

How to Navigate the Technical Sessions

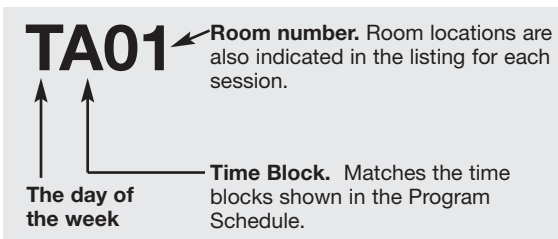
There are four primary resources to help you understand and navigate the Technical Sessions:

- This Technical Session listing, which provides the most detailed information. The listing is presented chronologically by day/time, showing each session and the papers/abstracts/authors within each session.
- The Author and Session indices provide cross-reference assistance (pages 63-66).
- The floor plan on page 11 shows you where technical session tracks are located.
- The Master Track Schedule is on the Inside Back Cover.

Quickest Way to Find Your Own Session

Use the Author Index (page 63) — the session code for your presentation will be shown along with the room location. You can also refer to the full session listing for the room location of your session.

The Session Codes



Time Blocks

Wednesday

- WA — 8:30am - 10:00am
- WB — 10:30am - 11:30pm
- WC — 12:30pm - 2:00pm
- WD — 2:00pm - 3:30pm
- WE — 3:30pm - 5:00pm

Thursday

- TA — 8:30am - 10:00am
- TB — 10:30am - 12:00pm
- Special Lunch Plenary** — 12:00pm - 1:30pm
- TC — 1:30pm - 3:00pm
- TD — 3:30pm - 5:00pm

Friday

- FA — 8:00am - 9:30am
- FB — 9:45am - 11:15pm
- FC — 11:30pm - 1:00pm

Wednesday, 8:30am - 10:00am

■ WA01

01-Broadway A

Integration of Analytics for Point of Care Decision Support

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Tarun Mohan Lal, Mayo Clinic, Rochester, Minnesota
mohanlal.tarun@mayo.edu

1 - Implementation of Analytic Solutions: Journeys of an ACO and a Primary Care Practice

Christie Lawrence, VP, Healthcare Marketing / Business Development, KPN Health Analytics, 8140 Walnut Hill Lane, Suite 925, Dallas, TX, 75321, United States of America, Christie.Lawrence@KPNHealth.com, Dr. Edward J. Bujold, MD, FAAFP

This presentation will share the journey of a primary care practice and a MSSP ACO's use of analytics to transform into a highly efficient and effective patient-centered medical home and integrated delivery network. Do's and don'ts regarding implementation will be discussed along with actual ROI achieved. Bottom line, use of analytics significantly improved quality metrics, reduced the cost of care, and engaged patients, providers and their staff.

2 - Real World Evidence: Unifying Payers, Providers and Pharma via Data and Analytics

Jamie Powers, Industry Consultant, SAS, 100 SAS Campus Drive, Bldg C, Cary, NC, 27517, United States of America, Jamie.Powers@sas.com

As healthcare moves towards more value- or outcomes-based approaches, there is a convergence of payer, provider and pharma interests, most notably centered around data. In this session learn how healthcare companies are creating a data and analytics "ecosystem." Best practices are presented along with real examples from the perspective of pharmaceutical companies. Data examples include claims data, EMR and historical clinical trials. Most importantly, how these come together to inform strategy will be highlighted.

3 - Cloud-Based Models for Analytics: Key Considerations

Paddy Padmanabhan, CEO, Damo Consulting Inc, One Lincoln Center 18W140 Butterfield Rd, Oakbrook Terrace, Oakbrook, IL, 60181, United States of America, paddy@damoconsulting.net

Cloud-based models are gaining adoption rapidly for analytics in healthcare. Traditional software forms are increasingly offering their products on cloud-based platforms as subscription services. A whole new breed of analytics start-ups are providing innovative solutions through cloud-based models, often building the entire offering stack with open source and commercial software, and overlaying that with proprietary analytics tools and models. How do you select one that is most suited for your enterprise? How do you ensure data security and access controls when deploying a cloud solution? The session will discuss key considerations and best practices related to the increased use of cloud-based solutions for healthcare analytics, including HIPAA and data security aspects in the era of big data.

