



UNIVERSITY OF MIAMI
MIAMI HERBERT
BUSINESS SCHOOL

MANAGEMENT SCIENCE
DEPARTMENT

HEALTHCARE ANALYTICS WORKSHOP

APRIL 12, 2024

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PROGRAM FLOW

BREAKFAST & WELCOME <i>Finker-Frenkel Promenade</i>	8:15 - 8:50 AM
OPENING REMARKS Vice Dean Harihara Prasad Natarajan	8:50 - 9:00 AM
SESSION 1	9:00 - 10:30 AM
Promoting Generics: Effects on Pharmaceutical Quality Dr. Hessam Bavava	
Data-Driven Analytics for Community Programs: Breaking the Revolving Doors Dr. Pengyi Shi	
COFFEE BREAK <i>Aresty 339</i>	10:30 - 11:00 AM
SESSION 2	11:00 - 12:30 PM
Opening Rural Clinics: Effects on Healthcare Networks and Access for Underserved Communities Dr. Masoud Kamalahmadi	
From Secrets to Savings: The Impact of Hospital Price Transparency Rule on Cost and Quality of Healthcare Services Dr. Niam Yaraghi	
First, Do No Harm: Do Staffing Shortages Drive Abuse and Malfeasance in U.S. Nursing Homes? Dr. Jong Myeong Lim	

PROGRAM FLOW

LUNCH 12:30 - 1:30 PM

Finker-Frenkel Promenade

SESSION 3 1:30 - 3:00 PM

**Redesigning Shift Work to
Incorporate Heterogeneous Worker
Preferences**

Dr. Hummy Song

**The impact of historical workload
on nurses' perceived workload**

Dr. Jing Dong

COFFEE BREAK 3:00 - 3:30 PM

Aresty 339

SESSION 4 3:30 - 5:00 PM

**Helping the Captive Audience:
Advance Notice of Diagnostic
Service for Hospital Inpatients**

Dr. Nan Liu

**Gatekeeper or Second Opinion?
The Role of Artificial Intelligence
in Physician-in-the-Loop Systems**

Dr. Tinglong Dai



Dr. Hessam Bavafa

Associate Professor, Wisconsin School of Business

Promoting Generics: Effects on Pharmaceutical Quality

Generic drugs are a cornerstone of affordable healthcare. We examine the pharmaceutical quality effects of the Generic Drug User Fee Amendments (GDUFA), a hallmark legislation enacted by Congress in 2012 that armed the FDA with resources to improve the timeliness of generic drug application reviews. GDUFA succeeded in shortening the total application review time, which includes waiting time, from a median of 44 to 14 months. We find, however, that generic drugs approved after GDUFA have 28.6% higher recall rates. We show that this effect has been persistent since the second year of the law's implementation and that the increase in recall rates was driven by manufacturing-related deficiencies, specifically, contamination issues. We also investigate heterogeneity by recall severity and find that the increase in recalls after GDUFA is driven by severe (Class I and II) recalls. These findings inform previously unquantified quality reductions stemming from the policy promoting generic drugs.



Dr. Pengyi Shi

Associate Professor, Mitchell E. Daniels, Jr. School of Business

Data-Driven Analytics for Community Programs: Breaking the Revolving Doors

Recidivism -- the “revolving door” where formerly incarcerated individuals commit new offenses -- is one of the most challenging issues facing the modern criminal justice system. This cycle is particularly pronounced among individuals suffering from Substance Use Disorder (SUD). Rather than receiving necessary medical treatment, these individuals are repeatedly criminalized and incarcerated for minor offenses. Community-based programs have been advocated to break this vicious cycle but often lack analytics-based decision support. In this talk, I will discuss ongoing research projects conducted in partnership with local community corrections, focusing on the complex journey of individuals with SUD through the criminal justice and social support systems. We leverage reinforcement learning to develop prescriptive analytics for optimizing the allocation of limited treatment resources. We integrate Large Language Models with agent-based simulation for predictive analytics. Our analytics aim to assist in identifying individuals at risk, ensuring effective resource allocation to maximize societal benefits, and addressing disparities in treatment access.

Joint work with Xiaoquan Gao, Bingxuan Li, Nan Kong, and Amy Ward.



