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, institional setting
2. Natural experiment in VA: variation in electronic reminders
3. Research in progress: diabetes / health factors
4. Results
5. Future work

Literature

- 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

Information: The Clinician's Problem

- 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.

Health IT at the VA

- 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

Health IT at the VA

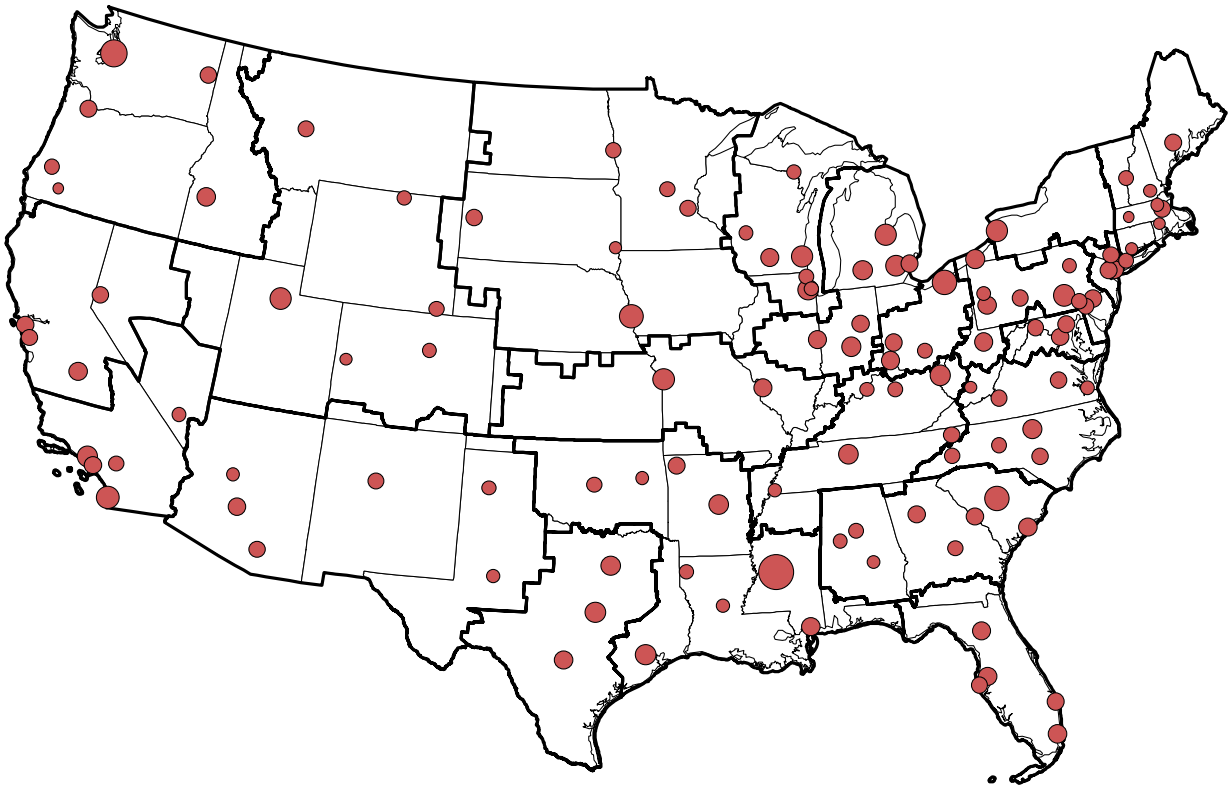
- Electronic reminders a very common way to communicate potential patient issues to physicians, however, relatively primitive
- Examples:
  - Reminder to screen for smoking
  - If smoker, reminder to counsel against smoking
  - If diabetic, reminder to do yearly foot exam and eye exam