■ WA02

02-Broadway B

Healthcare Modelling in Europe

Cluster: EURO Working Group on Operational Research Applied to Health Services (ORAHs)

Invited Session

Chair: Michael Pidd, Professor of Management Science, Lancaster University, Department of Management Science, The Management School, Lancaster, LA1 4YX, United Kingdom, m.pidd@lancaster.ac.uk

1 - Modeling the Diagnostic Pathway for Chest Pain in Emergency Departments

Martin Pitt, Associate Professor, University of Exeter, Veysey Building, Salmon Pool Lane, Exeter, UK, EX2 4SG, United Kingdom, m.pitt@exeter.ac.uk

The National Institute for Health and Care Excellence (NICE) in the UK has recently issued generic cost effectiveness guidance for the use of high sensitivity cardiac troponin (HSctn) in the diagnostic pathway for chest pain. In particular, NICE has highlighted the potential use of HSctn for 'early rule out' of myocardial infarction and the associated benefits of earlier discharge. However implementation of this guidance is specific to the configuration and context of each acute hospital and any service redesign needs to take account of disparities. This project used discrete event simulation to model the diagnostic pathway for seven acute hospitals in the southwest UK. The model was separately configured for each hospital and then used to assess both the care and resource implications of pathway re-design which encompassed the use of HSctn for diagnosis and its potential for 'early rule out' strategies. The wider implications and challenges of cost-effectiveness analysis of service delivery alternatives will be discussed in this presentation.

2 - A Hybrid Simulation Model for Age-Related Macular Degeneration

Sally Brailsford, University of Southampton, Southampton Business School, Southampton, United Kingdom, S.C.Brailsford@soton.ac.uk, Joe Viana, Stuart Rossiter, Amos Channon, Andrew Lotery

This paper describes a hybrid discrete-event/agent based/system dynamics simulation model, implemented in the software AnyLogic, for the eye disease age-related macular degeneration (AMD), a common cause of sight loss in people aged over 65. The overall aim of the hybrid model was to use the specific example of AMD to explore the wider links between the health and social care systems in the UK, as part of the Care Life Cycle, a 5-year multidisciplinary Research Council funded programme into the impact of an ageing population on supply and demand for health and social care.

■ WA03

03-Broadway C

Stochastic Models in Healthcare

Contributed Session

Chair: Maartje Zonderland, Senior Consultant Healthcare Solutions, Medtronic, Earl Bakkenstraat 10, Heerlen, Netherlands, maartje.zonderland@medtronic.com

1 - A Forward Looking Risk Adjustment Approach using Markov Chain Simulation

Gregory McKinney, Business Analytics Consultant, Kaiser Foundation Health Plan, Inc., 371 Hearst Ave., San Francisco, CA, 94112, United States of America, gmckinne@pacbell.net

Risk Adjustment (RA) is used to set health plan payments reflecting the expected cost of providing care for their members. Plans receive higher payments for members with multiple chronic conditions and less for members with fewer health issues. We use on the RA model specified by the Centers for Medicare & Medicaid Services (CMS) for the Medicare Advantage program. By using Markov Chains, a health plan can predict future risk scores and capitation payments based upon historic experience. Simulation can then quantify the uncertainty around those future projections.

2 - Incorporating Nurse Absenteeism into Long-Term Staffing with Demand Uncertainty

Kayse Lee Maass, Ph.D. Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, leekayse@umich.edu, Mark Daskin, Mary Duck, Hannah Schapiro, Zhehui Wang, Boying Liu, Rama Mwenesi

It is critical from a cost, patient care and nurse satisfaction perspective that nurses be utilized efficiently and effectively. In this study, we develop a new long-term staffing model that accounts for uncertainty in the hospital census as well as nurse absenteeism. Three types of nurses are considered: unit, float and temporary nurses. Based on our preliminary results, we estimate that the potential cost savings nationwide are several billion dollars.

3 - A Reservation Policy for Medical Diagnostic Resource Allocation

Weifen Zhuang, Associate Professor, Xiamen University, Xiamen University, School of Management, Xiamen, China, wfzhuang@xmu.edu.cn, Li Luo, David D. Yao

The paper studies a resource allocation problem accessed by three types of patients. Both inpatients and outpatients have to make an appointment in advance and emergency patients walk in directly. We formulate it via a DP model, analyzing the structural properties and fully characterizing the optimal reservation policy. An upper-bound and a lower-bound to the DP value are created and shown to be asymptotically optimal with their gap quantified. Three heuristic policies are developed and compared analytically. Numerical study illustrates that our heuristics outperform the hospital's target policy significantly.