Dr. Masoud Kamalahmadi

Assistant Professor, Miami Herbert Business School

Opening Rural Clinics: Effects on Healthcare Networks and Access for Underserved Communities

Over 60 million Americans live in rural areas, facing limited access to healthcare resources and consequently experiencing poorer health outcomes than their urban counterparts. Enhancing rural healthcare access is crucial yet challenging due to geographical barriers, limited patient volumes, and a shortage of medical professionals. Compounding these challenges is the limited knowledge about the impacts of healthcare service expansions on rural residents' outcomes. Leveraging the opening of new outpatient clinics by the Department of Veterans Affairs (VA), we conduct a quasi-experimental difference-in-differences analysis to identify the causal impacts of this service expansion on rural veterans' access to care and service utilization patterns. We find a significant increase in veterans' enrollment and service utilization in the VA system, particularly in more rural areas. We also investigate the broader impacts of these clinics on patient demand throughout the entire network, revealing that while new rural clinics substituted for some services in other facilities, they also generated additional referrals for services not offered by them. On the other hand, we find a decline in hospitalizations, indicating that the expansion of outpatient services may have facilitated earlier diagnoses and interventions, ultimately improving health outcomes. However, we also find a rise in visits to non-VA providers, suggesting that the surge in referrals may have strained capacity in other VA facilities. This increased care fragmentation could potentially limit the benefits of service expansions. Our study contributes to understanding the impact of clinic expansions on healthcare access and utilization, providing valuable insights for healthcare organizations striving to optimize service expansions in rural areas.



Dr. Niam Yaraghi

Associate Professor, Miami Herbert Business School

From Secrets to Savings: The Impact of Hospital Price Transparency Rule on Cost and Quality of Healthcare Services

In the United States, the lack of competition within the healthcare market is notably influenced by the opacity of service pricing, leading to unchecked price increases without improvements in service quality. The hospital price transparency rule, implemented on January 1, 2021, seeks to address this by requiring the disclosure of prices, aiming to stimulate competition and lower costs. Yet, the policy's effect on pricing and consumer behavior remains largely unexplored. This study employs a difference-in-differences analysis of inpatient data from Florida hospitals to assess the impact of the Federal price transparency rule on hospital pricing and patient decision-making, leveraging the phased compliance of hospitals with the regulation. Our analysis reveals that while the price transparency rule does not broadly reduce hospital prices, it leads to lower charges for self-pay patients opting for elective procedures who are sensitive to price and can shop for better deals. This group leverages price information to compare different providers, thereby enhancing market competition and prompting hospitals to reduce prices to attract these patients. Furthermore, our findings indicate that after the implementation of the policy, patients choose hospitals that not only comply with the rule but also offer prices below the market average, particularly benefiting those seeking elective services. This suggests that price transparency primarily aids cost-aware patients with the flexibility to choose more affordable providers. Our research underscores the nuanced impact of price transparency on healthcare costs and patient welfare, offering valuable insights for future healthcare policy development.

Joint work with Xiru Pan.



Dr. Jong Myeong Lim

Assistant Professor, Miami Herbert Business School

First, Do No Harm: Do Staffing Shortages Drive Abuse and Malfeasance in U.S. Nursing Homes?

Nursing homes have faced a nationwide staffing crisis over the past twenty years. We examine the consequences of the short-staffing crisis in motivating institutional malfeasance and wrongdoing, in particular, the use of antipsychotic drugs. It has long been recognized that the so-called “chemical restraints” can be abused in nursing homes to improperly sedate patients. While the Centers for Medicare and Medicaid Services (CMS) have been disclosing the rates of antipsychotic drug usage at the nursing home level, the reporting rule that excludes patients diagnosed with certain medical conditions creates perverse incentives for nursing homes to misdiagnose residents in order to artificially lower their publicly disclosed rates. To fully capture the extent of antipsychotic drug usage, we construct a novel dataset that includes the unadjusted raw rates of antipsychotic drug usage obtained directly from the CMS using Freedom of Information Act requests. We find that nursing homes’ staffing levels do substantially impact their use of antipsychotic drugs. In particular, an hour’s decrease in a nursing home’s daily staff hours per resident increases its number of residents on antipsychotic drugs by 7.9 on average. Furthermore, we show that staffing’s effect on drug usage rates is more pronounced among for-profit nursing homes than nonprofit nursing homes.

Joint work with Ken Moon and Minje Park



Dr. Hummy Song

Assistant Professor, The Wharton School

Redesigning Shift Work to Incorporate Heterogeneous Worker Preferences

Shifts are the dominant way to organize work in many contexts requiring 24/7 coverage. While the detriments of shift work are well-documented both at the individual and organizational levels, its deployment is often unavoidable given round-the-clock staffing needs. We explore a potential operational lever—incorporating heterogeneous preferences over shift characteristics, which we refer to as the shift choice system—to mitigate ramifications of shift work on worker well-being and turnover. Leveraging rich and novel survey, shift, and administrative data, we document that acute care nurses exhibit heterogeneous preferences over shift schedules, driven by both pecuniary and non-pecuniary considerations. We also show that nursing managers largely reflect preferences into scheduled shifts, albeit imperfectly. We find that the shift choice system improves worker well-being, as measured by self-reported fatigue and work-life balance. Using a difference-in-differences approach, we estimate a 0.58 p.p. decrease in probability of quitting, but only among more experienced nurses. We find these effects are not driven by differences in the degree to which preferences are reflected in scheduled shifts, but rather by corresponding improvements in fatigue and work-life balance concentrated among more experienced nurses. We do not find evidence to suggest that the shift choice system affects care quality. Our results indicate that allowing for shift choice is an effective responsible scheduling strategy that can improve worker well-being and reduce turnover for highly experienced nurses.

