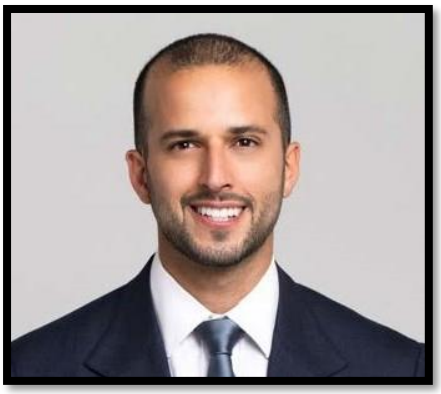
EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

Systems Engineering in Global Health: An Agent-Based Approach to Understand P4P in Maternal and Child Health in Tanzania

ABSTRACT – Attaining the United Nations Sustainable Development Goals requires significant maternal and child health improvement especially in low- and middle-income countries. Systemic interventions and incentive realignment through performance-based payments are common in these countries, and Systems Engineering offers a unique perspective into the highly contextualized implementations of these programs. Agent-based models (ABMs) can simulate health systems and their dynamic response to reforms, capturing feedback loops between agents and incorporating heterogeneities. We built an ABM to recreate the effects of supply-side payment for performance (P4P) scheme for childbirth care in Tanzania and how it affects demand-side behaviors. We modeled three agent classes: women of reproductive age, providers (facilities), and a district manager. We considered decisions and behaviors including woman agent facility-based delivery and provider agent bonus responses (such as the level of kindness to show patients and whether to charge informal fees). Individual and collective experiences shape a woman agent's attitudes toward facility-based deliveries. Provider resource and strategy sharing were also possible in the model. We compared model projections, with/without P4P, of the percentage of births occurring in facilities and the agent behaviors and characteristics underpinning these. This enabled the identification of district-, facility- and community-level pathways creating demand for facility delivery and the influence of P4P. We demonstrated that program evaluation data could inform the development of an ABM to disentangle the pathways to impact and program bottlenecks through virtually reconstructing agents and observing emergent system-level behaviors. Our framework has broader global health implications and methodological steps for others seeking to use ABM to understand better how health system strengthening programs like P4P affect the behavior of providers and patients.

This is a joint work as part of the COSMIC Research Project (link)



Dr. Abdullah Alibrahim
Assistant Professor
Industrial & Management Systems Engineering
Kuwait University

SPEAKER BIO – Abdullah Alibrahim, Ph.D., is an Assistant Professor of Industrial and Management Systems Engineering at the College of Engineering and Petroleum, Kuwait University. His research bridges disciplinary gaps between innovative engineering methods and pressing healthcare challenges to improve system design and performance. Alibrahim holds a PhD in Industrial and Systems Engineering from the University of Southern California (USC, 2017). He also has a master's degree in Operations Research Engineering from USC (2015) and master's and bachelor's degrees in industrial and Systems Engineering from the University of Wisconsin, Madison (2011 and 2010, respectively). He graduated from the Health Systems Engineering Lab at Viterbi School of Engineering at USC, focusing on applications of engineering and systems science in healthcare. His research employs Systems Engineering and Complexity Science approaches for healthcare system financing, design, and operations. This involves utilizing various tools and methods to study the healthcare system, its elements, and its connections. He specializes in computational simulation, advanced data analytics, and machine learning to inform the design of healthcare policies and processes. Dr. Alibrahim has peer-reviewed publications on models informing health policy related to healthcare costs, competition, quality of care, and patient choice of providers. He presented at numerous international conferences on engineering, health management, and health policy. Dr. Alibrahim leads funded projects on assessing patient journeys across the cancer care continuum, the burden of non-communicable diseases on hospital systems, and geographical analyses of opioid use disorder treatment systems. Dr. Alibrahim is a Research Fellow at the Belfer Center of the Harvard Kennedy School and is a consultant in several research teams at the University of Chicago and the London School of Hygiene & Tropical Medicine focusing on analyses of health disparities and systems improvement. He also consulted for the Office of the Undersecretary of Planning at the Ministry of Health – Kuwait. He is a Research Fellow at the GeoHealth Lab in Dasman Diabetes Institute – Kuwait, and a Visiting Research Fellow at the Middle East Centre at the London School of Economics - UK.

USC Viterbi
School of Engineering
Daniel J. Epstein Department of Industrial and Systems Engineering

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3:30 PM – 4:50 PM
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