The VA Natural Experiment

- 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

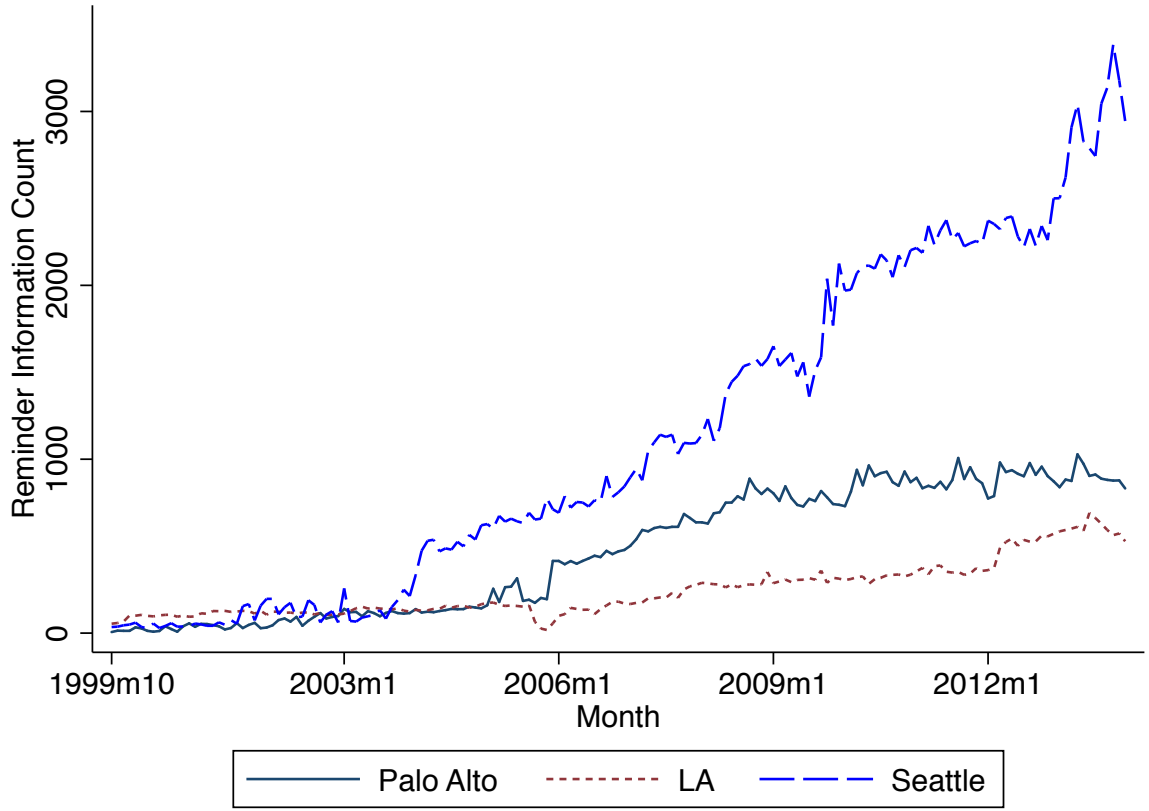
The VA Natural Experiment

- 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