4 - A Markov Model Approach for Surgical Process Analysis in Cataract Surgery

Maartje Zonderland, Senior Consultant Healthcare Solutions, Medtronic, Earl Bakkenstraat 10, Heerlen, Netherlands, maartje.zonderland@medtronic.com, Richard J. Boucherie

Variability of surgical times heavily affects efficiency and utilization of the operating room. In this study a Markov model is developed that characterizes the steps of the surgical process and their contribution to the total surgical time, including variability. Using Cataract surgery as an example, the model gives insight in the surgical process, without the necessity of analyzing a large number of surgeries for application of statistical methods.

■ WA04

04-Broadway D

Decision Making for Optimal Treatment Strategies

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Hamidreza Badri, PhD student, University of Minnesota, Department of Industrial and Systems Eng, Minneapolis, MN, 55455, United States of America, badri019@umn.edu

1 - A Batch, Off-Policy, Actor-Critic Algorithm for Optimizing Mobile Interventions

Susan Murphy, Professor of Statistics, University of Michigan, Department of Statistics, 311 West Hall, 1085 S. Univ., Ann Arbor, MI, 48109-1107, United States of America, samurphy@umich.edu, Richard Sutton, Hamid Maei, Katie Witkiewitz, Yanzen Deng, Eric Laber

We develop an off-policy actor-critic algorithm for learning an optimal policy from a training set composed of data from multiple individuals. This algorithm is developed with a view toward its use in mobile health.

2 - Data-Driven Decision Making in Large-Scale Spatio-Temporal Decision Problems

Nicholas Meyer, Graduate Student, North Carolina State University, SAS Hall, Raleigh, NC, United States of America, njmeyer@ncsu.edu, Eric Laber, Krishna Pacifici, Brian Reich, John Drake

Spatio-temporal decision problems are prevalent in many sectors of science and society. An effective decision strategy must be expressive, computationally scalable, and interpretable in a subject matter context. We derive a semi-parametric estimator of an optimal decision strategy that scales linearly in problem size.

3 - Robust Optimization of Dose Schedules in Radiotherapy

Hamidreza Badri, PhD student, University of Minnesota,
Department of Industrial and Systems Eng, Minneapolis, MN,
55455, United States of America, badri019@umn.edu,
Kevin Leder

Optimal radiation schedules are acutely sensitive to the perturbations in model parameters. This paper proposes two radiation scheduling concepts (robust and stochastic optimization) to incorporate inter-patient uncertainties into the optimization. Authors demonstrated how the configuration of optimal solutions changes compared to conventional schedules, which do not account for uncertainty.

■ WA05

05-Broadway G

Panel: Healthcare Systems – Big Data and IT Challenges

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Eva Lee, Professor & Director, Industrial And Systems Engineering, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

1 - Panel: Healthcare Systems — Big Data and Its Challenges

Moderator: Eva Lee, Professor & Director, Industrial And Systems Engineering, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu, Panelists: Michael Schrage, Victoria Jordan, Warren S. Sandberg

The promise of big data in healthcare is revolutionary. Use of big data will ease the transition to authentic data-driven evidence-based healthcare, allowing healthcare professionals to improve the standard of care based on millions of cases, define needs for subpopulations, and identify and intervene for population groups at risk for poor outcomes. To date, few healthcare professionals would claim that the promise of big data has been fulfilled. This panel brings together healthcare and business leaders to debate and discuss challenges and opportunities in this area.

■ WA06

06-Broadway H

Analytics and Visualization in Emergency Departments

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Kalyan Pasupathy, Associate Professor, Mayo Clinic, 200 First St SW, Rochester, MN, 55905, United States of America, Pasupathy.Kalyan@mayo.edu

1 - Analyzing and Visualizing Clinical Pathway Adherence in the Emergency Department

Vikas Kumar, Graduate Research Assistant, Georgia Institute of Technology, North Avenue NW, Atlanta, GA, 30332, United States of America, vkumar78@gatech.edu, Rahul Basole, Mark Braunstein, Duen Horng Chau, Mayank Gupta, Minsuk Kahng, Burt Lesnick, Hyunwoo Park, Robert Pienta, Nicoleta Serban

Increasingly available digital EHR clinical data has the potential to help evaluate clinical pathway adherence. However, current methods were developed in an earlier era and are either subjective or don't make use of clinical data. We propose a stepwise, rule-based algorithm for measuring population pathway adherence as well as a case-by-case adherence visualization tool using MATLAB and apply it to 562 ED visits for pediatric asthma. Our preliminary results exemplify the objective and quantitative nature of our approach and its suitability for large-scale process measurement in the ED.

