Interoperable information in prediction modeling:

contribution and application to patients

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Disclosures

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Work was a collaboration with many colleagues:

Vest JR, Ben-Assuli O. Prediction of emergency department revisits using area-level social determinants of health measures and health information exchange information. International Journal of Medical Informatics 2019;129:205–10. doi:10.1016/J.IJMEDINF.2019.06.013

Kasthurirathne SN, Vest J, Menachemi N, et al. Assessing the capacity of social determinants of health data to augment predictive models identifying patients in need of wraparound social services. Journal of the American Medical Informatics Association 2018;25. doi:10.1093/jamia/ocx130

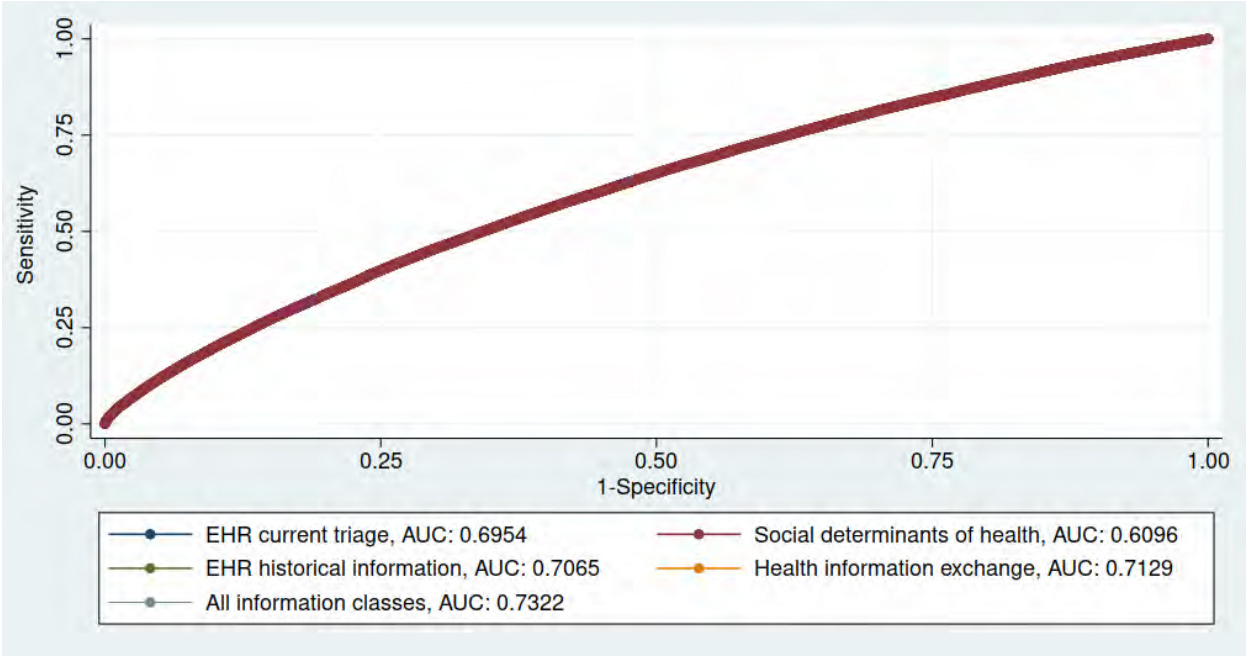
Vest JR, Menachemi N, Grannis SJ, et al. Impact of Risk Stratification on Referrals and Uptake of Wraparound Services That Address Social Determinants: A Stepped Wedged Trial. American journal of preventive medicine 2019;56:e125–33. doi:10.1016/j.amepre.2018.11.009

Patients' health depends on factors and experiences outside the context of a single health care encounter.

Predicted 30-day revisit rates among 279,611 adult ED encounters at an Indianapolis safety-net hospital using two class boosted decision trees.

