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Regular Session 1: Impact of Analytics

The Effect of Predictive Analytics-Driven Interventions on Healthcare Utilization
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Abstract
This paper studies a commercial insurer-driven intervention to improve resource allocation. The insurer developed a claims-based algorithm to derive a member-level healthcare utilization risk score. Members with the highest scores were contacted by a care management team tasked with closing gaps in care. The number of patients outreached was dictated by resource availability and not by severity, creating a set of arbitrary cutoff points, separating treated and untreated members with very similar predicted risk scores. Using a regression discontinuity approach we find evidence that predictive analytics-driven interventions directed at high-risk individuals reduced emergency room and specialist visits, yet not hospitalizations.

The Value of Personalized Medicine: Treatment Effect Heterogeneity One Year Beyond Left Ventricular Assist Device Implantation
Jeff McCullough¹, Sriram Somanchi²
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Abstract
The rapid rise in digital health information and the growing sophistication of machine learning methods creates an opportunity to personalize care to individual patients. We employ generalized random forests, a novel combination of machine learning and econometrics, to estimate patient-specific treatment effects for the use of ventricular assist devices (VADs) in the treatment of advanced heart failure (AHF). We then develop a model that decomposes quality into treatment skill and clinical judgment. We use this decomposition to understand the value of treatment effect heterogeneity in medical decision making. We find VADs improve one-year survival by about 20 percentage points for relatively low-risk AHF patients. This corresponds to the clinical trials literature. The average treatment on the treated is, however, 8 percentage points and 17% of treated patients have negative expected treatment effects. Judgment errors have a large impact on patient mortality overall, illustrating the potential gains from decision support.
Workload, Predictive Accuracy, and the Value of Algorithm-Enabled Process Innovation: The Case of Sepsis
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Abstract
Predictive algorithms have an increasingly important role in supporting the day-to-day operations of businesses. Yet, fully realizing the value of algorithms lies critically in the opportunity to re-engineer the related processes and redefine roles in ways that make organizations more effective; we refer to this phenomenon as algorithm-enabled process innovation (AEPI). In this paper, we focus on how and when AEPI creates value, particularly in light of dynamic operational environments (i.e., workload) and behavioral responses to algorithmic predictions (i.e., algorithmic accuracy). We examine the broad research problem in the context of an AEPI effort focused on early identification and treatment of a deadly clinical condition known as sepsis. In particular, we collaborate with a large U.S. based hospital system to collect a rich set of clinical and nonclinical data and use econometric approaches to examine the relationship between sepsis AEPI and patient mortality. We find that sepsis AEPI reduces the risk of death from sepsis by 2.9% (a 32.6% relative reduction in mortality risk) in the central hospital. For the 5,116 sepsis patients who stayed in the hospital during the three-year period of our study, this reduction translates to approximately 148 lives saved. We also find that a higher than usual workload at a hospital unit (e.g., an oncology unit, which provides care for cancer patients) generally reduces the effectiveness of the alert. In addition, an increase in the average number of accurate (resp., inaccurate) alert experience during the stay of a sepsis patient increases (resp., decreases) the value of sepsis AEPI. The results suggest that organizations interested in AEPI efforts should be cautious that workload and experience with algorithmic accuracy can diminish or increase the value of AEPI. Our manuscript offers insights around how and when coupling data-rich environments with process innovation can create organizational and societal value.

Regular Session 2: Online Reviews

Many Platforms, One Voice: Exploring How eWOM Reflects Quality Through Online Ratings
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Abstract
Digitalization is making a profound influence on the way consumers and businesses interact and transact. Driven by the extensive amount of widely available information, consumers now have the opportunity not only to compare products and services, but also to seek the opinion of others, which ultimately shape consumers’ perceptions of quality. Our study, therefore, aims to empirically test the link between population-perceived quality and online ratings across the three most trusted eWOM sources – Facebook, Google, and Yelp. To do so, we use a unique data set collected from multiple publicly available sources. As a result, we are able to examine how online ratings reflect patients’ opinions about hospital quality across three types of online platforms. Our results show that while high-quality hospitals can benefit from rating volume on Facebook and Yelp, they should be considerate
about the negative influence of high volume of Google ratings. Also, although Facebook and Google ratings are more valuable in separating low-end hospitals from the average and high-end providers, Yelp ratings are more informative for hospitals in the higher quality segment. By providing new empirical evidence of the relationship between online ratings and the underlying consumer-perceived quality, the study contributes to prior research on electronic word-of-mouth in the domain of professional services.

What Determines The Patient Experience? Comparing Yelp Reviews of Urgent Care Centers and Emergency Rooms
Mahoney Kevin¹, Eisenstein Eric², Mudambi Susan²
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Abstract
For acute but non-life threatening health conditions, patients have multiple alternatives to traditional hospital emergency rooms. Access to online reviews on Yelp and other digital platforms facilitates patient self-triage. Reviews provide information on consumer experiences, cost-of-care, and clinical outcomes of urgent care centers (UCC) and emergency rooms (ER), and offer rich and detailed narratives that are often lacking in standardized patient satisfaction surveys. To develop insights about patient experiences and mindset, a topic modeling approach was used to identify and analyze themes from a sample of 16,447 Yelp reviews of ERs from 1,566 hospitals, and 84,502 Yelp reviews of 5,601 UCCs. Overall, Yelp reviewers rate UCC experiences significantly higher than ER experiences, with an emphasis on value that incorporates convenience, time, amenities and out of pocket costs. Differences in reviews between ER and UCC providers generally align with health care consumer’s biases and expectations regarding aspects such as wait time, clinical care quality and confidence in clinical care.

Digitizing Disclosure: The Case of Restaurant Hygiene Scores
Weijia Daisy Dai¹, Michael Luca²
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Abstract
Collaborating with Yelp and the City of San Francisco, we revisit a canonical example of quality disclosure by evaluating - and helping to redesign - the posting of restaurant hygiene scores on Yelp.com. Implementing a difference-in-differences strategy, we find that posting restaurant hygiene scores on Yelp leads to a 12% decrease in purchase intentions for restaurants with low scores (as predefined by the City) relative to those with higher scores. We then create a “hygiene alert” – a message that appears only for restaurants identified by the City as having “poor” operating conditions with “high-risk” hygiene violations (using the same low score threshold as above) – and find a further 9% decrease in purchase intentions. Moreover, the presence of an alert reduces the restaurant’s likelihood of getting a second alert. We conclude that disclosure policy should focus not only on what information to disclose but also on how and where to design disclosure.
Research Panel 3: Measurement

Harmful Controls: Avoiding Estimation Bias in Empirical Health IT Research
M Zia Hydari¹, Narayan Ramasubbu¹, Edward Kennedy²

Abstract
As a social science, the information systems (IS) community has a continued focus on posing and answering causal questions. When causal questions are answered using observational studies, it is possible to consistently estimate the causal effect of the treatment if the treatment assignment is individualistic, probabilistic, and unconfounded. In empirical work, the assumptions of individualistic assignment and probabilistic assignment generally do not generate much controversy. However, the assumption of unconfounded assignment generates much controversy and debate. The underlying reason for this controversy is that the unconfounded assignment assumption is untestable. Empirical researchers spend significant effort in thinking about and convincing others about the constitution of the set of controls that will make the treatment assignment unconfounded.