2 - Improving the Accuracy of Emergency Department Modeling: Augmenting EHR Data with RTLS Data

Seth Hostetler, Lead Process Engineer, Geisinger Health System, 100 N Academy Ave, Danville, PA, 17822, United States of America, sethhostetler@gmail.com

This session will discuss a simulation model developed for the Geisinger Wyoming Valley emergency department, using traditional data sources, to improve patient flows. We will discuss the results from this model, as well as gaps in this method. Finally, an improved modeling method for visualizing patient and staff work flows, utilizing data from a real-time locating system, will be presented.

3 - Scheduling for Medical Residents

William Pozehl, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, pozewil@umich.edu, Young-Chae Hong, Amy Cohn

We develop and solve optimization models for scheduling medical residents into service rotations on a yearly basis and shifts in an emergency department on a monthly basis. We discuss the similarities, differences, and relationship between these scheduling problems and explore their impact on patient care and resident education.

4 - A Data Mining Approach to Understand Factors Associated with Frequent Emergency Department Use

Hyojung Kang, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16802, United States of America, hqk5116@psu.edu, Harriet Nembhard

Frequent users of the emergency department (ED), also referred to as "frequent flyers" affect efficiency, quality, and cost of care in a hospital. A better understanding of frequent flyers will provide insights into solutions for ED crowding and ED-based care coordination. The objective of this study is to provide a framework to analyze factors associated with ED frequent flyers. We develop a statistical machine learning model and test the model using actual hospital data.

■ WA07

07-Broadway J

Calibration Methods for Mathematical Models of Health Applications

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Eva Enns, University of Minnesota, 420 Delaware St. SE, Minneapolis, MN, 55408, United States of America, eenns@umn.edu

1 - Calibration of Piecewise Markov Models using a Bayesian Change-Point Analysis

Fernando Alarid-Escudero, PhD Student/Graduate Research Assistant, University of Minnesota School of Public Health, Division of Health Policy and Management, 420 Delaware St. SE, Minneapolis, MN, 55455, United States of America, alari006@umn.edu, Karen Kuntz, Eva Enns, Richard Maclehose

To calibrate the transition probabilities to and from an unobserved state of a piecewise Markov model to fit a relative survival curve of stage 3 colorectal cancer patients. Methods: We used a Bayesian Markov chain Monte Carlo (MCMC) change-point model to estimate the optimal cutoff time points of a three-piecewise Markov with a structure defined by the progression of the disease. Results: Compared to a single-piece approach, the piecewise calibration method improved the goodness of fit by 60%. The posterior mean of the estimated change points was 3 and 24 months.

2 - Input Selection using Model Calibration

Lauren Cipriano, Assistant Professor, Ivey Business School, 1255 Western Road, London, ON, N6G 0N1, Canada, lcipriano@ivey.uwo.ca, Eva Enns, Chung Yin Kong

We compare methods for selecting best-fitting sets in a multi-target calibration problem. Using simulation, we seek to identify which methods are able to generate best-fitting input sets that accurately reflect the distributional characteristics of the 'true' input parameter uncertainty. We explore how choices surrounding the selection of best-fitting sets in model calibration impacts decision uncertainty estimates and value-of-information analysis results in health economic models.

3 - An Iterative Convex Optimization Approach to Calibrating Markov Models with Aggregated Data

Eva Enns, University of Minnesota, 420 Delaware St. SE, Minneapolis, MN, 55408, United States of America, eenns@umn.edu, Fernando Alarid-Escudero, Jeremy Goldhaber-Fiebert

Many of the parameters that govern the evolution of a natural history disease model are not or cannot be directly observed in clinical settings. We present a two-step iterative convex optimization-based (TICO) algorithm for estimating the transition probabilities and cohort distribution trajectories that best fit partially-observed cohort state distributions collected at intervals much longer than the timescale of the underlying disease dynamics. We compare the performance of the TICO algorithm in fitting empirical and simulated data to other general calibration methods.

