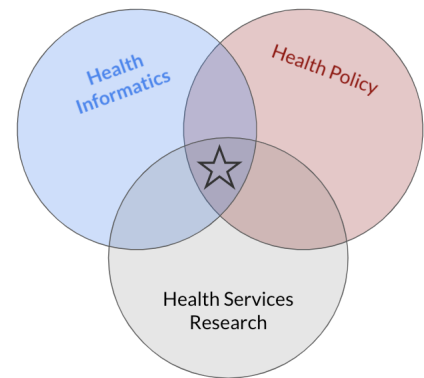


Nate C. Apathy, PhD | Research Statement

“This would be so much better if...”

We participate every day in systems that we wish were better. We constantly strive to improve the systems we control and those most integral to our lives and wellbeing. Few would contest the claim that the health care system is both integral to our wellbeing and in desperate need of improvement in quality, efficiency, and patient experience. The desire to improve the health care system has motivated recent shifts in payment reform and efforts to make care more efficient, effective, and patient-centered. These improvement efforts are often underpinned by innovation in health information technology (IT), and can succeed or fail based on how these technologies are designed, implemented, and used. As a result, *those of us designing, implementing, and evaluating these tools must focus our efforts on finding the most effective ways in which health IT can support systemic improvement of delivery and health.*

My research explores **how the use of IT can improve health care**. I situate my research at the nexus of health informatics, health services research, and health policy. Given my 10 years of experience in health informatics in both industry and academic roles, I anchor my portfolio in health informatics and draw heavily from both health policy and health services research for quasi-experimental methods; policies as interventions to be evaluated; clinical applications and use cases; and outcomes of cost, quality, and access.



The growth of health IT adoption over the past two decades has established the infrastructure and tools to increase information flows between providers, improve clinical decision-making, and ultimately advance the nation’s health. However, to achieve these goals, it is crucial to understand the nature of health IT use and how policies influence that use, thereby catalyzing or inhibiting system-wide progress. My research aims to illuminate how health IT use translates to better provider decisions and improved patient and population health. My work informs system implementation and organizational, state, and federal policies.

My **primary research interest** is in the area of **health IT use** and falls into two domains, noted below. I study health IT use and factors influencing that use. My work focuses on constructing and validating measures that capture usage of health IT tools (e.g. electronic health records (EHRs) and health information exchange systems) using system-generated log data. Furthermore, I study how policies influence the use of health IT. I examine institutional policies, federal guidelines, payment policies, and nationwide quality improvement programs that influence providers’ and hospitals’ use of health IT. This work informs health IT usability research, policies to reduce provider administrative burden and burnout, and regulation of health IT.

Measures of health IT use. To evaluate health IT, researchers must capture granular, valid measures of system use. In my dissertation work, I used health information exchange log files to construct novel measures of team-based use of health information exchange. During my postdoctoral fellowship, I have built a relationship with a major EHR vendor, Epic Systems, that has facilitated access to the largest provider-level longitudinal EHR usage data compiled for research use. This database supports numerous studies, and contains >350,000 unique ambulatory providers totaling >10 million weekly observations of >100 measures (e.g. time in the EHR, time spent writing notes, and note composition measures). My studies leveraging this database analyze the relationship between note composition styles and provider efficiency, identify provider note composition phenotypes using machine learning and their relationship to note length and time, and examine how providers go about changing notes over time. My related work surveying the landscape of vendor-provided EHR use measures has been published in the *Journal of the American Medical Informatics Association (JAMIA)*, and the aforementioned studies are targeted to clinical outlets, given the high relevance this work has to clinician burnout.

Additionally, in work funded via an R21/R33 grant from the National Institute on Drug Abuse, I have used EHR log data to construct both use and outcome measures in an evaluation study of clinical decision support tools for opioid prescribing. This work has important implications for both informatics researchers and policymakers seeking to implement guidelines into health IT systems and evaluate the effects of clinical decision support interventions. Published work from this study has appeared in the *Proceedings of the American Medical Informatics Annual Symposium* and future work is targeted to be published in the *Journal of the American Board of Family Medicine*, *JAMIA*, and clinical outlets.

Impact of policy and reform efforts on health IT use. A mix of organizational, state, and federal regulations influence health IT adoption and use, prompting research on the impacts of these policies to inform future regulatory efforts. I study adoption and use of health IT at the organizational and individual provider levels. In two studies of health information exchange by hospitals, I evaluate first the relationship between state consent laws for health information exchange and the volume of exchange use, and second the effect of accountable care organization (ACO) membership on the breadth of information exchange networks. This study leverages a novel difference-in-differences estimator to measure the causal effect of ACO membership on information networks, and both are published in *The American Journal of Managed Care*. The braided relationship between health IT and delivery system reform has informed my work exploring physician participation in the federal Merit-Based Incentive Payment System (MIPS), published in *Health Affairs*. Finally, a provider-level study of the impact of the 2021 Evaluation & Management (E/M) billing guidelines on E/M billing and documentation burden using the longitudinal EHR usage data noted above is currently under review at *Annals of Internal Medicine*.

