Field trials testing AI to nudge preventative health behaviors

Amir Goren, Ph.D.

Geisinger

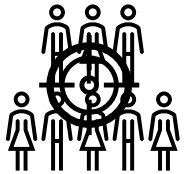
Flu Vaccination, Nudges, & AI

Influenza can lead to serious complications (e.g., CVD), hospitalizations, and even death, esp. among the elderly and those with comorbidities (high-risk patients).[1-6]

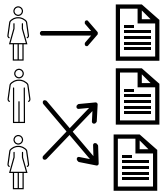
Flu shots are safe and effective, but vaccination rates remain low.

Behavioral **nudges** have had modest success at increasing flu shots.[7-9]

In healthcare, two promising uses of artificial intelligence (**AI**) are:



1. **Targeting**: Identifying high-risk patients most in need of intervention



2. **Tailoring**: Identifying distinct interventions predicted to be most effective for specific patients (aka precision nudging)

We ran four pragmatic field RCTs across four flu seasons (>200,000 patients) to test whether these uses of AI can improve upon existing standard practices

What is a nudge?

Cognitive constraints: Due to limited cognitive resources, people do not always act in their self-interest, and often in predictable ways

We respond to context, even when irrelevant to a decision

Nudge = ***Making it easier to make the "right" choice***; key attributes include:

- **Changes to the "choice architecture"** = altering the organization or presentation of options to decision-makers, typically at little or no expense
- **Improving outcomes** = increasing decision-makers' chances of making the "right" choice (best for most people/in most cases):
  1. Improved health (e.g., preventive screenings)
  2. Equal health at lower cost (e.g., generic drugs)
- **Preserving choice** = decision-makers free to choose differently from nudge

Causal inference: Conduct randomized evaluation of nudges; assess of unintended consequences

Targeting with AI: Background

How do patients react to being informed about the use of AI in their care? Conflicting suggestions from lab research:

- Algorithm aversion[11]
- Algorithm appreciation[12]

AI may be especially controversial in the context of vaccination (algorithm aversion + anti-vaccine sentiment)

But informing patients of their flu risk may nudge greater vaccination

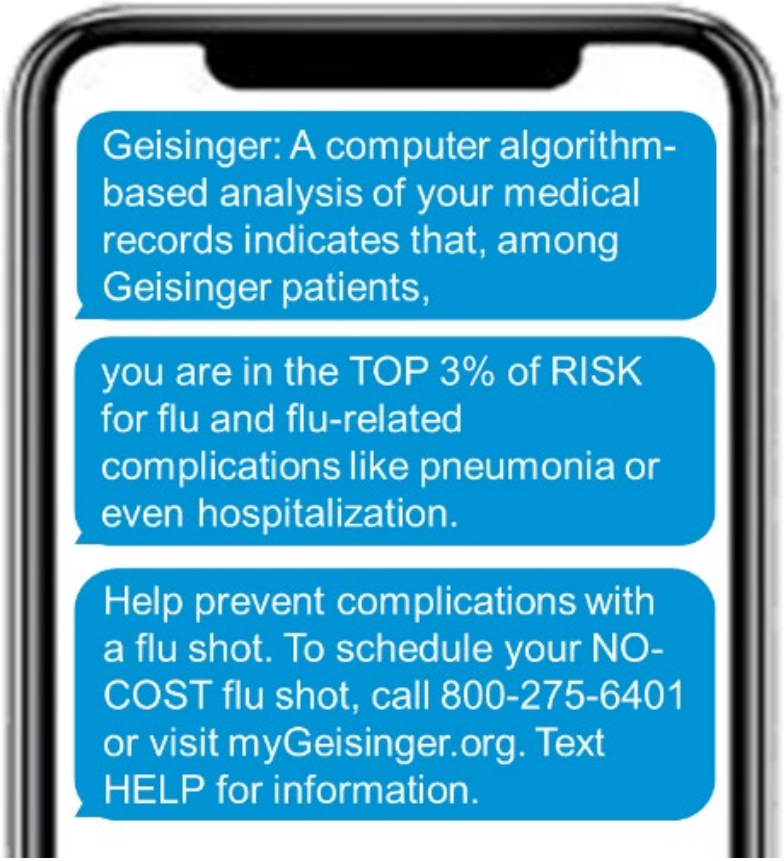
Targeting with AI: Aims and Methods

Aims:

- Do **high-risk nudge messages** (via letters, patient portal, & SMS) **increase flu vaccination** in patients at **high risk** for flu & flu-related complications?[13]
- Are messages more or less **effective** if they disclose that **AI was involved in the risk determination**?