But are all controls good in the sense that adjusting for these variables reduces bias? Much work has been done in the last few decades in categorizing certain classes of observed variables as “harmful controls,” since adjustment for these variables introduces or amplifies bias instead of eliminating or reducing it. In this article, we discuss three broad classes of variables that are harmful controls and illustrate their harm using simulated data for a health IT example. Specifically, we first motivate the problem of estimating the effect of electronic medical records (EMRs) on patients’ length of stay (LOS) in hospitals. Using simulated data, we then show that adjusting for harmful controls would actually bias the estimated effects. The takeaways from our examples are broadly applicable in other IS settings.

Is 60 the New 40? An Assessment of the Measures Cognitive Age vs. Chronological Age
Maximilian Haug¹, Heiko Gewald¹
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Abstract
Elderly people increasingly engage in the use of information technology. However, one can observe differences within this group in technology use and behavior. Therefore, treating all seniors as a homogenous group is not sufficient. Classifying them based on their chronological age reveals no new insights why these differences exist. This calls for an alternative approach to measure age: the cognitive age. We draw on the concept of the individual’s self-perception of age and how it influences their daily use of information technology. A quantitative study was conducted in the US with 120 elderly respondents. The sample was split in subgroups of seniors with lower cognitive than chronological age and those who do not feel younger as their chronological age. Results show that cognitive age reveals differences within the behavior within the sample of seniors, which could not be identified with the chronological age. As a conclusion that if seniors shall use IT in different ways, investigations where cognitive age originates are needed.
Research Panel 4: Online Communities

Is My Treatment Peer Approved: Impact of Online Health Community on Treatment Compliance for Chronic Patients
Ermira Zifla¹, Sunil Wattal¹
¹. Temple University

Abstract
Treatment compliance for patients with chronic health problems is important for the management of their illness due to the long-term nature of their conditions. In this study, we examine how online community ratings for different types of treatments are associated with treatment evaluations and compliance for members of an online health community. We use data from a prominent online health community to understand how treatment ratings from other community members are associated with treatment evaluations and treatment compliance for patients with chronic health conditions. We find that other community members’ treatment evaluation valence is positively associated with patient treatment evaluation and treatment compliance. We also find moderating effects of the community size and ratings variance. We discuss the theoretical implications of these results for the online health communities literature and the practical implications for patients and healthcare providers.

Modeling Users’ Continuous Participation: Evidence from Online Weight-Loss Communities
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Abstract
Users’ participation in virtual communities is a complex process. On the one hand, there exist more than one dynamic sources, such as sequential dynamics and temporal dynamics. On the other hand, users may develop different participation focuses through the participation process. These aspects are underexplored in the extant literature. This research gap motivates us to develop an effective approach to calibrate users’ online behaviors. Specifically, we develop a multi-dimensional continuous-time hidden Markov model (HMM). This model is able to control both sequential and temporal dynamics of users’ online behaviors. In addition, it allows us to explore users’ multiple correlated behavioral dimensions at the same time. To gauge the effectiveness of our approach, we root our research in the context of weight management. The data is collected from a leading online weight-loss community in the US. Our main findings include 1). Timing information can bring valuable insights on users’ participation pattern in virtual communities, and it improves our model forecast performance. 2). Users may shift their participation focuses during the participation process. 3). Different social-support exchange strategies have statistically different effects on users’ weight management, and these effects are mediated by users’ community commitment. Together, these findings suggest that overlooking information imbedded in observed behaviors of users may result in inaccurate or even falsified conclusions on participation pattern. In addition, personalized health care strategy need to be implemented when individual’s condition is complicated and varying with time, such as chronic diseases like obesity and diabetes. Further, we provide several application examples to illustrate the practical values of our study, in which we combine our empirical model with machine learning techniques. These examples can be readily applied to a variety of business settings such as personalized recommendation,
precision marketing and user characterization. Our working paper can be found at http://ssrn.com/abstract=3285599.

Regular Session 5: Impact of HIT I

The Impact of Telehealth on Healthcare Resource Utilization
Indranil Bardhan¹, Eric Zheng²
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Abstract
We study the impact of telehealth on healthcare resource utilization, using patient claims level data, in the state of Maryland. Using a quasi-natural experimental design, where we observe whether telehealth service was provisioned during a patient-provider encounter, we investigate the impact of telehealth encounter on future utilization of healthcare resources using a matched control-treatment design. We find that telehealth is associated with an overall reduction in outpatient and ER visit rates, as well as significant decrease in the average distance traveled by patients to clinics. We also find that the impact of telehealth is significantly improved when a visit involves a chronic condition. This research addresses the growing debate over telehealth’s effectiveness and provides supporting empirical evidence on whether telehealth consistently leads to better care at lower cost and lower utilization rates. Our results also suggest that intervention using telehealth technologies, especially for chronic disease patients, can address some of the disparities in the healthcare services that exist today.

The Complementarity of Health Information and Health IT for Reducing Opioid-Related Mortality and Morbidity
Lucy Xiaolu Wang¹
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Abstract
In response to the opioid crisis, each U.S. state has implemented a prescription drug monitoring program (PMP) to provide health providers with patients’ controlled substance prescription information. I study whether health information technology (IT) complements the availability of patient information in PMPs to reduce opioid-related mortality and morbidity. I construct a novel data set that records state health IT policies that improve PMP data interoperability in cross-system integration and interstate data sharing. Utilizing difference-indifferences methods, I find that health IT policies reduce opioid-related mortality and morbidity. The inpatient morbidity reductions are most substantial in states that created PMPs but never mandated their use. The impacts are also strongest for the most vulnerable groups – middle-age and low- to middle-income patients and are robust when stratified by age, income, location, and insurer type. The total benefits from improved interoperability far exceed the associated costs. (Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3176809)
Regular Session 6: HIT Outside the Clinic

Does Telemedicine Reduce Emergency Department Congestion? Evidence from New York State
Shujing Sun¹, Susan Feng Lu², Huaxia Rui¹
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Abstract
Overcrowding in emergency departments (EDs) is a common yet nagging problem. It is not only costly for hospitals but also compromises care quality and patient experience. Hence, finding effective ways to improve ED efficiency is of great importance. Using a large dataset from New York State, we investigate the role of telemedicine in enhancing ED efficiency. We show that on average, ED telemedicine adoption significantly reduces patients’ length of stay by 15.3% and waiting time by 9.6%. Such an effect is not a byproduct of other widely adopted health IT applications. Interestingly, the effect of telemedicine is larger for less severe patients or when the ED is at a higher occupancy level. Also, we show that the efficiency improvement does not come at the expense of care quality or patient cost. Therefore, our research points to telemedicine as a potential cost-efficient solution to alleviate ED overcrowding.