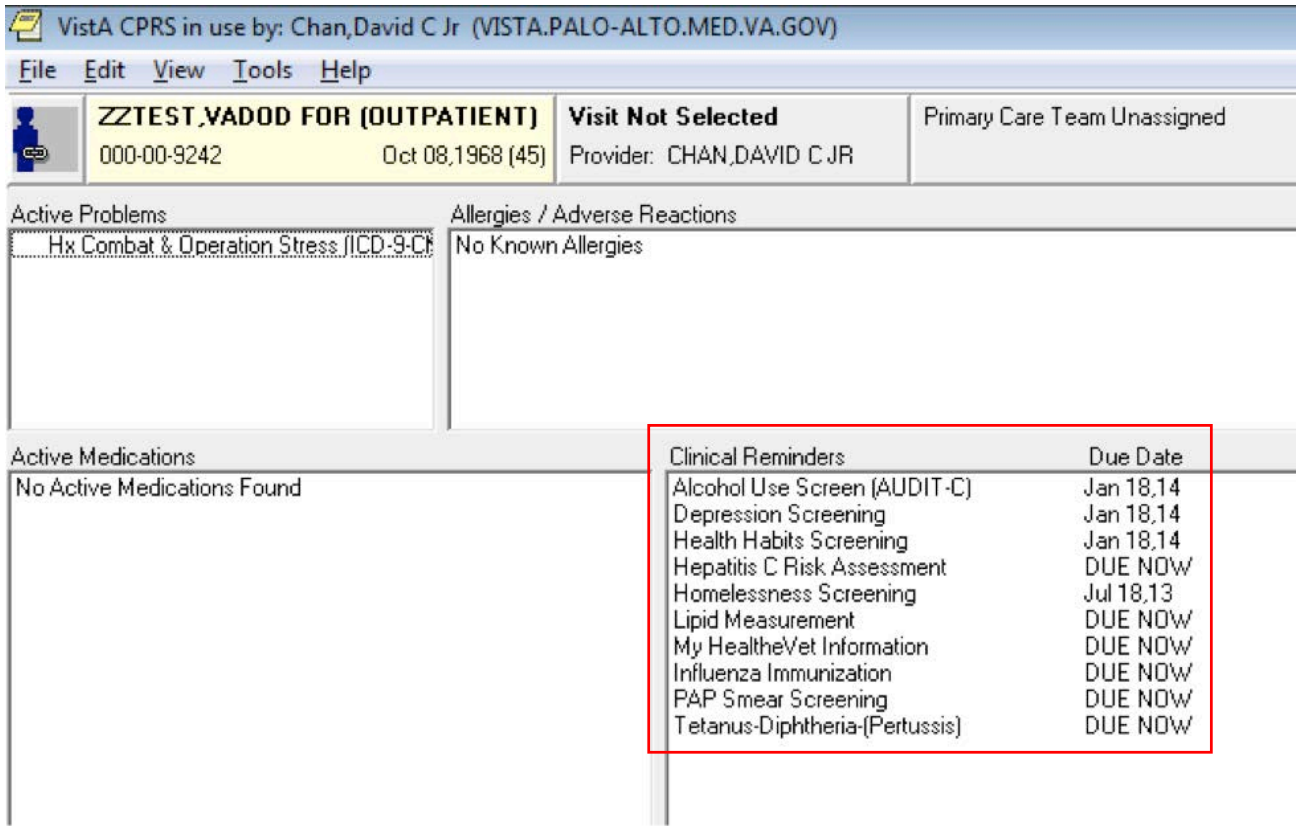
- Time series variation by station



- This paper: Use within station-time variation (by individual patient visit)