■ WA08

08-Broadway K

Analytics in Healthcare Operations

Cluster: Health Operations & Logistics

Invited Session

Chair: Kai Yang, Professor, 4815 Fourth Street, Detroit, MI, 48201, United States of America, kyang777@gmail.com

1 - Enterprise Data Management: A Critical Foundation for Analytics

Christopher Heien, Senior Data Strategist, CIGNA, 523 E 85th St Apt 5A, New York, NY, 10028, United States of America, Christopher.Heien@Cigna.com, Jennifer Griffin

"Data" are quantitative and qualitative values used by analytics functions to derive insights and support effective decision-making. Enterprise Data Management (EDM), rooted in Information Lifecycle Management, is the critical foundation required to support high quality analytics. Effective EDM elevates data capabilities and implements data management policy to provide a holistic cross-functional data management framework. This paper presents the relational components of EDM and illustrates how they facilitate higher quality of data to produce higher confidence of insights.

2 - Predicting Healthcare in Medical Homes with Bayesian Non-Parametric Models

Issac Shams, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, United States of America, issacsh@umich.edu, Saeede Ajorlou, Kai Yang

Motivated by large health care data obtained from the US Veterans Health Administration (VHA), we develop a Bayesian non-parametric regression model that involves a set of hierarchical patient/team factors to account for individual/across team heterogeneity. A Bayesian shrinkage approach is used to select among effects at base/higher levels. The method is applied to a real case study and helped to predict clinical portfolio demands in medical home setting.

3 - Allocating Scarce Resources in a Patient Centered Medical Home (PCMH)

Jingxing Wang, Mr, University of Michigan, 1205 Beal Ave., 2860 IOE Building, Ann Arbor, MI, 48109, United States of America, jeffwjx@umich.edu, Romesh Saigal

We consider a two stage stochastic allocation problem to assign the number of hours of Primary Care Physician to teams in a PCMH. In the first stage, a preliminary assignment is made. In the second stage, the demand is observed and the preliminary assignment adjusted to meet it exactly. We use real options theory and present three ways to achieve a fair and consistent mechanism to price the disruption caused by adjustment. The assignments are made such that the price of disruption is the same.

■ WA09

09-Cumberland 1

Economics of Health Information Sharing

Cluster: Health Information Technology and Management

Invited Session

Chair: Mehmet Ayyaci, Assistant Professor, University of Texas at Dallas, Jindal School of Management, Information Systems, Richardson, TX, United States of America, mehmet.ayyaci@utdallas.edu

1 - Financial Benefits of Health Information Exchange in Emergency Departments

Niam Yaraghi, The Brookings Institution, nyaraghi@brookings.edu

I present the results of a randomized control trial study on the effectiveness of HIE services in reducing the likelihood and the number of laboratory tests and radiology examinations. HIE is associated with 2.0750 and 1.7183 units of reduction in log odds of performing at least one laboratory test and radiology examination. HIE is associated with respectively 0.7248 and 0.4363 units of reduction in the log count of the total number of performed laboratory tests and radiology examinations.

2 - The Optimal use of Health Information under Physicians' Defensive Behavior in Health Systems

Yeongin Kim, PhD Student, University of Texas at Dallas, Jindal School of Management, Information Systems, Richardson, TX, 75080, United States of America, yxk130930@utdallas.edu, Srinivasan Raghunathan, Mehmet Ayyaci, Turgay Ayer

Motivated by screening for diseases, we study physicians' defensive behavior due to information sharing and the optimal design of guidelines for a two-staged healthcare delivery process. Using a game theoretic modeling setup, we surprisingly find that the ambiguity in the guidelines for patient screening is the optimal strategy to deal with defensive behavior.

3 - Does Health Information Exchange Move Patients through Emergency Departments Faster?

Mehmet Ayyaci, Assistant Professor, University of Texas at Dallas, Jindal School of Management, Information Systems, Richardson, TX, United States of America, mehmet.ayyaci@utdallas.edu, Herbert Wong, Turgay Ayer, Zeynal Karaca, Jan Vlachy

We study the impact of Health Information Exchanges on operational efficiency in emergency departments (ED) as measured by LOS while explicitly taking into account 1) service load as indicated by ED census at the hour of admission, 2) service intensity as indicated by patient's comorbidity score or the mode of patient arrival, and 3) organizational factors. We find that patients spend up to 14 minutes less in the ED following HIE adoption.