“Where to, Doc?” Electronic Health Record Systems and Patient Mobility
Kartik Krishna Ganju¹, Hilal Atasoy², Paul A. Pavlou²
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Abstract
Electronic Health Record (EHR) systems enable the coordination of care across providers and locations by sharing information electronically. This is particularly important for patients with chronic conditions who require regular care from multiple specialists over a long period of time. EHR systems can allow patients with chronic conditions to coordinate their care from a network of ambulatory outpatient centers rather than a central inpatient location, and, as a result, patients can receive care at locations that are more convenient to them and offer better quality care. In this paper, we examine the adoption of EHR systems in inpatient and outpatient facilities, and its effects on mobility of patients with chronic conditions. The results showed multiple changes in the management of chronic care visits due to EHR systems. First, we found evidence that the adoption of EHR systems is associated with an increase in the number of ambulatory locations at which patients with chronic conditions receive their care. Second, these patients have a greater number of visits to those ambulatory centers. Third, patients interact with more healthcare providers at ambulatory centers, controlling for the increased number of visits. These effects on patient mobility are stronger in rural areas, and when the ambulatory centers are located close to inpatient centers. We also found that increased patient mobility is associated with lower healthcare costs. Finally, we discuss implications on patient mobility and the quality of care for patients with chronic conditions in ambulatory centers after the adoption of EHR systems.
Polypharmacy and Care Coordination Intensity among Working-age American Adults with Multiple Chronic Conditions
Maria Ukhanova¹, Ajit Appari²
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Abstract
Managing polypharmacy (use of multiple medications) for working-age adults with multiple chronic conditions (MCC) has become a significant challenge in the fragmented US healthcare system. This retrospective study sought to address two important research gaps: what are the commonly occurring MCC patterns, and how care coordination intensity is associated with polypharmacy among working-age adult Americans.

First, we conducted exploratory factor analysis (EFA) on 42 chronic conditions to identify gender-specific MCC patterns using 6-years (2008-2013) claims data of 452,834 commercially insured adults (18-64yrs) residing in Texas. Next, we evaluated the association between major polypharmacy (4-plus simultaneous medications during any 90 consecutive days in 2013) and care coordination intensity (continuity of care index representing visits dispersion across providers), and physician-specialty mix representing E&M by specialists versus generalists during 2012-2013) by estimating mixed-effects logistic models with ZCTA-level random effects for 112,759 adults, enrolled during 2012-2013, having at least one MCC pattern and 4-plus evaluation and management (E&M) outpatient claims. Analysis was adjusted for individual-level factors [birth-cohort, healthcare utilization] and ZCTA-level socioeconomic factors [household income, rurality, minority and foreign-born population concentration]. Endogeneity of care-coordination measures from 4-plus E&M claims requirement was accounted using propensity score.

EFA revealed four clinically meaningful gender-specific patterns with overlapping condition membership across gender: [men] metabolic-urologic, cardiovascular-metabolic, musculoskeletal, and hepatorenal-autoimmune; [women] metabolic, cardiovascular, musculoskeletal, and renal-autoimmune. Across patterns 36-50% of men and 41-53% of women were on major polypharmacy regimen of 4-plus medications, and polypharmacy risk increased by a factor of 1.15-1.23 in men and by 1.14-1.22 in women for 10 percentage-point increment in care continuity. Men and women with metabolic or cardiovascular related MCC patterns are at higher risk of major polypharmacy if they frequently consult specialists.

Our findings offer important insights on commonly occurring MCC patterns among working-age adults and association of polypharmacy risk with care coordination intensity.

A Perfect Marriage: When Medicare Advantage Payers Team Up With Brick-and-Mortar Retailers
Da Hae Jeong¹, Sang Pil Han¹, Sungho Park¹
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Abstract
Expanding Medicare Advantage (MA) program is an important goal for both payers and policymakers as it provides business opportunities for the payers and improves the health of the beneficiaries. In this paper, we focus on the relatively new form of the marketing strategy in the Medicare Advantage market, the payer-retailer partnership, to provide actionable insights to the payers and the policymakers. We empirically analyze the effect of the marketing alliance between MA payers and brick-and-mortar retailers on market share of the payers, using Humana-Walmart alliance in the Medicare Advantage market as an example. To mitigate concerns on the endogenous nature of the alliance decision and the non-disperse implementation of the partnership, we employ Walmart store entrance
and exit as a source of geographic and temporal variation, and leverage this variation in our estimation using difference-in-difference technique. Our finding shows that the payer-retailer marketing alliance boosts an insurance payer’s market share by 4.3%. We uncover the underlying mechanism at play by demonstrating that (1) the impact size of the partnership incrementally increases by the number of the brick-and-mortar stores available in a county and (2) the payer-retailer partnership has a stronger impact in the counties with the larger senior population. These results shed new lights on the importance of traditional offline touch-points for MA payers to interact with senior populations even in the increasingly digital environment, and provide insights for the regulatory bodies such as the Center for Medicare and Medicaid Services (CMS) about how to regulate new forms of inter-industry partnerships in the MA market.

Regular Session 7: Impact of HIT II

The Role of Decision Support Systems in Attenuating Racial Biases in Healthcare Delivery
Kartik Krishna Ganju¹, Hilal Atasoy¹
¹. Temple University

Abstract
Although significant research has examined how offline biases may exhibit themselves online, there has been limited research of the effect that Information Systems can have on attenuating healthcare biases. In this paper, we take the first steps to examine the role of clinical decision support systems in attenuating systematic biases that result in African-American patients receiving more amputations relative to white patients. Using a panel of inpatient data from four states across the US, we find that the adoption of the clinical decision support systems leads to a decrease in black patients receiving amputations – highlighting the role that Information Systems can play in promoting unbiased decision making.

Does Health IT Save Money and Lives? New Evidence from Vendor Heterogeneity and Product Innovation
Jianjing Lin¹, Mary Olson²
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Abstract
This paper examines the extent to which differences among Electronic Medical Record (EMR) vendors and differences in the timing of adoption affect the financial and clinical performance in hospitals. Under the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act, the government provided $27 billion in subsidies to eligible hospitals and physicians to adopt certified EMRs. However, prior research has found little systematic econometric evidence that the technology is producing the anticipated effects. These studies have largely neglected the innovative nature of the industry and assumed that the products made by different vendors were homogeneous. Such assumptions may not be warranted in the research-intensive, competitive health IT industry.

We hypothesize that product heterogeneity between vendors could impact product performance. The variations in the timing of adoption may also have implications for assessing this correlation. We merge various datasets and focus on the US hospital IT adoption from 2006 to 2010. The financial outcomes
include Medicare payments, the number of diagnoses, and other charges of various services. The patient outcomes include 30-day mortality rates, and length of stay. To address potential endogeneity issues, we apply instruments related to vendor characteristics and vendor market position.

We find that EMR adoption leads to a reduction in Medicare inpatients, but that the reduction varies substantially by vendor. We also find that not all vendors improve patient mortality. Among those lowering morality rate, the improvement ranges from 2-8%. The results associated with the timing of adoption suggest benefits from adoption accrue to both early and late adopters, but the pattern differs a lot by vendors.

Our results show that not all certified EMRs lead to the anticipated outcomes and suggest that the government’s requirements for "meaningful use" (to be eligible for subsidies) could be too general.

The Maternity Conundrum: Can Information Technology Improve Intergenerational Health Outcomes of Mothers and of Babies?

Min Chen¹, Monica Chiarini Tremblay², Rajiv Kohli²
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Abstract
Health at birth is an important predictor of long-term outcomes and the wide variation in Cesarean section rates raise questions about the quality of maternal care and have important cost implications. While information technology (IT) holds great promise for improving the quality and efficiency of care and for lowering the health care costs, it is far from certain whether and how Electronic Health Records (EHR) improve maternal and infant well-being and lower future risk in outcomes. This study addresses this issue by empirically examining the link between hospitals’ use of various functionalities of EHR and the actual clinical outcomes predicting future health risks for mother and baby. We link data on EHR adoption and hospital characteristics from the American Hospital Association (AHA) annual survey database and its IT supplement survey to the universe of birth records in Florida between 2008 and 2014, and we exploit within-hospital variation in EHR use over time. We find evidence that EHR improve overall health status in newborns and reduce the likelihood of maternal complications. The positive effect on infant health outcomes is primarily driven by the functionality that enabled care providers to view results of lab reports and the “consultation requests” functionality under Computerized Provider Order Entry (CPOE).