Geisinger partnered with Medial EarlySign to develop a flu high-risk machine learning algorithm that produced personalized risk scores[14]

Patients determined to be at high risk (top 10% or top 20%) were randomized to a **nudge message condition** or **passive control (no nudge)**

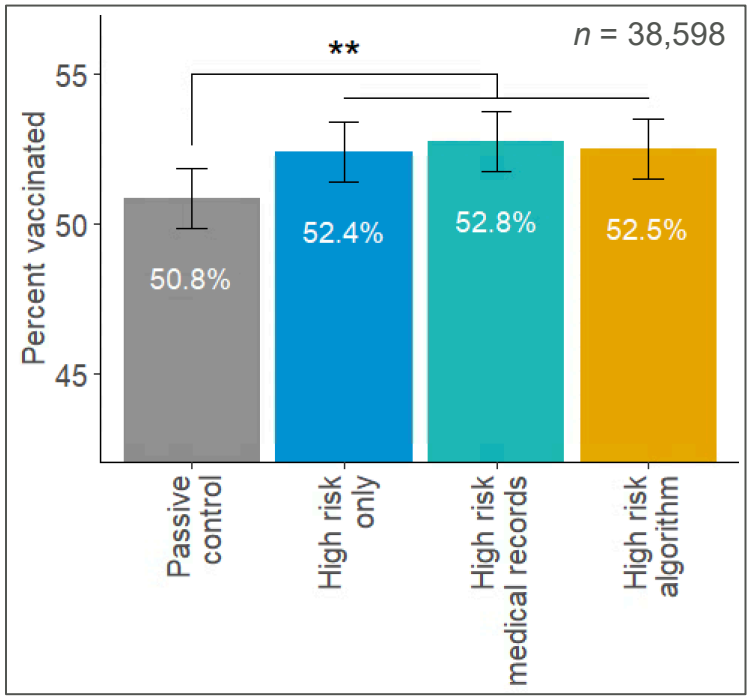


Geisinger | Medial EarlySign | NBER National Bureau of Economic Research | MIT | NIH National Institute on Aging

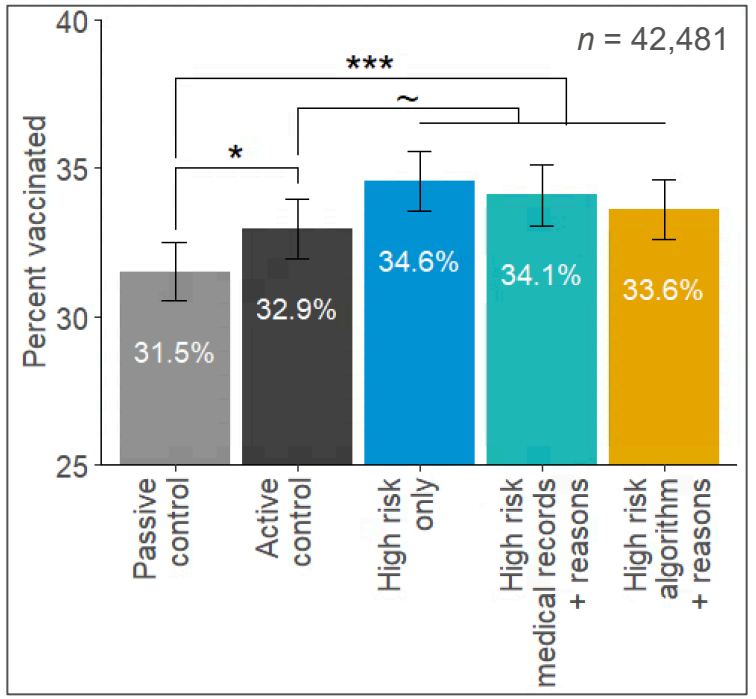
Study 1: NCT04323137
Study 2: NCT05009251
Study 3: NCT05509283