Current triage information	Prior visit history	Encounters with other providers	Environmental & Social Context
44 measures Data generated at or associated with the ED encounter only	44 measures Historical data from the hospital	30 measures Data from Indiana Health Information Exchange (statewide)	41 measures SES status Behaviors Built environment Health services Social circumstances

Including more contextual information improved model performance



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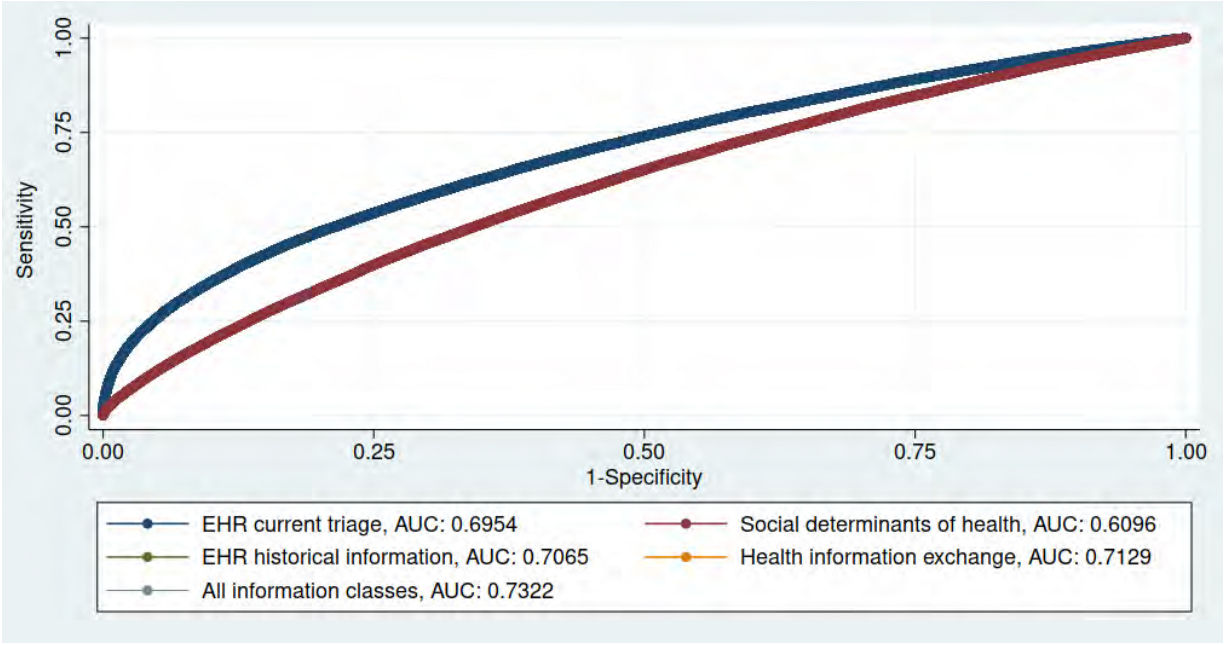