Regular Session 8: Prediction

Predicting Hospital Readmission Risk Using Trajectory-Based Deep Learning Approach

Xie Jiaheng¹, Zhang Bin¹, Zeng Daniel¹
1. University of Arizona

Abstract
Hospital readmission refers to the situation where a patient is re-hospitalized with the same primary diagnosis within a specific time interval after discharge. Hospital readmission causes $26 billion preventable expenses to the U.S. health systems annually and often indicates suboptimal patient care.
To alleviate those severe financial and health consequences, it is crucial to proactively predict patients’ readmission risk. Such prediction is challenging because the evolution of medical events (illness trajectory) is dynamic and complex. The state-of-the-art studies apply statistical models which assume homogeneity among all patients and use static predictors in a period, failing to consider patients’ heterogeneous illness trajectories. Our approach – TADEL (Trajectory-Based DEep Learning) – is motivated to tackle the problems with the existing approaches by capturing various illness trajectories and accounting for patient heterogeneity. We evaluated TADEL on a five-year national Medicare claims dataset including 3.6 million patients per year over all hospitals in the United States, reaching an F1 score of 0.867 and an AUC of 0.884. Our approach significantly outperforms all the state-of-the-art methods. Our findings suggest that health status factors and insurance coverage are important predictors for readmission. This study contributes to IS literature and analytical methodology by formulating the trajectory-based readmission prediction problem and developing a novel deep-learning-based readmission risk prediction framework. From a health IT perspective, this research delivers implementable methods to assess patients’ readmission risk and take early interventions to avoid potential negative consequences.

How AI Plays its Tricks: Interpreting the Superior Performance of Deep Learning-Based Approach in Prediction
Weiguang Wang¹, Margret Bjarnadottir¹, Guodong Gao¹
1. University of Maryland at College Park

Abstract
Artificial Intelligence, especially Deep Learning based approaches, has been criticized for its “black-box” approach in recent years. The lack of interpretability of their performance makes people uncomfortable when applying these models in critical situations. In this study, we aim to contribute to the interpretability of the Deep Learning model. We propose to use long short-term memory based recurrent neural network to incorporate the sequential information in healthcare costs for more accurate healthcare cost predictions. We first compare the performance of our deep learning approach with traditional machine learning methods including linear regression, lasso regression, ridge regression, and random forest. Among all the methods, deep learning shows the best performance. To interpret the roots for its superior performance, we first use subgroup analyses to understand the advantages of deep learning model on different types of patients. We then propose a novel interpretation method to examine how the deep learning model performs differently from other methods when facing fluctuations in the monthly costs. Our work makes important contributions to the interpretability of deep learning models.

Aiding the Prescriber: Personalized Risk Modeling for Chronic Opioid Use
Margret Bjarnadottir¹, David Anderson², Al Nelson³, Ritu Agarwal¹
1. University of Maryland at College Park, 2. Villanova School of Business, 3. Innolytics

Abstract
The opioid epidemic is a matter of considerable public policy concern. The literature and policy briefs have implicated the prescribing behavior of clinicians as one important factor fueling the sharp rise in opioid use and addiction. In this paper we develop and validate high performing prediction models that can serve as the foundation for real-time support for prescribers making treatment decisions related to opioid therapy. Consistent with guidelines issued by the Centers for Disease Control and Prevention related to personalized assessments, we obtain a person-specific score for the risk of becoming a
chronic opioid user which could be utilized by prescribers at the point of care delivery. Our modeling leverages a unique data set containing over 12 million observations of all active duty US Army soldiers over a four-year. The models constitute the foundation for automated decision support by estimating the risk of chronic opioid use during an outpatient encounter. Further we derive a parsimonious set of factors and corresponding scoring mechanism that provide good predictive accuracy in data-poor health services delivery settings. Our models help isolate the most important characteristics of patients who are at risk of opioid dependence, and offer suggestions for changes in prescribing behavior for high risk patients.

Regular Session 9: Information Sharing

Antecedents and Outcomes of Health Information Sharing: Role of EMR Configuration
Indranil Bardhan¹, Bao Chenzhang²
1. University of Texas at Austin, 2. University of Texas at Dallas

Abstract
Despite significant investments in health information technologies (IT), there is still a dearth of information sharing among healthcare providers and hospitals, which constrain adopters from reaping the full benefits of health IT. In this study, we examine the impact of electronic medical records (EMR) sourcing strategies of healthcare providers, as well as their participation in health information exchanges (HIE), on the extent of health information sharing. Drawing on seven years of data from a national sample of US hospitals, we find that hospitals which use single-vendor and best-of-breed EMR solutions exhibit greater levels of information sharing, compared to hospitals which use self-developed EMR systems. We also observe that HIE participation and EMR similarity among regional providers are positively associated with the level of information sharing, and their impact is stronger after the passage of the Affordable Care Act (ACA). Moreover, the marginal benefit of joining HIEs dramatically reduces when EMRs are able to communicate with each other. We further find that health information sharing improves hospital care outcomes in terms of emergency department efficiency, health expenditures, and length of stay. Our results highlight the role of EMR sourcing strategies in promoting information sharing across providers, and identification of the underlying mechanisms through which the benefits of health IT on hospital outcomes are realized.

Empowering Patients Can Increase Digital Divide: The Effects of Patient Portals on Kidney Allocation
Yeongin Kim¹, Mehmet Ayvaci², Srinivasan Raghunathan³, Bekir Tanriover³
1. Virginia Commonwealth University, 2. University of Texas at Dallas, 3. University of Texas Southwestern

Abstract
Despite the efforts to improve the kidney allocation process for transplants, notable inefficiencies and disparities across patient populations exist. The goal of this study is to examine (i) whether the adoption of a patient-oriented IT (patient portals) can mitigate inefficiencies in the allocation of care resources (kidneys) in general; (ii) whether the adoption of such IT magnify or alleviate the disparity issues around access to transplants. Using a national data of kidney transplant records, we show that the likelihood
that the patient receives deceased donor transplant at a given point in time increases in the presence of patient portals. However, the varying impact of IT across sub-populations may indicate that the efforts to bridge the digital divide may benefit some groups of patients at the expense of other groups, leading to further service disparities in the care service.

Air Matters: The Impact of Air Quality Information Disclosure through Web Portals on Public Health Conditions
Sang Pil Han¹, Youngki Park², Ki-Kwang Lee³, Hyun Cheol Kim⁴
1. Arizona State University, 2. School of Business, George Washington University, 3. Dankook University, 4. National Oceanic and Atmospheric Administration

Abstract
More than 90% of the world’s population lives in areas where air pollution exceeds safety thresholds, according to the World Health Organization (WHO). Parts of Africa, Eastern Europe, India, China and the Middle East are the biggest danger regions. The literature and relevant policy studies on ambient air pollution mainly focus on its main causes and its harmful consequences but pay scant attention to the trends of new ways of air quality information delivery to the public using information technologies. This study investigates the impact of air quality information disclosure through web portals on health conditions of patients with chronic diseases such as asthma in the Seoul Metropolitan area. Our results show that the information disclosure policy substantially helps attenuate the adverse health impact of PM10 on the number of asthma patients. Specifically, the elasticity of asthma incidences to changes in PM10 levels decreases to about one third of the original intensity. Furthermore, we find yearly cost savings for populations at risk for asthma from the use of web portals is $0.6 million per 10% increase of the PM10 level. We discuss potential implications for policymakers and researchers by discussing practically possible strategies to improve the effectiveness of public disclosure and effective dissemination of time- and health-critical air quality information in increasingly polluted world.