Targeting with AI: Results

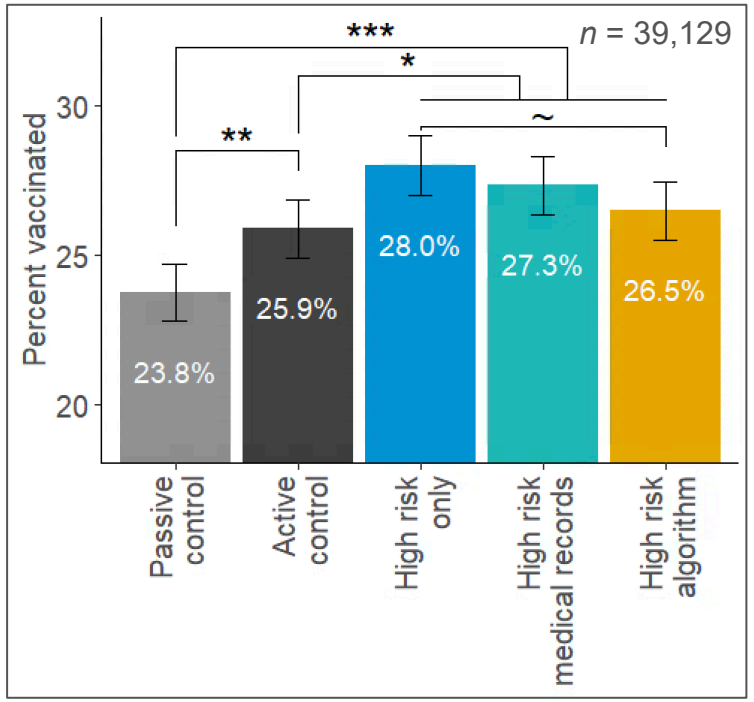
Study 1 (2020–21): Top 10% of risk



Study 2 (2021–22): Top 10% of risk



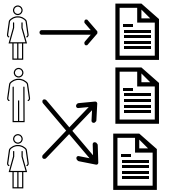
Study 3 (2022–23): Top 11–20% of risk



~$p < .1$, *$p < .05$, **$p < .01$, ***$p < .001$; Error bars represent 95% confidence intervals

- Vaccination higher with high-risk messages (colored bars) vs. control (grey) (Studies 1–3)
- No significant difference across different high-risk messages (across colored bars)
- Risk reasons—top risk score-contributing health factors—did not increase or decrease effectiveness of the high-risk messages (Study 2; analysis not shown)

Tailoring with AI: Background & Aims

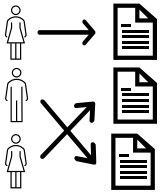


A 2020 “megastudy” at Penn Medicine and Geisinger tested 19 pre-appt text messages; flu shots increased by ~2 percentage points.[15]

The most effective message framed the flu shot as “reserved for you,” emphasizing psychological ownership.[16]

Aim: Can algorithmically-personalized messages—selected by a model trained on prior (megastudy) patient responses—outperform an effective message, a standard message, or no reminder?

Tailoring with AI: Methods



Patients (*n*=77k) with upcoming appts randomly assigned to:

- **Passive Control**: Usual care communications
- **Active Control**: Generic flu shot text messages 1–3 days pre-appt
- **Reserved For You**: Messages stating flu shot "reserved for you"
- **Algorithmically-Selected Nudge**: Message predicted most effective