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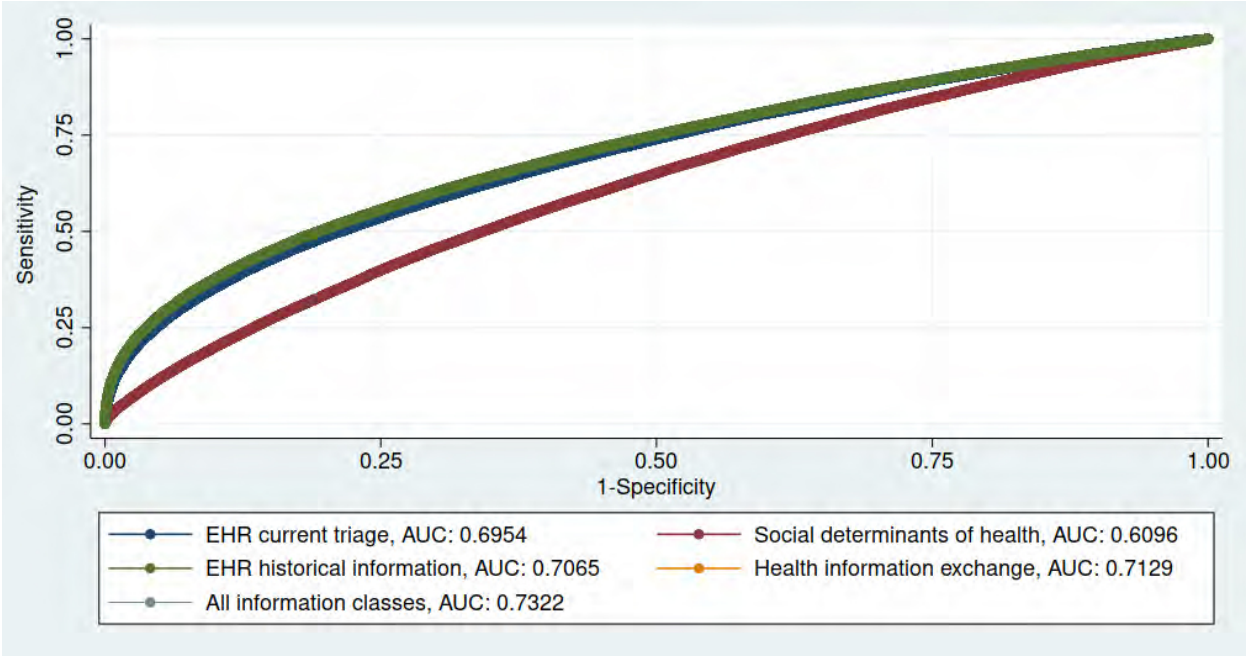

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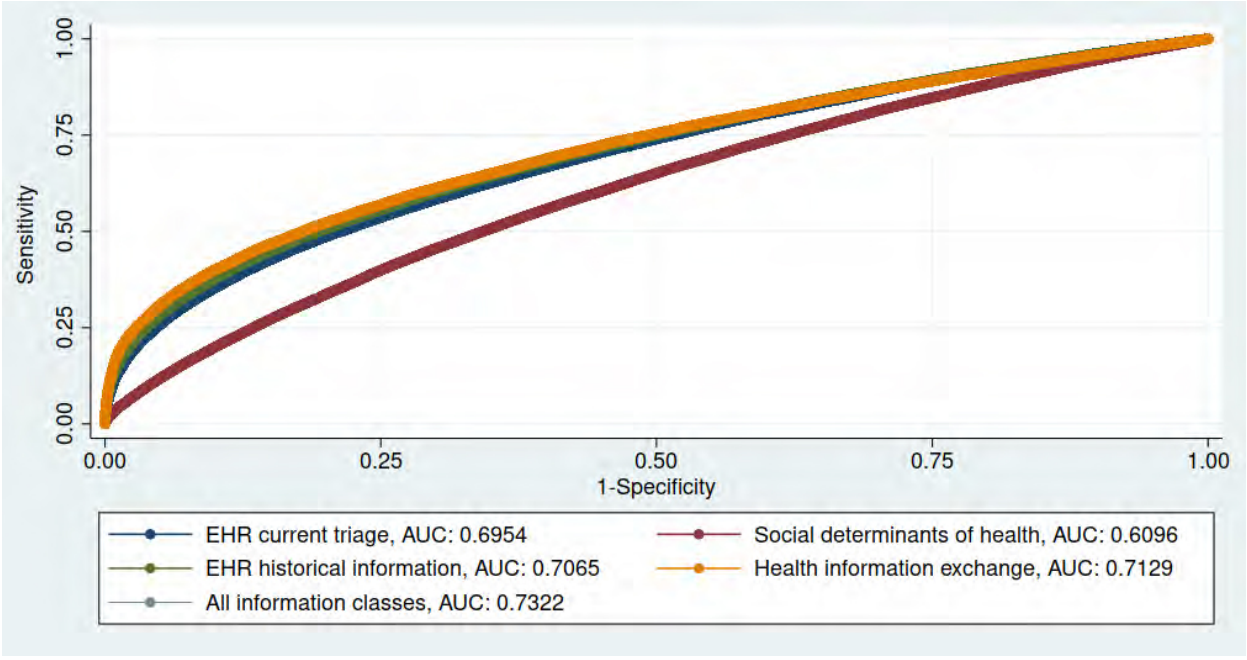