Joint work with H. Harriet Jeon, Song-Hee Kim, Kyeongsug Kim, Sangwoon Cho, and Jeong Hee Hong



Dr. Jing Dong

DeRosa Family Associate Professor, Columbia Business School

The impact of historical workload on nurses' perceived workload

Recent and ongoing nursing shortages have highlighted the valuable and skilled work that nurses provide around the clock in hospital inpatient care. Intense and sustained high nursing workload has been linked to nurse burnout and patient safety concerns, necessitating targeted approaches to better managing nursing workload. In this work, we take an empirical approach to understanding the effect of historical workload on nurses' perceived workload. We leverage a unique dataset that records detailed patient-to-nurse assignment information, an order-based workload measure, and a clinically perceived workload measure for each patient during each shift. We also address several identification challenges, including endogeneity, missing values, and measurement errors. Our estimation results show that one level of increase in historical order-based workload can lead to a 0.629 increase in the discrepancy between the clinically perceived workload and the order-based workload. Based on the temporal effect of nursing workload, we design an integer program-based patient-to-nurse assignment policy that achieves a more balanced workload over time while maintaining a high level of continuity of care.



Dr. Nan Liu

Associate Professor, Carroll School of Management

Helping the Captive Audience: Advance Notice of Diagnostic Service for Hospital Inpatients

How to schedule patients is a classic operations management problem in healthcare. There are two standard paradigms of dynamic scheduling: advance scheduling and allocation scheduling. Advance scheduling provides patients with specific service times, letting patients enjoy the most convenience, whereas allocation scheduling puts patients on a waitlist and gives providers the flexibility of calling patients for service at the last minute.

Hospital inpatient diagnostic service is usually managed via allocation scheduling: inpatients are treated as the “captive audience” on-demand, and they are notified only when hospital diagnostic service capacity is available. This arrangement causes significant chaos and inefficiencies in operations. We propose an innovative scheduling policy, called advance notice, to manage hospital diagnostic service. Patients are placed in a common queue waiting to be called for service, and they will be provided both a fixed preparation time and a guaranteed service time window in advance (neither a last-minute notice nor an exact service time in the future). The advance notice policy represents a new scheduling paradigm to strike a fine balance between the two classic ones: it enjoys the benefit of allocation scheduling (giving the provider flexibility in using her capacity) and that of advance scheduling (reducing patient online waiting). We formulate and analyze a Markov Decision Process model to study advance notice decisions. Our numerical study, populated by data from a large academic medical center in the U.S., demonstrates significant improvement in operational efficiency by switching from current practice to adopting our advance notice policy.



Dr. Tinglong Dai

Bernard T. Ferrari Professor, Johns Hopkins Carey Business School

Gatekeeper or Second Opinion? The Role of Artificial Intelligence in Physician-in-the-Loop Systems

A significant portion of FDA-cleared AI devices can be viewed as classifiers that help diagnose specific patient conditions. How such devices should be used in routine care delivery is a topic of much debate: some see AI as a gatekeeper before patients consult physicians, while others see AI as a second opinion after the consultation. Our paper models and analyzes both approaches. We consider a setting in which each patient can consult a specialist, an AI system, or both to obtain a diagnosis specific to a medical condition. The service design decision is whether the patient should consult the AI or the specialist first. The “AI first” approach views the AI as a gatekeeper for the encounter with the specialist, while the “specialist first” approach views the AI as a second opinion that the specialist consults before making a diagnosis. We model and analyze the implications for diagnostic performance and patient outcomes under these two approaches, and provide insights into when AI should be used as a gatekeeper or as a second opinion. For both approaches, our model incorporates a decision-making process that depends on an initial signal, known as the anchor. In light of this anchoring effect, we show that, contrary to popular belief, using AI as a gatekeeper does not necessarily increase missed diagnoses. Nor does it necessarily reduce false-positive diagnoses and hence unnecessary treatments. We show that using AI as a second opinion leads to fewer missed diagnoses, but may or may not reduce false-positive diagnoses. In general, using AI as a gatekeeper is beneficial for low-risk patients and when concerns about unnecessary treatment are high. The use of AI as a second opinion is favored for high-risk patients and when concerns about missed diagnoses are high.