Research Roundtable 10: Deep Learning

Discovering Medication Nonadherence Reasons with Sentiment-Enriched Deep Learning Approach
Jiaheng Xie¹, Xiao Liu², Daniel Zeng¹, Xiao Fang³

Abstract
Medication nonadherence (MNA) refers to the behavior when patients do not fill prescriptions. To take proactive measures and prevent harmful outcomes, the stakeholders need to understand patients’ reasons for MNA. Current studies attempt to provide one-size-fits-all solutions to the “average patients” and utilize survey or experiment design with small sample sizes to obtain a snapshot of this issue. To address these issues, we develop a sentiment-enriched deep learning approach to detecting patient and drug-specific reasons for MNA using health social media data. Our model reached a precision of 87.29%, a recall of 93.27%, and an F1-score of 90.18%. This study contributes to information systems research by designing a deep-learning-based framework for detecting tailored reasons for MNA in real time. The framework is generalizable to understand motivations of various human behaviors. We also contribute to healthcare IT by discovering previously unknown MNA reasons from online health IT platforms.
Machine Learning and Deep Learning for Healthcare Decision Support: Multiple Imputation Improves Predictions - A Clinical Example of ICU Readmission
Ruo-Ting Sun¹, Yu-Wei Lin¹, Michael J. Shaw¹
1. University of Illinois at Urbana-Champaign

Abstract
Artificial intelligence systems in health market are getting more popular since the evolvement of computational power. Deep learning models (Neural Networks) are known for their prediction power, especially widely used from all works of life; however, rare of them are adopted in the healthcare institutions due to the lack of model explainability – a black box. Clinicians cannot rely on an unexplainable system to make diagnoses, especially in the Intensive Care Unit (ICU). This study used the ICU readmission dataset in MIMIC III database as an example, and applied recurrent neural network (RNN), a deep learning approach, for dealing with patients’ last 48-hour time series data to predict the ICU readmission. By comparison with the C5.0 machine learning model, which is known for the power of interpretation, the underlying data biases can be solved by multiple imputation for substantial missing values in the electronic health record (EHR). Furthermore, the performance of the C5.0 model approaches the RNN model, and a list of rules are derived for supporting clinical decisions. This study contributes to literatures of explainable AI (XAI), which aims at enhancing interpretability, and gives insights to healthcare professionals for medical decision support.

Yu-Wei Lin¹, Michael J. Shaw¹
1. University of Illinois at Urbana-Champaign

Abstract
Ventilator weaning assessment is a non-trivial task. The literature points out that the existing assessment criteria should only be thought of as considerations, and many medical cases reveal that patients were successfully weaned from the ventilator without satisfied any of them. In this paper, we focus on predicting personalized oxygenation acceptable states (e.g., RSBI, minute ventilation, respiratory rate, and tidal volume) and physiologically acceptable conditions (e.g., cardiovascular system and hemoglobin) for invasive mechanical ventilator weaning. Form MIMIC III dataset, we extract 2596 ICU episodes from 2450 patients between 2001 and 2012. Each episode is labeled by computing the mean of patient’s physiological status and oxygenation condition in a given time period, 2 hours in this study, before extubation. These patient-specific label values serve as the target “acceptable” condition for successful ventilator weaning detection in supporting medical decision making. In our experiments, we compare the differences between these labeled values and the personalized assessment criteria values acquired by the following three different methods: (1) standard criteria for weaning trial in practice, (2) a polynomial regression model, and (3) deep learning models, including recurrent neural network models and several variations. We use the root mean squared error (rMSE) and mean absolute error (MAE) as the methods to quantify the differences. The experiments results show that RNN model can provide more appropriate personalized assessment values. This paper highlights the significance of personalized ‘acceptable’ physiological status and oxygenation condition for ventilator weaning assessment. It also contributes to the literature by utilizing data-driven results to show the ability of machine learning models in signals detection for medical early warning by using ICU applications as
examples. We expect the knowledge discovered in this study can immediately be used to support healthcare decision making.

Research Panel 11: Security

Does Sharing Make My Data More Insecure? An Empirical Study on Health Information Exchanges and Data Breaches
Leting Zhang¹, Min-Seok Pang¹, Sunil Wattal¹
1. Temple Universisty

Abstract
We examine the security implications of hospitals joining in an Health Information Exchange (HIE). Specifically, how does joining in the HIE affect hospitals’ data breach risks? What organizational factors moderate this effect? On one hand, the hospitals in the HIE would be a more attractive target to intruders, and they may also lack sufficient incentives to invest in information security. However, the HIE implements IT governance, risk, and control mechanisms to reduce breach risks (IT GRC). We employ a six-year (2009-2014) panel data and use linear probability model and propensity score matching (PSM) for our analyses. Results show that joining in an HIE decreases hospital’s data breach risks. We also find that this mitigation effect is stronger at hospitals of a smaller size and with a higher security capability.

This paper potentially contributes to the IS literature by studying information security in an interorganizational information systems and the effectiveness of IT GRC. We also provide security implications for policymakers and healthcare practitioners.

Understanding the Relationship Between Data Breaches and Hospital Advertising Expenditure
Sung Choi¹
1. Vanderbilt University

Abstract
Breached hospitals incur significant costs associated with remediation activities, yet the costs associated with data breaches are not readily captured in hospital financial disclosures. We estimated the relationship between data breaches and hospital advertising expenditure. Observational data on hospital expenditure was analyzed using a propensity score matched regression. Study sample included non-federal acute-care inpatient hospitals from 2011 to 2014. Hospital advertising was captured Voicetrak survey of traditional media outlets. The regression was specified as a generalized linear model using a gamma distribution and log link. A data breach was associated with a 60% increase in annual advertising expenditure, holding observable characteristics constant. Efforts to repair the hospital’s image and minimize patient loss to competitors are potential drivers of the increased advertising spending.
Regular Session 12: Big Data

The Hidden Cost of Transitioning to a Paid Service: The Effect of Unexpected Revealing of New Patient Prospects on Physicians’ Service Quality in Online Healthcare Communities
Seyoung Seol¹, Lu Yan¹, Jingjing Zhang¹, Hillol Bala¹, Luan Wang²
1. Indiana University Bloomington, 2. School of Management, Harbin Institute of Technology

Abstract
In this research, we seek to understand how physicians would respond to a policy change, i.e. promoting paid consultations over free services, on an online platform. We found that, contrary to general expectations, physicians’ service quality increased for free consultations and decreased for paid consultations. Our findings have important theoretical and practical implications. The extended abstract is available at http://ssrn.com/abstract=3285916.