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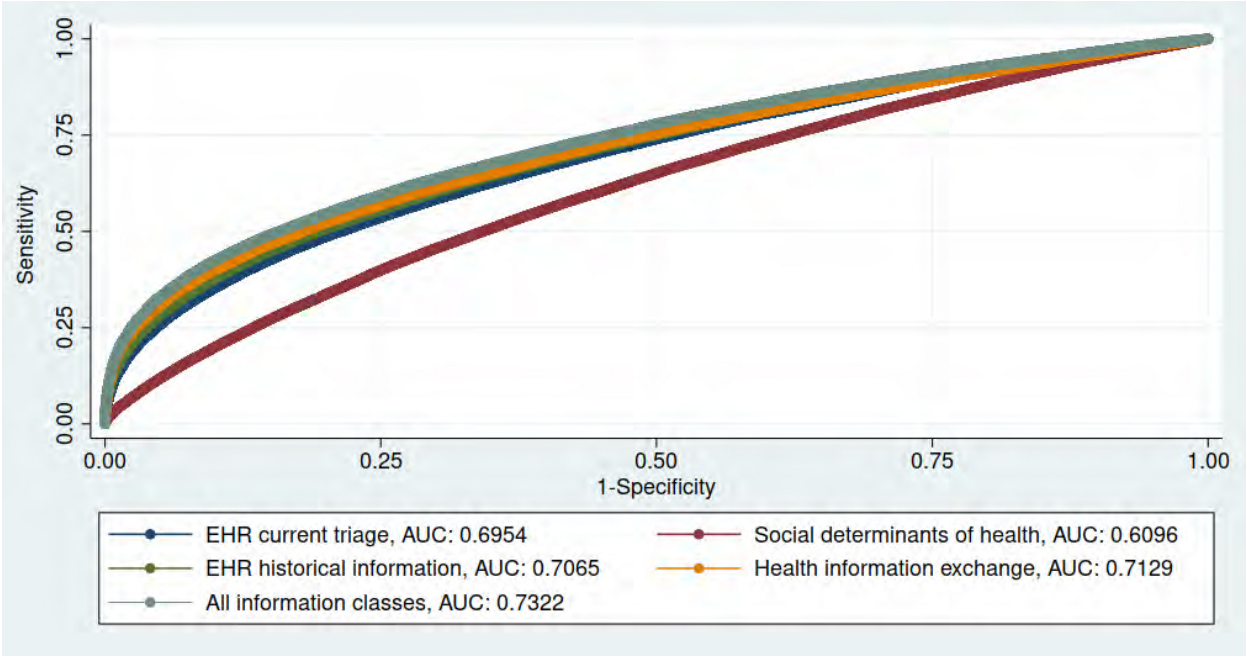
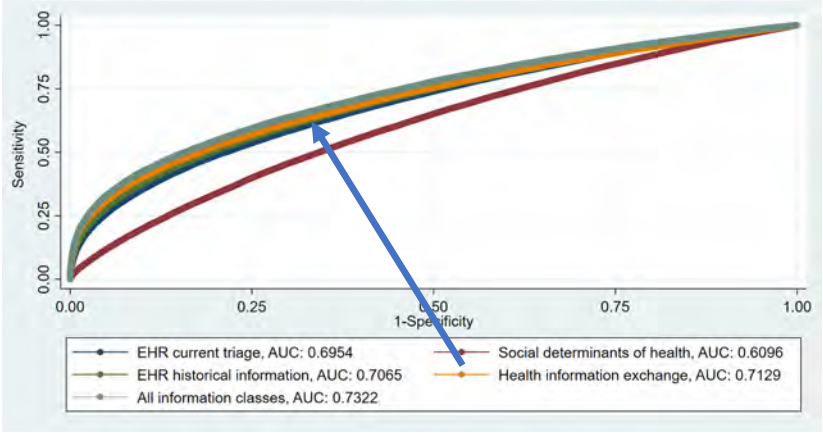


Models using HIE information performed better than models with single information types.

