- Can represent HF counts linearly or in quartiles
- \( X_{it} \): splines of age, gender, Elixhauser indices, splines of lagged HbA1c, DM HF count in some specifications
- Station-month fixed effects \( \eta_{st} \), doctor fixed effects \( \zeta_j \), in some specifications patient fixed effects \( \xi_i \)
Graphical Evidence

- Residualized HbA1c on residualized non-DM HFs in prior visits

![Graphical Evidence](image-url)
Results also hold individually for each of the 18 VistA systems.
Falsification Test

- Residualized HbA1c on residualized non-DM HF count in future visits
Moving from no non-DM HFs (or almost equivalently 1Q) to 4Q non-DM HFs associated with increase in HbA1c of 0.12 to 0.15

- Comparison: intensive lifestyle modification and drug therapy leads to 0.5 to 1 decrease in HbA1c
- So we could have a spillover that is 15-30% the size of formal diabetic therapy!

Potential evidence of negative effect of HIT on clinical care, through mechanism of limited clinical attention (i.e., “information overload”)
Future Work

- Use VA data to better elucidate mechanism
  - Can observe prescriptions. Do non-diabetes reminders reduce the likelihood that physicians will fill important prescriptions?
  - Other non-HbA1c effects in diabetes (fewer eye or foot exams)

- Link HFs, endogenous artifacts of electronic reminders, to the actual reminders
  - Reminder logic encoded in VistA, non-trivial to implement, but in principle possible
  - Can separate whether reminder was displayed vs. whether provider responded to it
Future Work

- Building on whether reminders are displayed, find natural experiments involving appearance of new diabetic reminders
  - Are there benefits to diabetic care from having these reminders?
- Also, once analysis is at reminder level, have more description of reminders (possibly by survey)
  - Some reminders may be much more difficult to deal with than others
  - Some reminders may be more relevant / helpful than others
- Heterogeneous effects across different types of patients, different types of providers
  - What types of organizations within the VA are doing a better job of mitigating negative spillovers
Future Work

- Broader agenda of testing HIT’s effect on patient care
  - VA currently in project to redesign VistA
  - Possibilities to work with operational leadership at least to collect data on what physicians are seeing
  - Idea of beta-testing changes in VistA with respect to clinician behavior