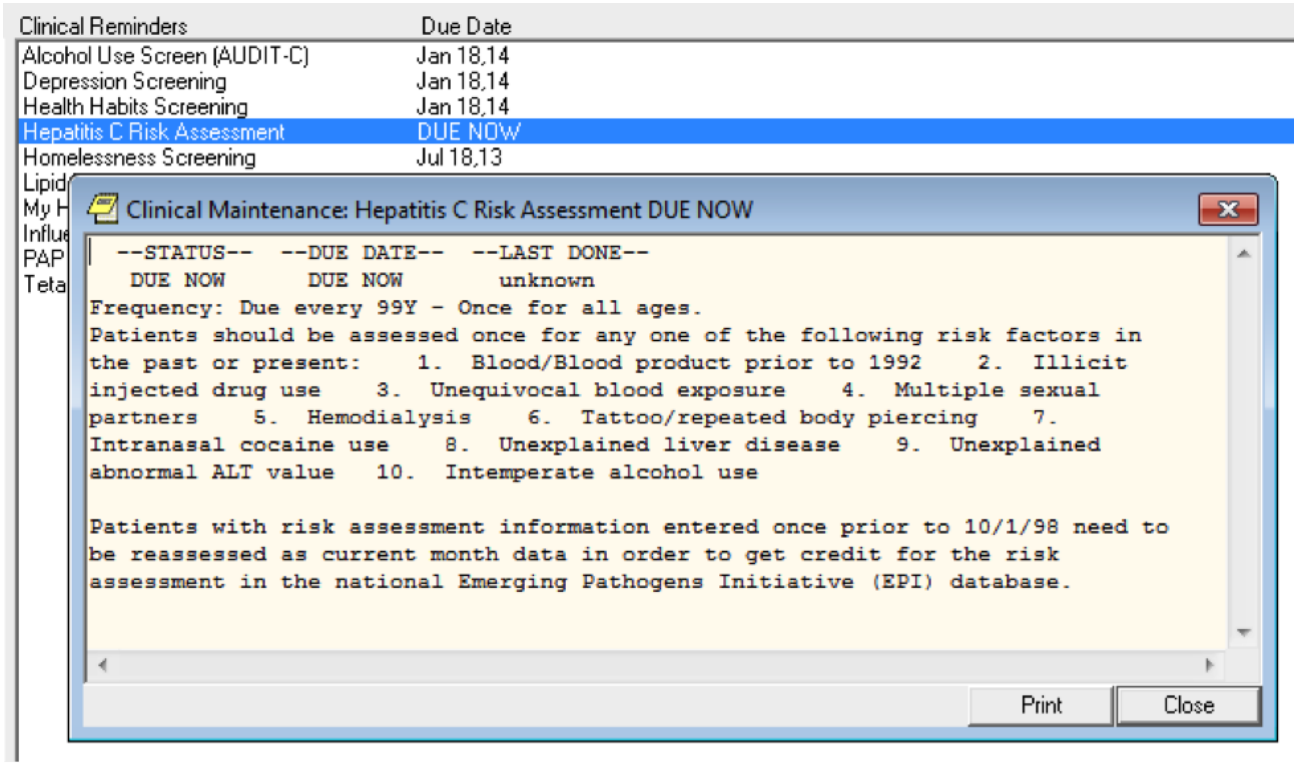
Electronic Reminders in the VA: Clinical Interface

- 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 efficicacy
  - 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