My **secondary research interest** is in ***leveraging clinical decision support thresholds for quasi-experimental studies***. The underlying design of EHR-based decision support alerts constitutes the ideal empirical setting for a host of *regression discontinuity* studies. This quasi-experimental approach uses non-gameable cutoff values (like a test result) to approximate randomization.¹ For example, Penn Medicine has implemented an alert that suggests the provider conduct a brief suicide screening for patients scoring a 10 or higher on a PHQ-9 depression screen. A study of this alert would compare outcomes for patients scoring a 9 (*just below* the cutoff for alerting) with those scoring a 10 (thus more likely to receive suicide risk screening), and allow for estimation of the causal effect of the suicide screening. My early career experience implementing EHRs in large health systems familiarized me with the design, build, auditing, and data extraction of these alerts and their underlying thresholds. Combining this knowledge with my training in informatics and use of EHR log data facilitates a rich pipeline of studies leveraging this data and study design, enabling evaluations of the effects of a wide range of clinical recommendations.

I also maintain a diverse set of extended research interests that include machine learning and predictive modeling of patient risk using EHR data, effective visualization of those risks to inform clinical decision-making, the impact of health IT regulations on informatics innovation, and the use of novel data sets for health services and health policy research.

My **future research agenda** extends my primary and secondary areas of research to understand how the use of health IT impacts patient and population health outcomes. After establishing validated measures of health IT use patterns, a natural extension is to explore the extent to which specific use patterns leads to improved health outcomes for patients and reduced administrative burden and burnout for providers. The research questions guiding my future work include:

What do providers perceive as salient aspects of EHR-derived burden? How does this vary across clinical settings, specialties, and workflows?

How can EHR audit log data assist in constructing reliable measures of that burden?

What health IT-based interventions reduce these measures of provider-perceived EHR burden?

Do reductions in these measures of burden result in improved physician well-being and care quality?

My research agenda as a junior faculty member will focus on constructing meaningful measures of EHR use tied to burden, designing workflow and IT interventions to aid in reducing that burden, and evaluating if reductions in burden are tied to improved patient outcomes and provider well-being. I anticipate that this work will be attractive to **extramural funding agencies** with both policy and clinical areas of focus, as funders have increasingly recognized the importance of evaluating the role of health IT in clinical care. In particular, the Agency for Healthcare Research and Quality (AHRQ) includes a

¹ Guduguntla V, McWilliams JM. Exploiting Clinical Decision-Making Thresholds to Recover Causal Effects From Observational Data: Randomization Without Trials. *JAMA Intern Med.* 2021 June 1;181(6):774–5. https://bit.ly/jama_rdd

robust health IT portfolio, with a focus on improving the quality of care. Additionally, the National Library of Medicine (NLM) has long supported innovative research in biomedical informatics, including measure development and the use of EHR log data for research. My work has substantial potential for extramural funding, due to the priority these agencies place on research to advance the use of health IT to improve patient outcomes.

Furthermore, my research agenda has direct policy **relevance to ongoing legislative and regulatory action**. Following the 21st Century Cures Act, regulators at the Office of the National Coordinator for Health IT (ONC) within the Department of Health and Human Services have been tasked with increasingly complex regulatory responsibilities over interoperability health IT usage more broadly. As a result, these regulators require valid quality measures for health IT use, as exemplified by the ongoing call for measures for the EHR Developer Reporting Program. Additionally, the Centers for Medicare and Medicaid Services have spent almost \$40 billion to fund the incentive programs encouraging adoption of health IT, and my work directly contributes to understanding the benefits of that investment. This knowledge is critical to informing future efforts to encourage the most effective use of health IT.

In conclusion, my research is predicated on the fundamental assumption that ***effective use of health IT can improve health outcomes***. With my research career, I hope to inform precisely how those improvements can and should take place. Use of health IT should not be incentivized simply for its own sake. Rather, researchers and policymakers have an obligation to construct policies that encourage and enable the *most highly beneficial* use patterns and design of health IT in terms of *patient health outcomes*. Health system leaders and health IT developers share this obligation. While health IT certainly has benefits that do not involve direct patient health outcomes, it is my belief that we - researchers, policymakers, health system leaders, and developers - are obligated to do everything in our power to ensure that the investments made in these technologies save lives and improve health.

Relevant Publications

Apathy, NC; Holmgren, AJ; Werner, RM. Growth in health information exchange with ACO market penetration. *American Journal of Managed Care*. In Press (Accepted for Jan 2022 Health IT Issue)

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Apathy, NC; Everson, J. High rates of partial participation in the first year of the Merit-Based Incentive Program. *Health Affairs*. 2020;39(9).

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Apathy, NC; Holmgren, AJ. Opt-in consent policies: potential barriers to hospital health information exchange. *American Journal of Managed Care*. 2020;26(1).

Holmgren, AJ; **Apathy, NC**. Hospital adoption of API-enabled patient data access. *Healthcare: The Journal of Delivery Science and Innovation*. 2019;8.

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