■ WA10

10-Cumberland 2

Hospital Operational Process Modeling and Optimization

Cluster: Health Operations & Logistics

Invited Session

Chair: Nan Kong, Associate Professor, Purdue University, 206 S. Martin Jischke Dr., West Lafayette, IN, 47907, United States of America, nkong@purdue.edu

1 - Patient Assignment and Operation Room Scheduling under Uncertainty of Operations Cancellation

Xiaolei Xie, Assistant Professor, Tsinghua University, 614 Shunde Building, Tsinghua University, Beijing, China, xxie@tsinghua.edu.cn, Yongjia Song

We study optimal operation room (OR) scheduling under the uncertainty of operation duration and procedure cancellation, the latter of which is commonly observed in practice yet less addressed in literature. A three-stage stochastic integer program (SIP) is formulated, which integrates the operational decisions with the tactical decisions. We derive cutting planes to improve this formulation, and propose decomposition algorithms as alternative approaches to solve this model. Simulation models are developed to validate the proposed stochastic optimization framework with a case study.

2 - Real Time Access Control of Patient Service in the Pediatrics Department

Jie Song, Dr., Peking University, NO. 298 Chengfu Road, Haidian District, College of Engineering, Beijing, 100871, China, songjie@coe.pku.edu.cn, Yunzhe Qiu, Zekun Liu

This paper develops a real-time appointment scheduling considering both the difference and fairness waiting time among heterogeneous patients. We use the utility theory to measure service satisfaction, which is integrated with CTMDP model. A myopic policy considering both the patients' waiting patience and hospital utilization is provided to minimize the overall disutility. A case based on the collaborated hospital is investigated, where the results confirm the effectiveness of the policy.

3 - Process Flow and Optimization for Improved Delivery of Surgical Instruments

Rama Mwenesi, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, rmwenesi@umich.edu

Efficiency in surgical instrument reprocessing is a critical challenge for most large hospital systems. Instruments that are insufficiently cleaned or maintained negatively impact patient safety and surgical outcomes. This study examines how i) instrument cleanability and ii) instrument-set configurations impact efficiencies in reprocessing outcomes as well as the associated quality of care and costs of delivery. Using data from a high-volume surgical center we evaluate process flow variations in the delivery of surgical instruments and present optimization-based models for improving delivery.

■ WA11

11-Cumberland 3

Advanced Healthcare Resource Allocation

Cluster: Medical Decision Making

Invited Session

Chair: Hao Huang, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, haoh7493@uw.edu

Co-Chair: Zelda Zabinsky, Professor, University of Washington, Industrial and Systems Engineering, Seattle, WA, 98195-2650, United States of America, zelda@u.washington.edu

1 - On Coordinating Anesthesiology and Internal Medicine in a Patient-Centered Surgical Home

Douglas Morrice, Professor, University of Texas-Austin, Information, Risk, & Operations Management, Austin, TX, United States of America, Douglas.Morrice@mcombs.utexas.edu, Ester Wang, Kumar Muthuraman, Jonathan Bard, Luci Leykum, Susan Noorily

In this paper, we consider different levels of coordination of anesthesia and internal medicine services through patient scheduling in a Patient-Centered Surgical Home. Our work is motivated by a study conducted at the University of Texas Health Sciences Center, San Antonio and its affiliated teaching hospital.

2 - Optimal Staffing of Patient Centered Medical Homes under Conditions of Highly Variable Demand

David Linz, Graduate Student Researcher, University of Washington, 3900 Northeast Stevens Way, Mechanical Engineering Building, Room G6, Seattle, WA, 98105, United States of America, ddlinz@gmail.com, Zelda Zabinsky, Paul Fishman, Joseph Heim

This paper examines the issue of staffing specialist care in a region of local patient-centered clinics. As previous literature suggests, there are some benefits to centralizing the provision of care as well as drawbacks. Using a bi-objective mixed-integer linear program, the paper outlines a process for making large-scale decisions about specialist staffing within a given geographic region. Furthermore, the paper demonstrates the utility of modeling demand of non-normal distributions especially those with high kurtosis.

3 - Simulation Optimization for Medical Imaging Resources Allocation

Hao Huang, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, haoh7493@uw.edu, Zelda Zabinsky, Joseph A. Heim, Paul Fishman

Orthopedic care usually involves imaging as a reference for shoulder diagnosis. Portable ultrasound machines are considered to replace or supplement magnetic resonance imaging (MRI), the traditional approach. A discrete-event simulation model is used to evaluate different system designs' cost and health utility loss. A multiple objective simulation optimization algorithm is introduced to approximate the Pareto optimal set and analyze the trade-off between performance metrics.