Automated Enforcement on the Road: Surveillance Technology and Traffic Safety
Aaron Zhi Cheng¹, Zhanyu Dong², Min-Seok Pang¹
1. Temple University, 2. University of Hong Kong

Abstract
Traffic safety has been a major societal and public health problem. Among various safety laws, regulations, and investments, automated enforcement in the form of surveillance technology (e.g., speeding checkers, red light cameras) is advocated to be a cost-effective approach to mitigating traffic accidents. However, there has been limited understanding of the impact of surveillance technology on traffic safety, its underlying mechanisms, and overall economic significance. To investigate these questions, we use police accident reports of a metropolitan in southern China and exploit the temporal and geographical variations in the installation of ~2,000 traffic surveillance cameras in 2014-2016. Our difference-in-differences estimates show a disproportionate decrease in vehicular damages and occupant injuries at the road segments installed with surveillance cameras. Second, we explore the underlying mechanisms of the observed effect and develop a stylized model for drivers’ safety efforts under surveillance. The theoretical prediction on the effect of surveillance technology can be decomposed into two parts: a positive impact on safe driving efforts that deters careless or reckless behaviors (a “Stick” role reflecting the Deterrent Hypothesis in the criminology literature) and a negative impact that facilitates a safer traffic environment and compensates accident risks (a “Carrot” role reflecting the Risk Compensation Hypothesis in the economics literature). The direction of the surveillance effect depends on the relative magnitude of these two countervailing impacts. Suggestive evidence supports the deterrent effect but not the risk compensation effect, implying that “Stick” prevails “Carrot”. Finally, we estimate incremental economic savings of vehicular damages and human cost savings of occupant injuries to be ~¥ 41 Million ($ 6.5 Million) thanks to the installation of surveillance cameras in the study city over a period of 3 years.
Digital Multisided Platforms and Women's Health: An Empirical Analysis of Peer-To-Peer Lending and Abortion Rates
Gorkem Turgut Ozer¹, Brad N. Greenwood², Anand Gopal¹
1. University of Maryland, 2. University of Minnesota

Abstract
The social implications of information technology, in particular the wide-spread adoption of digital platforms, have been discussed in detail in the anecdotal literature. Within the literature, scholars have examined the impact of platforms on social outcomes such as the prevalence of sexually transmitted diseases, the impact of drunken driving, and the identification of potential disease outbreaks. We augment this stream of research by considering how platforms which increase capital liquidity, i.e. peer-to-peer lending platforms, influences social outcomes in the form of access to medical care. We consider one such social outcome that has significant policy implications in the US – abortion rates. A woman’s right to choose remains a hot-button social and political issue within the US, with individual states and the Federal government implementing regulatory extensions which either increase, or limit, access to such procedures within their respective jurisdictions. The decision-making process that underlies an abortion is clearly complex. Extant research in this area identifies several important factors that affect how a woman may choose, and how aggregate policies can influence abortion rates in a given state or regulatory domain. Within this complex interplay, one concern in the decision to terminate a pregnancy is cost. Thus, access to immediate capital is critical should women opt to terminate, and the availability of peer-to-peer lending platforms may play an important role.
To determine such an effect, we examine how the entry of a peer-to-peer lending platform into a particular US state affects the rate of abortions observed in that particular state, building on the rationale that access to capital can help women facing barriers to access to abortion services overcome these barriers. Our results, based on a difference-in-difference model, show that the entry has a positive marginal effect on the number of abortions in a state, after controlling for time trends.

Regular Session 13: Gamification

Gamified Challenges in Online Weight-Loss Communities
Behnaz Ghahestani Bojd¹, Xiaolong Song², Yong Tan¹, Xiangbin Yan³
1. University of Washington, 2. Dongbei University of Finance And Economics, 3. University of Science and Technology, Beijing

Abstract
Online weight-loss communities connect users who share similar goals. Among the most popular features of these communities are gamified challenges which allow users pursue a short-term goal, and compare their weight-loss progress with other challenge participants using gamification elements such as leaderboards. In this paper, using the data from a leading online weight-loss community, we study the effect of gamified challenges on weight-loss progress. We utilize the system GMM and Inverse Probability Weighting (IPW) approach to address endogeneity issues. Our findings indicate that participation in gamified challenges has a positive effect on weight-loss. We also show heterogeneous effects across challenges based on the specificity level of the challenge goal and the number of challenge members. The results suggest that participating in challenges with (without) a target has a positive effect on weight-loss, when there are high (low) numbers of members. The results are explained by differentiating the salience of two types of information and incentives delivered by leaderboards:
user’s ranking and perceived progress of others. This study offers suggestions for healthcare providers to use effective online weight-loss interventions. Moreover, our findings can serve as guidelines for designing gamified information systems in goal-setting environments.

On Mobile Game Analytics for Pediatric Obesity Management
Yi-Chin Kato-Lin¹, Rema Padman², Sross Gupta³, Palak Narang³, Bhargav SriPrakash³, Uttara Bharath-Kumar³, Pradeep Krishnatray⁴, Bhairavi Prakash⁴, Sanjeeta Agnihotri⁵, Vasini Varadan⁶

Abstract
While video and mobile games have been shown to have a positive impact on behavior change in children, the mechanisms underlying game play that impact outcomes of interest are yet to be understood. With a focus on healthy eating behaviors, this study aims to 1) examine the impact of a dietary mobile game on food choices, 2) explore children’s game play patterns, and 3) understand the effects of game mechanisms.

We analyze game telemetry, survey data, and actual food choice data collected from a randomized controlled trial of an app among 104 school children. Statistical tests were used to examine the main effect of the mobile game. We then analyze chronological sequences of game plays and formulate a Markov model to understand key patterns in the game mechanics that players utilize as they navigate the game. Game mechanisms are quantified and used in regressions to examine their relationships with actual food choices.

Children from the treatment group chose significantly more good foods, on average, than the control group. Telemetry data analysis indicates high variability in game play patterns. Better food choices are associated with players who are more incentive reactive, highly engaged in terms of levels played, and either very observant or very active during the game play. Food facts that are read during game play also have a critical role in children’s food choices.

This study adds to the growing body of evidence that learning about healthy eating via mobile games, acting as Digital Vaccines, can positively impact children’s actual food choices. It also provides fresh insights about the underlying impact mechanisms. Additional RCTs in varied and longitudinal settings and deeper analysis of the resulting data are needed to confirm Digital Vaccines’ potential, starting from early childhood, to reduce the long-term risk of nutrition-related, non-communicable diseases.

Should We Play A Game? An Empirical Investigation of Location-Based Mobile Gaming and Mental Health
Aaron Zhi Cheng¹, Brad Greenwood², Paul A. Pavlou¹
1. Temple University, 2. University of Minnesota - Twin Cities Campus

Abstract
We examine how the introduction of location-based mobile games influences local incidence rates of mental health issues, viz. depression. Although prior research has discussed the economic and social implications of mobile games, limited work has explored their effect on mental health. Using Internet search data of depression-related terms to exploit the release of Pokémon Go into 12 English-speaking countries in 2016, we find that the introduction of the game is associated with a significant decrease in depression-related searches. Interestingly, we also observe that the entrance of location-based mobile games is associated with increases in physical activity, social interaction, and exposure to nature, all of which have been implicated as key factors can influence mental health. These results lend credence to
claims that location-based mobile games may be beneficial to the health of their users, and they underscore public and population health opportunities that underlie the design of location-based mobile games. Theoretical, practical, and public policy contributions and implications are discussed.