Model	AUC [Confidence Interval (C.I.) 95%]
(1) Social determinants of health	0.61 [60.72%–61.2%]
(2) EHR current visit	0.696 [69.3%–69.8%]
(3) EHR historical information	0.707 [70.4%–70.9%]
(4) Health information exchange	0.713 [70.9%–71.7%]
(5) All information classes	0.732 [72.9%–73.6%]

Note: all diffrences at the AUC levels are significant ($p < 0.001$).



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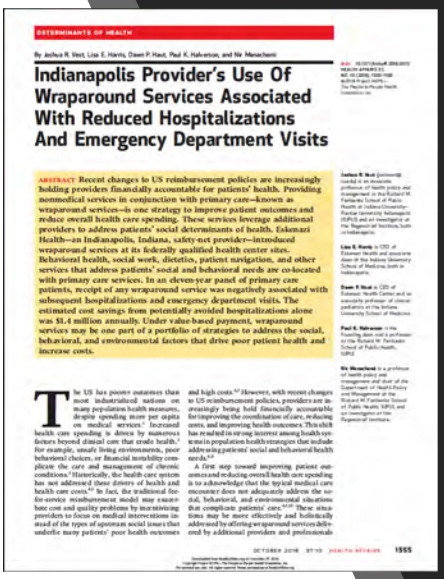
Application of information to patients:

Risk stratification for social services



DETERMINANTS OF HEALTH

By Joshua R. Vest, Lisa E. Harris, Dawn P. Haut, Paul K. Halverson, and Nir Menachemi

Indianapolis Provider's Use Of Wraparound Services Associated With Reduced Hospitalizations And Emergency Department Visits

ABSTRACT Recent changes to US reimbursement policies are increasingly holding providers financially accountable for patients' health. Providing nonmedical services in conjunction with primary care—known as wraparound services—is one strategy to improve patient outcomes and reduce overall health care spending. These services leverage additional providers to address patients' social determinants of health. Eskenazi Health—an Indianapolis, Indiana, safety-net provider—introduced wraparound services at its federally qualified health center sites. Behavioral health, social work, dietetics, patient navigation, and other services that address patients' social and behavioral needs are co-located with primary care services. In an eleven-year panel of primary care patients, receipt of any wraparound service was negatively associated with subsequent hospitalizations and emergency department visits. The estimated cost savings from potentially avoided hospitalizations alone was $1.4 million annually. Under value-based payment, wraparound services may be one part of a portfolio of strategies to address the social, behavioral, and environmental factors that drive poor patient health and increase costs.

The US has poorer outcomes than most industrialized nations on many population health measures, despite spending more per capita on medical services.[1] Increased health care spending is driven by numerous factors beyond clinical care that erode health.[2] For example, unsafe living environments, poor behavioral choices, or financial instability complicate the care and management of chronic conditions.[3] Historically, the health-care system has not addressed these drivers of health and health care costs.[4,5] In fact, the traditional fee-for-service reimbursement model may exacerbate cost and quality problems by incentivizing providers to focus on medical interventions instead of the types of upstream social issues that underlie many patients' poor health outcomes and high costs.[6,7] However, with recent changes to US reimbursement policies, providers are increasingly being held financially accountable for improving the coordination of care, reducing costs, and improving health outcomes. This shift has resulted in strong interest among health systems in population health strategies that include addressing patients' social and behavioral health needs.[8,9]

A first step toward improving patient outcomes and reducing overall health care spending is to acknowledge that the typical medical care encounter does not adequately address the social, behavioral, and environmental situations that complicate patients' care.[10,11] These situations may be more effectively and holistically addressed by offering wraparound services delivered by additional providers and professionals