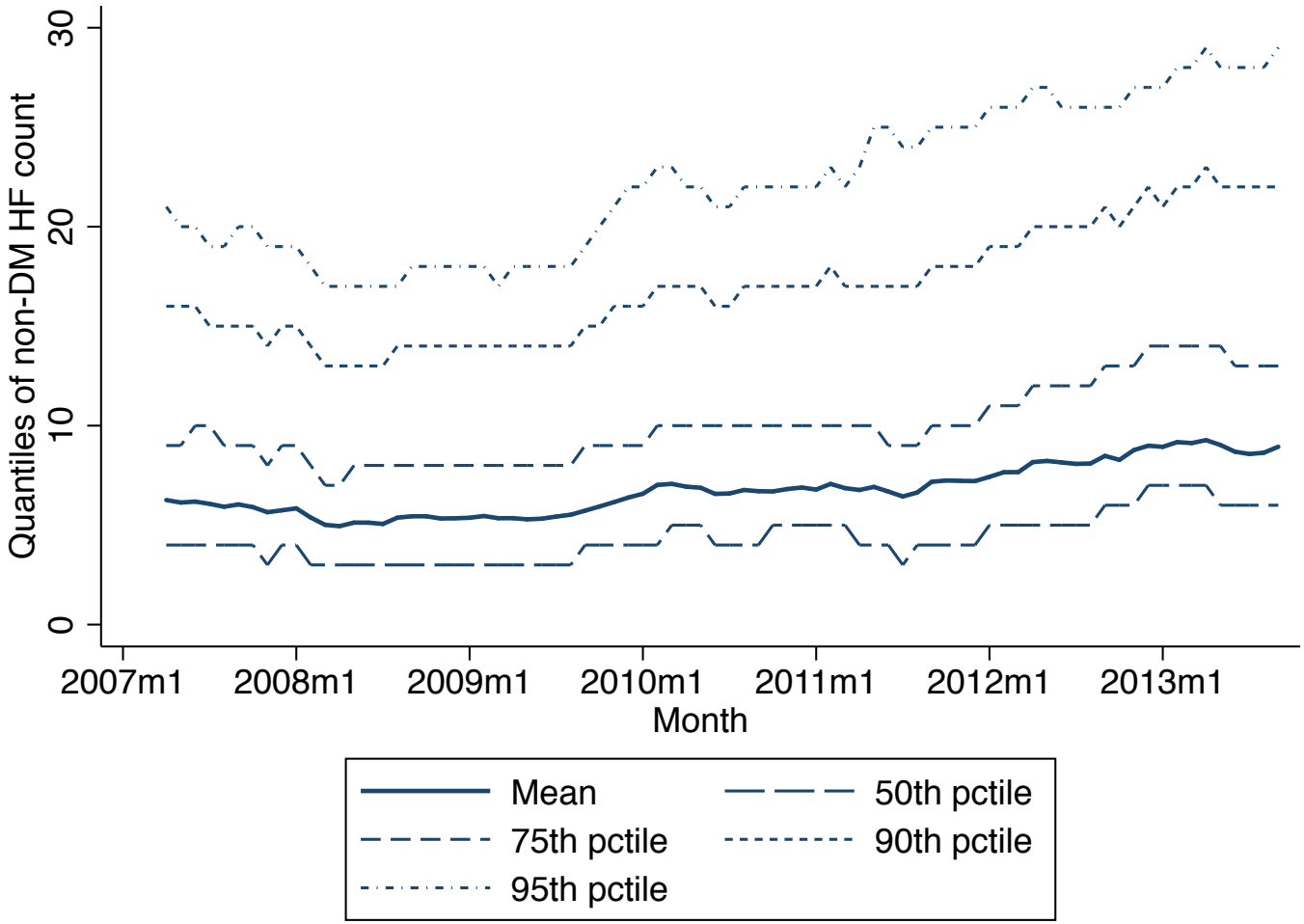
- Health factors (HFs): reminder-related pieces of information populated by clinicians responding to reminders
- Complication [in this current project]:
  - HFs might not be observed if (1) reminder was not displayed, or (2) clinician did not respond to a displayed reminder
- So for now HFs are potentially endogenous
  - But will show evidence of balance and robustness
  - Also will use clinical evidence linked to timing of HbA1c

Data

- 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

Variation in Numbers of Health Factors

- Substantial raw variation in HF counts across visits within station-month



Specification

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

$$Y_{ijst} = \sum_{s=t-6}^{t-1} \sum_{q=0}^{4} \alpha_s^q 1\left(Q\left(HF_{ijst}\right) = q\right) + \beta \mathbf{X}_{it} + \eta_{st} + \zeta_j + \varepsilon_{ijst},$$