Effect of Gamification on Healthful Activity: The Case of Fitbit Leaderboards
M Zia Hydari1, Idris Adjerid2, Aaron Striegel3

Abstract
Lack of physical activity represents a growing global health crisis, leading stakeholders to find interventions to improve individuals' health behaviors. Gamification of health behavior such as the use of leaderboards is one intervention that has the potential to increase healthful activity. However, the extant literature does not provide conclusive evidence on the benefits of such gamification. In this paper, we investigate the effect of Fitbit leaderboards on the number of steps taken by the user. Using a unique dataset of hundreds of Fitbit wearable users, some of whom participate in a leaderboard, we find that leaderboards lead to approximately a 9 percent increase in the users' daily steps.

Research Roundtable 14: HIT, Analytics and Performance

The Impact of Information Technology Capability on Hospital Performance
Pascal Nitiema1, Chuan Tian1, Radhika Santhanam1
1. University of Oklahoma

Abstract
Through financial incentives and mandatory dispositions, the United States Federal Government has promoted the deployment of Information Technology (IT) within health organizations as a solution for improving patient care outcomes and dealing with the staggering increase in health care costs. IT integration is expected to, among others, curb hospitals’ administrative costs through better management of the high volume of information generated in patient care and by providing a more efficient approach to hospital operations. It is therefore important to track the impact of IT integration on hospitals’ patient care and financial performance.

In this study, using the lens of the resource-based view (RBV) of the firm and the notion of IT capability, we examine the impact of IT integration in hospitals, during the timeframe 2014 through 2016. IT capability describes how well an organization has integrated IT in its strategy and operations and has long been used in information systems research. We propose a new way to score the IT capability of hospitals using data from the annual IT survey conducted by the American Hospital Association (AHA). We then identify financial performance variables directly tied to the care of patients. With archival data from the American Hospital Survey repository and the Healthcare Cost Reporting Information System (HCRIS) database, we examine the impact of IT capability on hospitals’ performance. We find that hospitals with higher IT capability scores exhibited higher operating expenses, but higher patient care revenues and higher net patient income. Our current findings lend support to the positive effect of IT integration on hospitals financial performance, and we are currently examining its impact on clinical outcomes.
A Framework of a Multi-Utility Driven Referral Decision Support System
Saeede Eftekharī¹, Niam Yaraghi², Ram Gopal², Ram Ramesh¹
1. SUNY at Buffalo, 2. University at Connecticut

Abstract
The objective of this study is to develop the framework of a multi-attribute utility driven referral optimization approach that would collectively yield referral decisions across a community of physicians, patients and their referral needs. The proposed methodology will yield an effective framework for a Referral Decision Support System (RDSS) that can be integrated with HIE services. We model referral as the outcome of a two-stage decision process: In the first stage, the primary care physician identifies a set of potential specialists for the referral. Typically, the identified set consists of specialists known to the primary care physician. Hence, the identified set usually is a subset of all potential specialists. In the second stage, the physician determines the utility of referring the patient to each specialist in the set and chooses the one that maximizes the utility value. Thus, current referral processes have two major shortcomings, restricted consideration of referral options and isolated referral decisions. To address these concerns, we propose a RDSS that determines the overall utility-maximizing referral decisions for a given set of patients by taking into account the set of all feasible specialists. Accordingly, the RDSS consists of the two components: estimation of the utility function and dynamic utility maximization in referral decisions. We propose two distinct approaches, zero-inflated logit regression and Simulation Investigation for Empirical Network Analysis (SIENA) model to estimate the utility function. The utility maximization is modeled as the generalized transportation problem with additional constraints.

Analytics and Artificial Intelligence Underlying Continuous Remote Care Workflows to Achieve Disease Status Improvement for Type 2 Diabetes
Nasir Bhanpuri¹, Adam Maruf¹, Amy McKenzie¹, Catherine Metzgar¹, Brent Creighton¹, Amit Shah¹, James McCarter¹
1. Virta Health

Abstract
Two recently published manuscripts describe the safety and effectiveness of a continuous care treatment for type 2 diabetes. In brief, at one year retention was 83%, there were substantial reductions in average blood glucose (-17% change in hemoglobin A1c [HbA1c]) and average body mass (-12% change), there were concurrent reductions in antidiabetic and antihypertensive medications (e.g. 94% of insulin users reduced or eliminated usage), and improvements in most cardiovascular disease risk biomarkers.

Virta Health continues to provide the treatment to a growing patient population. The care team, consisting of physicians and health coaches, provide the treatment at scale by combining clinical expertise, custom software tools, and machine learning (ML) coupled with a variety of health data.

One set of important tools are the proactive Prioritization Lists (PLs). The weekly PLs highlight the patients with a higher likelihood of benefitting from proactive outreach. Specifically, the lists incorporate predictions from machine learning (ML) models in addition to recent trends in biomarkers. The models include predicted risk of dropout, estimated weight change, and estimated changes in HbA1c. Since deployment, health coach efficiency, measured by patients served per hour, improved ~25-50%. In addition, among T2D patients receiving Virta through their employer or health plan, one-year outcomes were better than or equal to the results from the clinical trial. Retention was 90%, over
95% of insulin users reduced or eliminated usage, mean HbA1c significantly decreased (-19%, P<10E-10) and average body mass significantly decreased (-12%, P<10E-10).

Since deploying the PLs, there have been improvements in efficiency, retention, and clinical outcomes. However, the commercial patient cohort differs from the clinical trial patient cohort, in that the trial required in-person testing, and the treatment is continuously improving. Thus, the metrics may overstate the impact of the PLs.

An Observational Study of the Relationship Between Meaningful Use-Based Electronic Health Information Exchange, Interoperability, and Medication Reconciliation Capabilities
Gerald Elysee1, Jeff Herrin2, Leora Horwitz3
1. Benjamin Franklin Institute of Technology, 2. Yale School of Medicine, Department of Internal Medicine, Section of Cardiology, 3. NYU Langone Health, Division of Healthcare Delivery Science, Department of Population Health, Medicine, Center for Healthcare Innovation and Delivery Science

Abstract
Stagnation in hospitals’ adoption of data integration functionalities coupled with reduction in the number of operational health information exchanges could become a significant impediment to hospitals’ adoption of 3 critical capabilities: electronic health information exchange, interoperability, and medication reconciliation, in which electronic systems are used to assist with resolving medication discrepancies and improving patient safety. Against this backdrop, we assessed the relationships between the 3 capabilities. We conducted an observational study applying partial least squares-structural equation modeling technique to 27 variables obtained from the 2013 American Hospital Association annual survey Information Technology (IT) supplement, which describes health IT capabilities. We included 1330 hospitals. In confirmatory factor analysis, out of the 27 variables, 15 achieved loading values greater than 0.548 at P < .001, as such were validated as the building blocks of the 3 capabilities. Subsequent path analysis showed a significant, positive, and cyclic relationship between the capabilities, in that decreases in the hospitals’ adoption of one would lead to decreases in the adoption of the others. These results show that capability for high quality medication reconciliation may be impeded by lagging adoption of interoperability and health information exchange capabilities. Policies focused on improving one or more of these capabilities may have ancillary benefits.https://journals.lww.com/md-journal/fulltext/2017/10130/An_observational_study_of_the_relationship_between.26.aspx
Research Roundtable 15: Care Patterns

Improve the Quality of Care After Discharge by Selecting a Referral Network of Skilled Nursing Facilities
Yunsi Yang1, Fuqiang Zhang1
1. Washington University in St. Louis

Abstract
Since the implementation of the Affordable Care Act (ACA) and increasing use of value-based reimbursement, hospitals become more incentive to improve the care patient receive after discharge to avoid rehospitalization penalties and more accountable for the cost of post-acute care. Skilled Nursing Facilities (SNF) are Medicare’s biggest expense for post-acute care. Patients are discharged to under-qualified facilities because patients are provided with a full list of facilities in the area and asked to choose one with limited information available. To improve the efficiency of discharge planning, hospitals are seeking to collaborate with high-quality SNFs and narrow down the facilities on the list. Bed reservation program and Preferred Network are two approaches commonly used. The objective of this paper is to compare the quality of care received by patients in SNFs which are under these three settings: no partnership, Bed Reservation Program and Preferred Network. Considering hospital facing with uncertainty from patient choice and availability of SNF beds, we provide strategies for hospital to select a portfolio of SNFs in different settings. Moreover, we develop an algorithm to determine how many bed to reserve in each selected SNFs for Bed Reservation Program.