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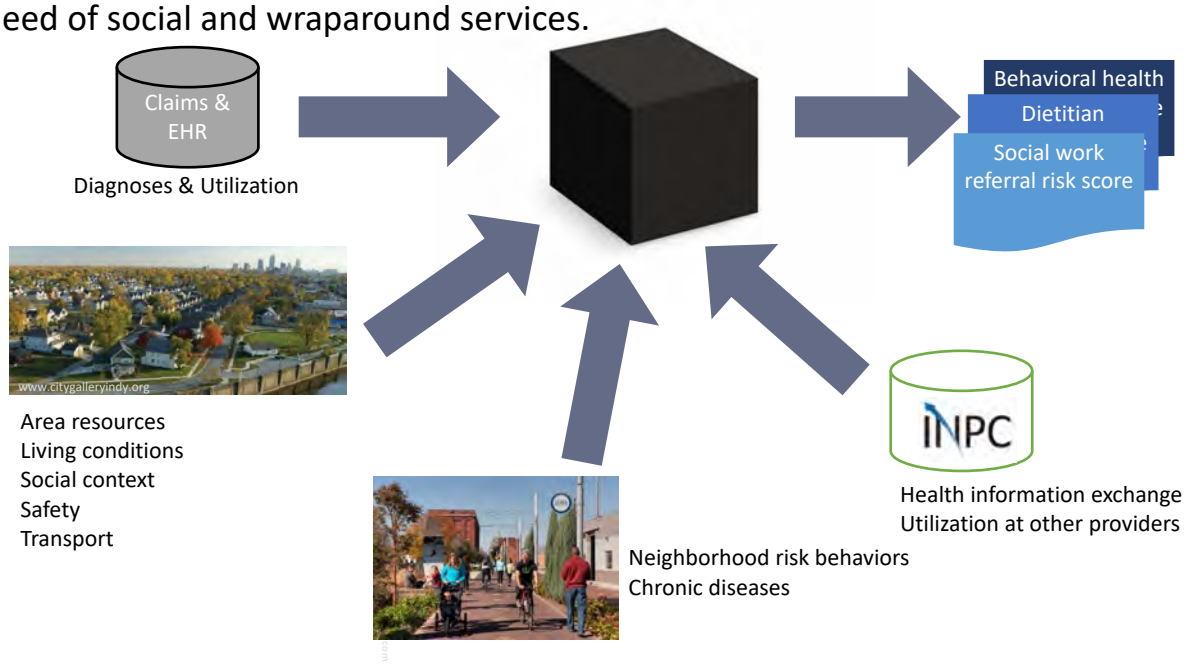
Delivering social and wraparound services:

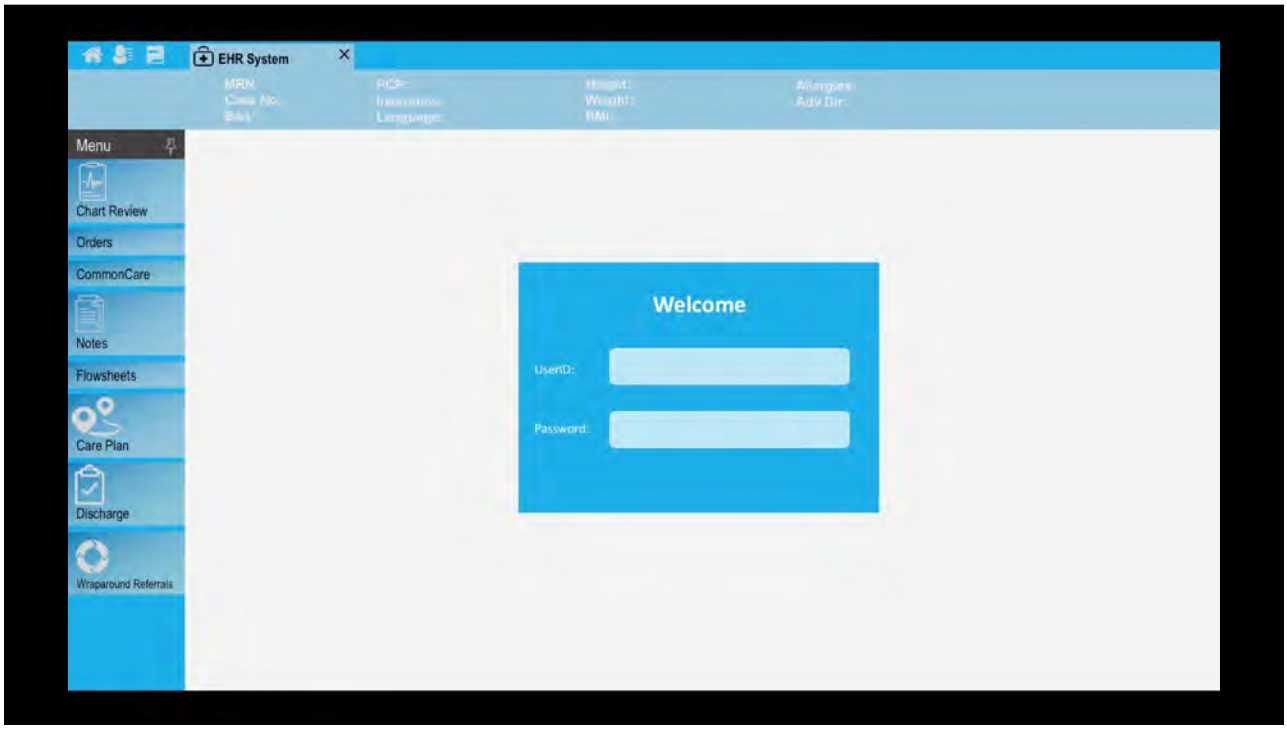
- reduces patient utilization
- avoids costs
- meets patients' needs

However, identifying patients most in need of social services is difficult:

- inherent challenges of screening
- limited service capacity

We implemented machine-learning based risk stratification to identify those in need of social and wraparound services.





Sample & Analyses

- 9 FQHC sites
- 238,087 encounters
- Adult primary care patients
- 12 month stepped-wedge design
- GEE logistics regression models
- Outcomes:
  - Referrals
  - Kept wraparound appointments

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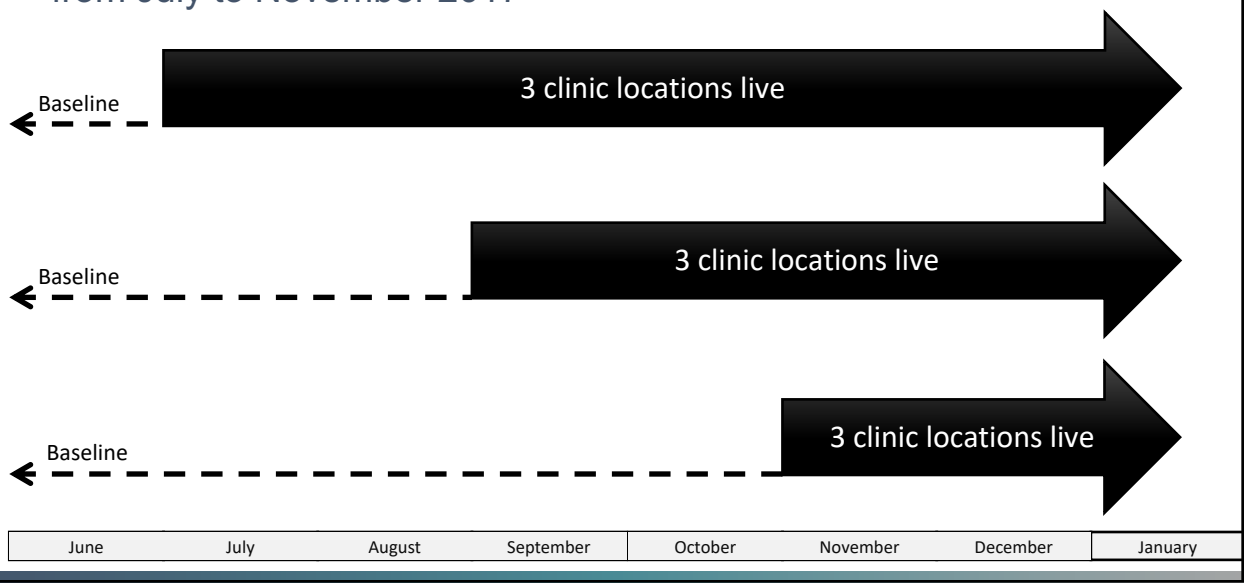
Risk stratification was rolled out 3 clinics at a time from July to November 2017