■ WA12

12-Cumberland 4

Behavioral Operations in Health Care Organizations

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Anita Tucker, Associate Professor, Brandeis University, 415 South Street, Waltham, MA, 02453, United States of America, atucker@brandeis.edu

1 - The Effects of Public Relative Performance Feedback on Variability and Productivity

Hummy Song, PhD Candidate, Harvard University, Wyss House, Soldiers Field Road, Boston, MA, 02163, United States of America, hsong@hbs.edu, David Vinson, Anita Tucker, Karen Murrell

Relative performance feedback (RPF) shows workers their performance in comparison to coworkers' performance. We study an emergency department that switched from private RPF, which used code numbers to identify physicians, to public RPF, which used names. We find that public RPF is associated with a significant decrease in variability and a 5% decrease in length of stay. These results stem from a diffusion of best practices from high-productivity physicians to lower-productivity ones.

2 - Discrete Choice Experiments in Healthcare Services

Rohit Verma, Singapore Tourism Board Distinguished Professor, Cornell University, School of Hotel Administration, Ithaca, NY, 14850, United States of America, rv54@cornell.edu

During the last few years, discrete choice experiments have become a popular approach for understanding tradeoffs and preferences of different stakeholders and decision-makers within the healthcare industry. This presentation will provide examples of several discrete choice experiments from the healthcare settings including new product innovation and supplier selection for expensive medical equipment.

3 - Collaboration and Professional Labor Productivity: An Empirical Study of Physician Workflows

Lu Wang, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60208, United States of America, vivianluluw@gmail.com, Jan Van Mieghem, Itai Gurvich, Kevin O'Leary

Collaboration in professional labor service can introduce a capacity loss. We conduct an empirical study of collaboration among physicians in a large hospital. While providing patient care services, physicians need to consult with consultants. Such collaborative activities often involve interruptions and may require a physician to switch from her current activity. With data collected by directly observing hospitalists, we show that switches inherent in collaboration reduce the physician's capacity, by 33%. We estimate a 5% avoidable loss by disentangling the benefit and cost of switches.

4 - A Simulation Model for Analyzing a Dedicated Psychiatric Care Unit within an Emergency Department

Charles Noon, Professor, University of Tennessee, Business Analytics & Statistics, Knoxville, TN, 37996, United States of America, cnoon@utk.edu, Yener Balan, Karen Murrell, Bogdan Bichescu

The national shortage of mental health services is straining emergency departments (EDs) due to the long length of stay for psychiatric patients in the ED. This research builds on the work at a California hospital that uses a promising new care model for treating psychiatric patients within the ED. Discrete-event simulation is used to validate and analyze the care model's impact on key metrics of patient flow and system financials. Through sensitivity analysis, we provide guidelines to help hospitals determine whether the new care model should be adopted and its expected benefits.

■ WA13

13-Cumberland 5

Choice Modelling Applications in Healthcare

Contributed Session

Chair: Orrin Cooper, Fogelman College of Business and Economics, University of Memphis, Memphis, TN, United States of America, olcooper@memphis.edu

1 - Patients' Perception Bias and Its Impact on Hospital Choice

Guihua Wang, University of Michigan – Ann Arbor, 1714 McIntyre Drive, Ann Arbor, MI, 48105, United States of America, guihuaw@umich.edu, Jun Li, Wallace Hopp

Using a patient-level dataset across 35 New York hospitals, we document wide quality gap among hospitals. We then use a discrete choice model to estimate what influences patient perception of hospital quality and quantify the level of sub-optimality of their choices of hospitals.

2 - The Effects of Online Word of Mouth on Physician Demand: Evidence from a Natural Experiment

Aishwarya Deep Shukla, PhD Student, Robert H Smith School of Business, 3330C R H Smith School of Business, University of Maryland, College Park, MD, 20742, United States of America, adshukla@rhsmith.umd.edu, Ritu Agarwal, Guodong (Gordon) Gao

We examine the impact of online word-of-mouth on consumer demand for healthcare services, through a natural experiment setting from a physician appointment booking platform in India. We find that doctors whose "recommendations" become visible experience a significant increase in the number of appointments they receive. We establish causality by eliminating many of the confounding factors that are hard to control for in the analysis of observational data.