Physician Pairing and Patient Outcomes: An Empirical Investigation
Zhe Deng1, Sezgin Ayabakan1, Subodha Kumar1, Paul A. Pavlou1
1. Fox School of Business, Temple University

Abstract
Healthcare coordination networks can be instrumental in shaping physicians’ orientation toward clinical practices, which can then impact patient outcomes. Past literature has shown significant effects of the nurse-physician collaboration, physician-pharmacist collaboration, physician-patient collaboration, hospital-physician collaboration, and inter-professional and interdisciplinary collaboration on patient outcomes in terms of care quality, costs, and safety. The effect of the coordination network backbone, physicians’ patient sharing network, has been overlooked. Using cross-sectional regression analysis and episode matching, we empirically analyze patient-sharing network characteristics, the number of shared patients (centrality degree) and physician homophily and measure their impact on patient outcomes in the case of multiple physician visits using Maryland’s diabetes patient discharge summaries between 2012 and 2017. We find the number of physician-shared patients (centrality degree) is associated with a positive and significant effect on the patient length of stay and negative and significant effect on mortality rate and readmission rate. These results offer empirical guidance for both practitioners and patients to choose healthcare partners. Practical and theoretical implications are discussed.
Examining the Impact of IT-Enabled Medicaid Health Homes on Reducing Healthcare Costs
Pamella Howell1, Raj Sharman2, Chet Fox3
1. University at Buffalo, 2. SUNY Buffalo, 3. Greater Buffalo United Accountable Care Organization

Abstract
Patients find it difficult navigating the complicated and fragmented healthcare system. Avoidable costs stemming from duplication and overutilization are often associated with the industry's fragmentation. The Medicaid health homes (MHH) is a program created to assist individuals in navigating the healthcare system. The health home provides care coordination services to Medicaid recipients with one or more chronic illness, including diabetes, hypertension, and mental health conditions such as depression. The objective of the MHH program is well established; however, few studies have explored the effectiveness of IT-Enabled health homes at lowering the cost of care. The study objective was to assess the impact of technology-enabled health homes on the total cost of care.

The dataset collected from the Eastern United States contained approximately 13,600 records from the claims of a single Medicaid-managed care organization. Utilizing propensity score matching and a conditional difference in differences analysis, the model explores the financial impact of health home enrollment on the quality of care for 11,715 patient records. We evaluate health homes mandated by the state to utilize electronic medical records and health information exchanges. This research is the first to comparatively utilize a quasi-experiment to assess their effectiveness in lowering costs. Performance testing results showed good discrimination with the model AUC of 0.87. The finding indicates that health home enrollment reduces the total cost of care between $4,074.00 and $4,566.00 in comparison to the propensity-matched, non-enrollee Medicaid population using nearest neighbor, kernel, stratified, or radius matching algorithms. Results also indicate a treatment effect of technology-enabled health homes on inpatient, outpatient, physician, and pharmacy costs.

Caring and Coping: Adaptation, Use, and Resistance of Electronic Health Records Systems
Quang Neo Bui1, Sean Hansen1, Manlu Liu, John Tu1
1. Rochester Institute of Technology

Abstract
The recent wave of clinical health information technology adoption has ushered in troubling issues such as increased workplace stress or demands for after-hour documentation. How do physicians cope with these challenges? This research draws upon coping theory to explore the triggers and outcomes of physicians' coping behaviors. Preliminary findings suggest that disconfirmation of expectation triggered the coping process, and physicians experienced multi-level effects in both individual work as well as general work processes.
Emerging Research Topics and Gaps in Health Information Technology and Analytics

Kenyon Crowley\textsuperscript{1,2}, Guodong (Gordon) Gao\textsuperscript{1}, Jeffrey McCullough\textsuperscript{3}, Ritu Agarwal\textsuperscript{1}

1. Center for Health Information and Decision Systems, Robert H. Smith School of Business, University of Maryland
2. College of Information Studies (iSchool), University of Maryland
3. School of Public Health, University of Michigan

Abstract

Research Objective: To identify emerging trends, knowledge gaps, and research priorities in health information technology (IT) and analytics from multiple stakeholders’ perspective.

Study Design: We analyzed the research presented at the 9th Annual Conference on Health IT and Analytics (CHITA) held October 2018 in Washington, DC. A central aim for the AHRQ-supported CHITA is to support the development of a research agenda through interactions between academics, policymakers and practitioners. Initial program committee discussions were crafted into the call for submissions. Presented research was distilled into key findings, discussion points, data required, and audience questions were documented. Policymakers shared strategic research priorities and participated in audience discussions led by senior researchers to synthesize and crystallize a research agenda.

Population Studied: Researchers, practitioner leaders and policymakers. CHITA 2018 participants included 133 attendees from over 90 organizations representing a diverse mix of academic programs; policy and practitioner organizations comprised 17% of participants.

Principal Findings: Four health IT and analytics research trends were identified:

Trend 1: Applying Artificial Intelligence (AI) to improve prediction. In recent years, major AI breakthroughs in computer science such as deep learning may significantly improve the accuracy of prediction, e.g. for readmission and chronic opioid abuse.

Trend 2: Empowered patients at the center of the value-based system. Transitioning to value-based healthcare, much of the attention has focused on providers. Patients should be given a more central role in the emerging value-based system.

Trend 3: Data privacy, protection and policy. While privacy and protection have always been a major focus for health data, this issue has become more critical. The proliferation of genomics data will reduce anonymity, while new data protection tools emerge. HHS participants highlighted the role of blockchain technology.

Trend 4: Expanding beyond traditional point-of-care delivery. Advances in technology and data sharing have made telehealth more feasible, and innovations in business models can expand the channels to brick and mortar retailers.

Three critical gaps in understanding that warrant further research:

First, more research is needed on the processes through which technology and data can create value. For example, how can providers be motivated to productively use technologies? Second, there is a need to better align predictive modeling with value. How AI and predictive analytics should be incorporated into practice and policy, while advancing patient and social value? Research on optimal ways to educate clinicians and policymakers is needed. Finally, a deeper understanding and systematic knowledge of how
to motivate patients to improve health behaviors is needed. Studies of behavioral nudges, the role of different types of incentives, how to optimally leverage wearable and mobile devices, etc.

Conclusions: Driven by both technology advances and policy changes, health IT and analytics research is undergoing substantial changes, as reflected in the four major trends. More research is needed to close the knowledge gaps for implementation and execution.

Implications for Policy or Practice: Action is needed to improve the frontline clinical workforce’s embrace of the growing trend in AI, mobile, behavioral interventions, and data management. Policy makers should consider new measurement and incentives to foster deeper adoption in the above fields.