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- **Strong prediction performance**
  across all performance metrics

- **65% increase**
  in social work referrals when risk scoring went live at primary care clinics

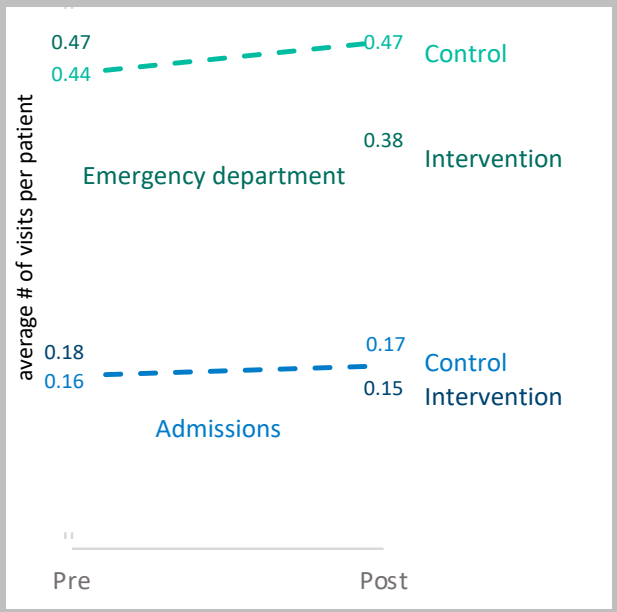
- **48% increase**
  in odds that referred patients will keep their appointments

Potential cost savings: sub-analysis

- Limited data to 6 months pre & post go live
  - 49,835 encounters
- Fixed-effect Poisson models
- Outcomes:
  - hospital admissions
  - emergency department visits
- Applied average HCUP costs to predicted differences in counts of encounters

$1.7 million in estimated cost savings

- 1 year pre-post analysis of ED visits and inpatients admissions after go-live
- $171 cost reduction per patient



under review

21

Interoperable information in prediction modeling: contribution & application to patients

- Interoperable health information exchange data contributed to prediction models
- Prediction modeling using interoperable data can be successfully applied to health care processes

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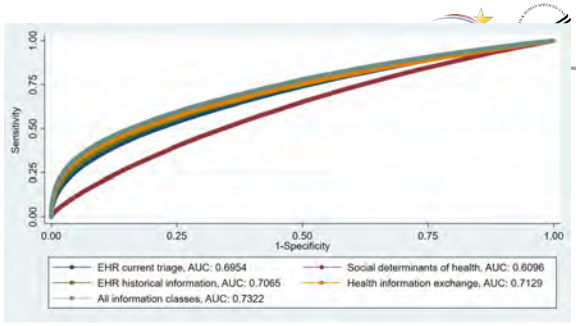

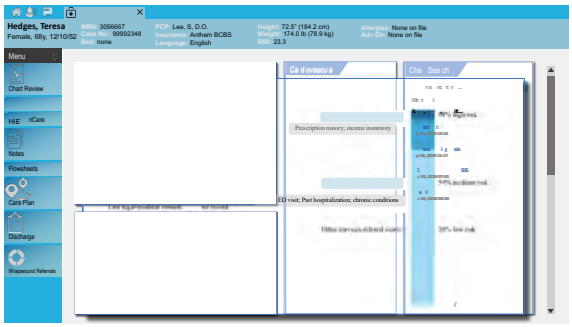

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