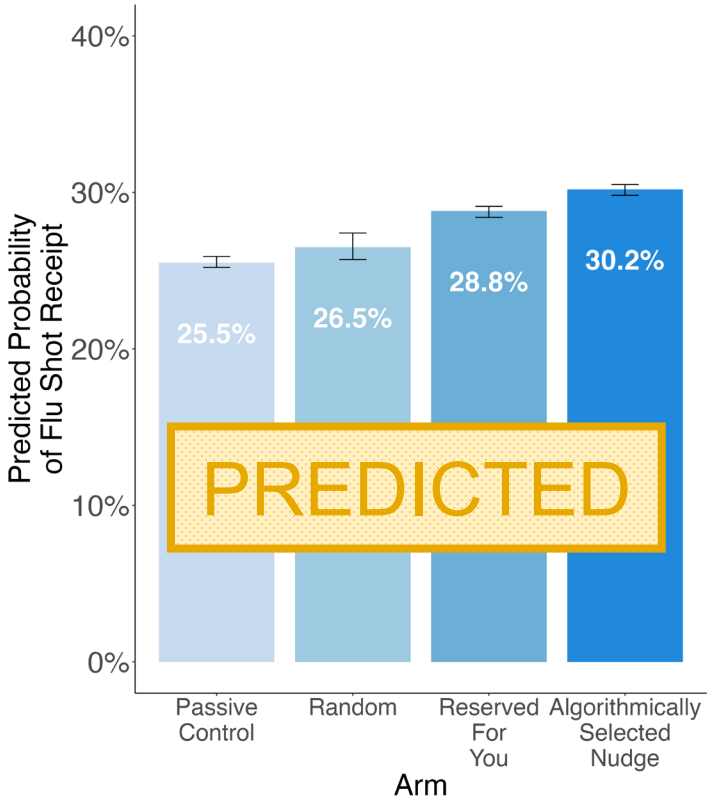
Primary outcome: Flu shot received between enrollment and scheduled appointment date

Geisinger MIT J-PAL ABDUL LATIF JAMEEL POVERTY ACTION LAB

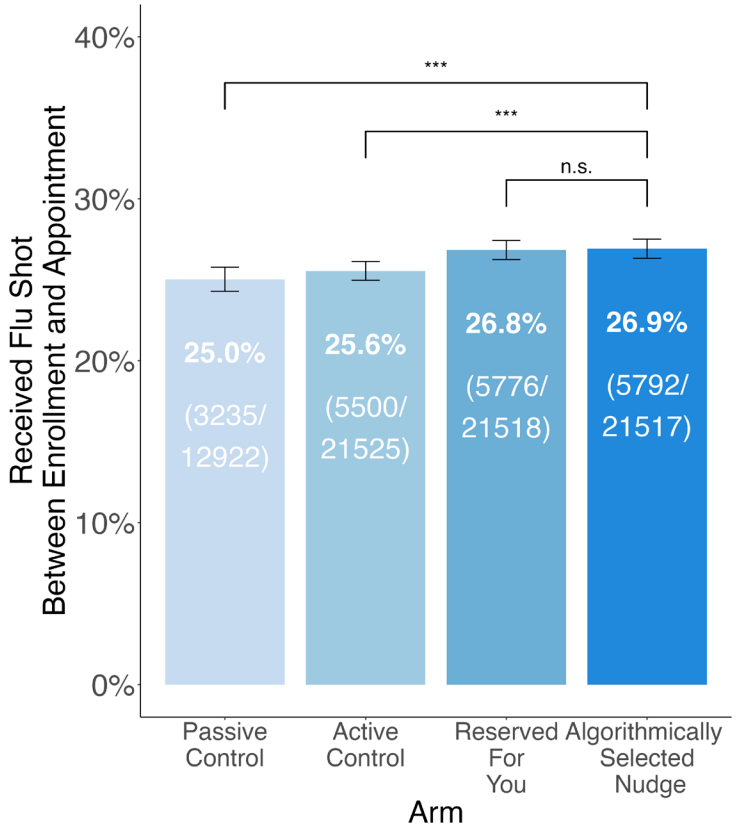
Tailoring with AI: Results

Preliminary results: DO NOT CITE

Algorithmically-selected nudge **predicted to outperform** all other arms in **2020–'21 data**



Algorithmically-selected nudge **did not outperform numerically best-performing nudge** in **2024 RCT**



~$p < .1$, *$p < .05$, **$p < .01$, ***$p < .001$; Error bars represent 95% confidence intervals

Discussion

Patients seem neither appreciative of nor averse to AI involvement in risk recommendations

Informing patients of their personalized AI-derived risk may be effective for encouraging preventative health behaviors

Tailoring message content with AI (**precision nudging** or providing **risk reasons**) may not increase effectiveness

Precise message wording accounts for little variation in effectiveness

THANK YOU!

Collaborators: Christopher Chabris, Michelle Meyer, Gail Rosenbaum, Sasha Brietzke, Maheen Shermohammed, Joseph Doyle, Rahul Ladhania, Donna Wolk, Ann Marie Tice