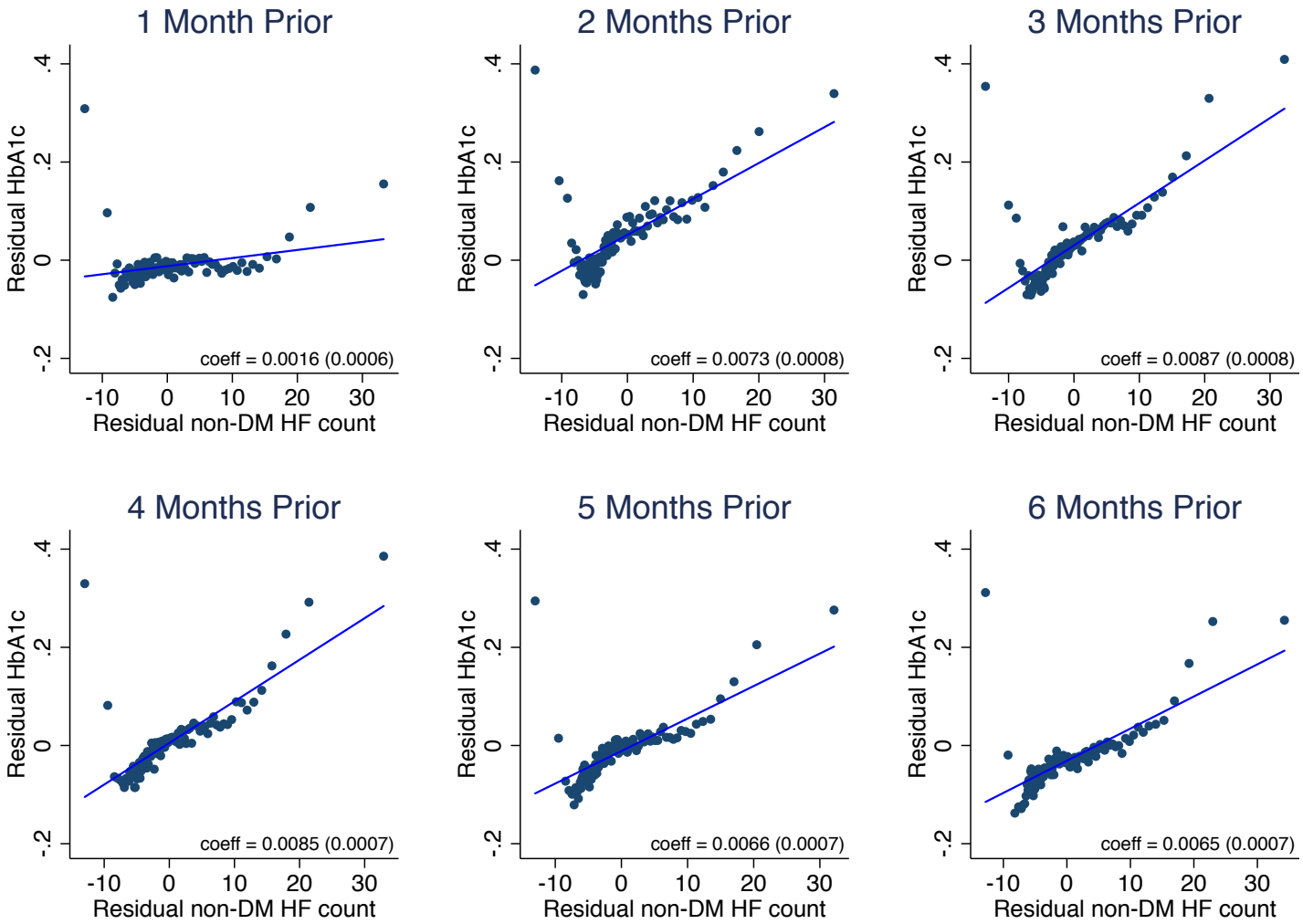
or

$$Y_{ijst} = \sum_{s=t-6}^{t-1} \alpha_s HF_{ijst} + \beta \mathbf{X}_{it} + \eta_{st} + \zeta_j + \varepsilon_{ijst}$$

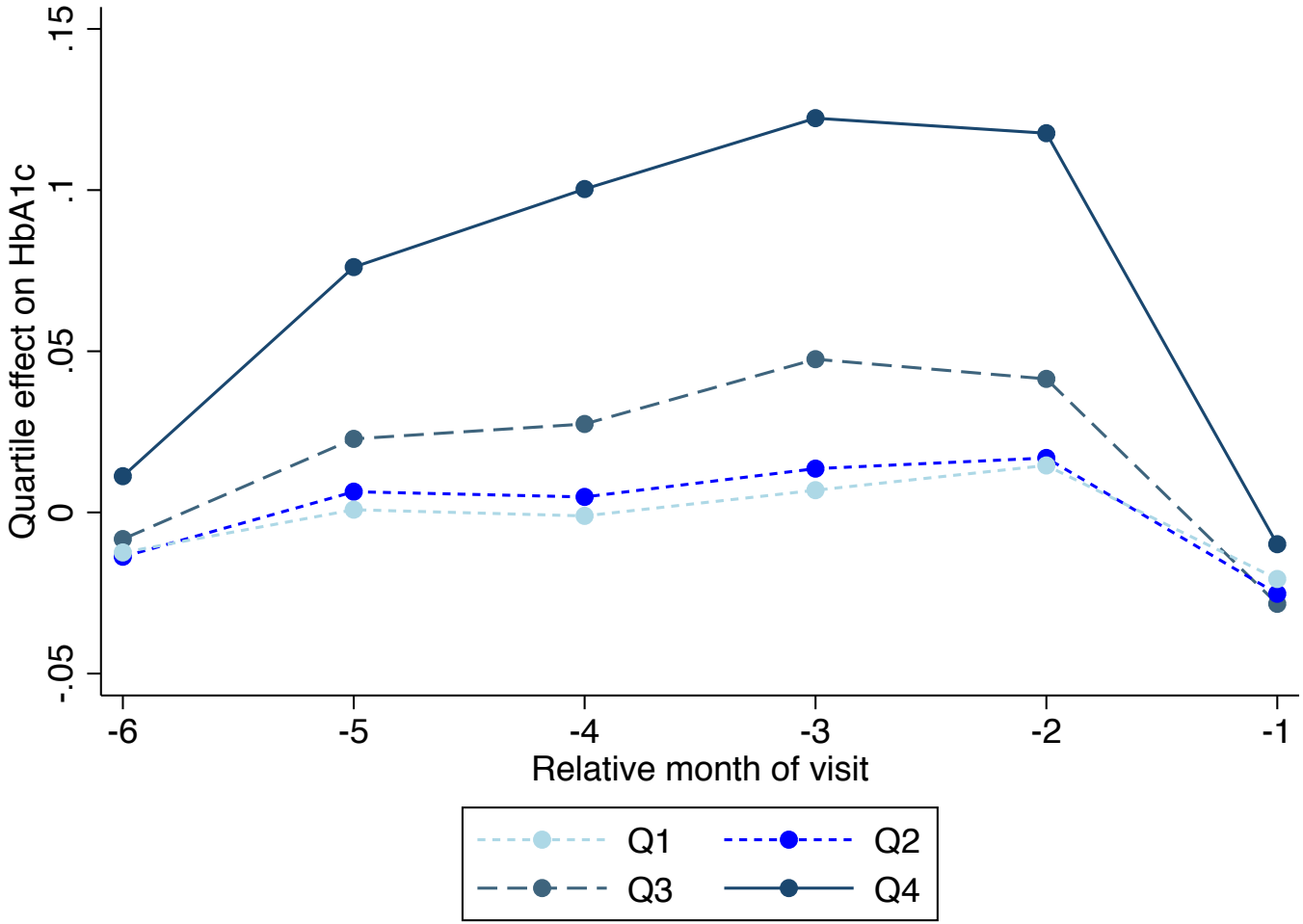
  - Can represent HF counts linearly or in quartiles
  - $\mathbf{X}_{it}$: splines of age, gender, Elixhauser indices, splines of lagged HbA1c, DM HF count in some specifications
  - Station-month fixed effects η_{st}, doctor fixed effects ζ_j, in some specifications patient fixed effects ξ_i

Graphical Evidence

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



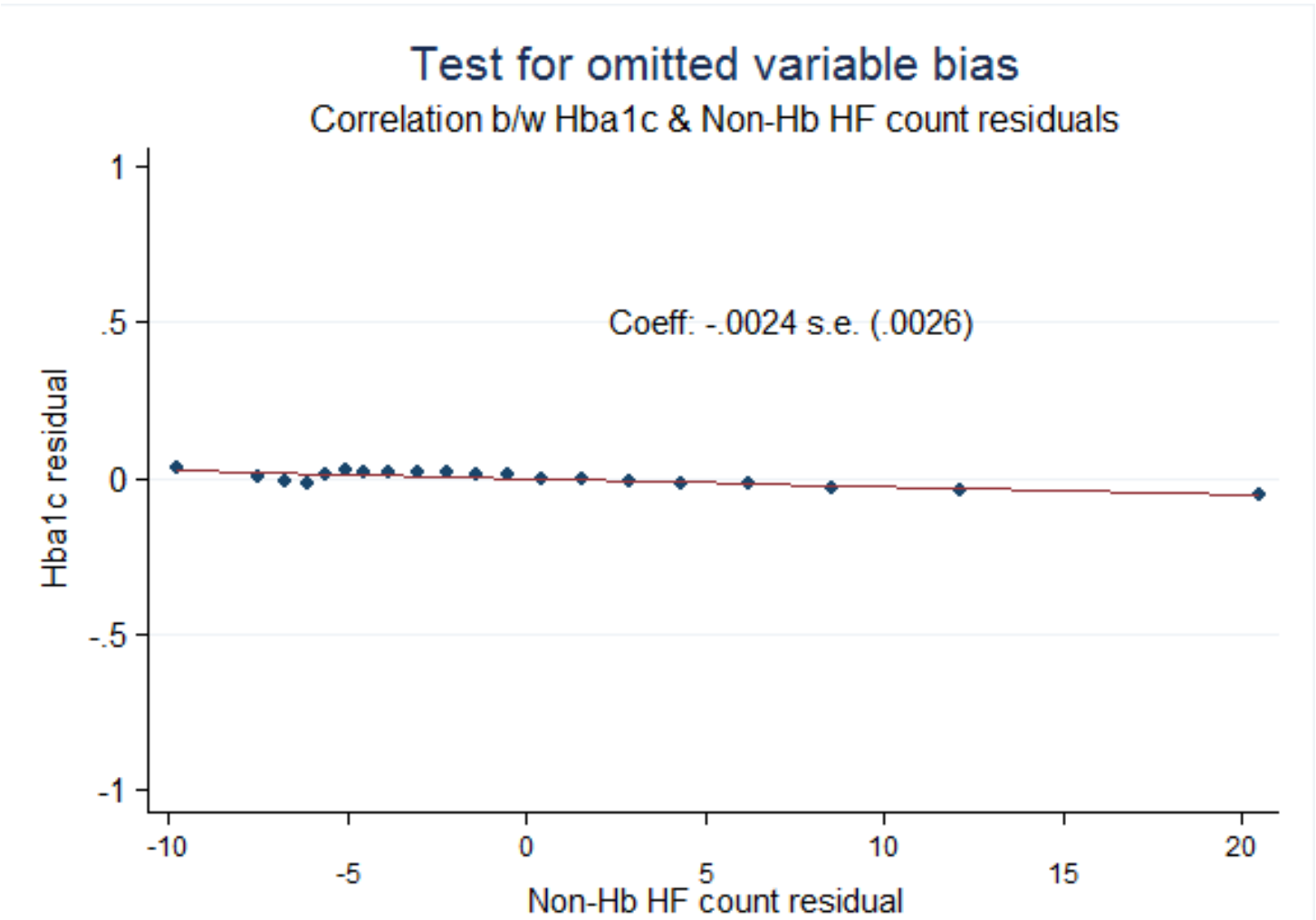
Pooled Results



- Results also hold individually for each of the 18 VistA systems

Falsification Test

- Residualized HbA1c on residualized non-DM HF count in **future** visits



Policy Implications

- 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