3 - Employer Health Plan Selection Decisions: A Stakeholder-Theory Based Analytic Network Process (ANP)

Orrin Cooper, Fogelman College of Business and Economics, University of Memphis, Memphis, TN, United States of America, olcooper@memphis.edu, Mehdi Amini

The Patient Protection and Affordable Care Act has introduced new challenges for employers including the decision regarding the selection and offering of health plans. This decision should meet the legal requirements and satisfy the potentially conflicting interests of the employer and employees. The Employer Health Plan Selection model uses a stakeholder-theory based Analytic Network Process approach. A case study is presented with sensitivity analyses to investigate the robustness of the selected plan and the potential trade-offs in identifying a health plan satisfactory to all stakeholders.

■ WA14

14-Cumberland 6

Predictive Modelling in Healthcare Operations I

Contributed Session

Chair: Ashish Gupta, Associate Professor and Director of Big Data & Analytics Research Center, University of Tennessee-Chattanooga, 615 McCallie Ave. College of Business, 406C Fletcher Hall, Dpt 6156, Chattanooga, TN, 37403, United States of America, gupta@utc.edu

1 - Geisinger Predicts Outpatient Demand for Appointments to Enable Optimal Provider Scheduling

Christopher Strömlad, Senior Modeler - Operations Research, Geisinger Health System, 100 N. Academy Ave, Danville, PA, 17822, United States of America, chris.stromblad@gmail.com, Priyantha Devapriya, Jason Puckey

Patient demand for a given service line can both be location and provider specific. If it is possible to accurately estimate the patient demand for appointments, we will be able to optimally schedule physicians to where the most pressing demand is. At Geisinger Health System we have a plethora of historical data about our patient population and their previous visiting pattern. We developed a predictive model to forecast patient demand, achieved an average R²-value of 0.90, and integrated the model into the current staff scheduling optimization process.

2 - Prediction of Length of Hospital Stay in a Neonatal Unit

Cansu Dagsuyu, Research Assistant, Cukurova University, Cukurova University Industrial, Engineering Balcali Campus, Adana, 01330, Turkey, cdagsuyu@cu.edu.tr, Nejat Narli, Ali Kokangul, Elifcan Gocmen, M. fide Zeynep Narli

One of the most important problems in the hospitals is uncertainty in length of patient hospital stay. Length of stay (LOS) is also an important indicator for assessing the efficient bed planning. We used feed-forward neural network approach and linear regression for prediction of the LOS based on the inputs including newborn birth weight, fever in a newborn, pulse, respiratory, blood pressure values in a neonatal unit.

3 - A Predictive Model for Improved Rehabilitation Care

Ashish Gupta, Associate Professor and Director of Big Data & Analytics Research Center, University of Tennessee-Chattanooga, 615 McCallie Ave. College of Business, 406C Fletcher Hall, Dept 6156, Chattanooga, TN, 37403, United States of America, gupta@utc.edu, Sagar Kapadia, Chris Young, Gary Wilkerson

This study develops an analytics model for predicting the ability of stroke patients admitted for inpatient rehabilitation care to independently care for them. We use various components of Functional Independence Measures (FIM) as a measure to capture their functional and cognitive abilities. These models can be used to evaluate the discharge path for the patient as well as determining appropriate care needed before or after the discharge. Findings could be utilized for delivering personalized therapy adherence programs and post discharge care procedures at Rehabilitation hospital.

Wednesday, 10:30am - 11:30am

■ WB01

01-Broadway F

Wednesday Plenary

Cluster: Plenary

Invited Session

Chair: M. Eric Johnson, Dean, Vanderbilt University, Owen School of Management, Nashville, TN, 37203, United States of America, eric.johnson@owen.vanderbilt.edu

1 - Consumer Driven Healthcare and the Role of an Intelligent Network

Kris Joshi, Executive Vice President Products, Emdeon, EVP - Products, 3055 Lebanon Pike, Nashville, TN, 37214, KJOSHI@emdeon.com

Healthcare is finally transforming, and the consumer is at the center of it – but, not always in a good way. With rapidly rising out-of-pocket costs, consumers are often left feeling confused, frustrated or cheated when they face unexpected bills. The concept of “value” in healthcare from a consumer standpoint remains elusive. Providers are struggling to deal with this new reality as they face mounting consumer bad debt. Payers are struggling to shift from an employer-driven group health model to a consumer driven retail market place. In this fluid marketplace, the opportunity for innovation is immense. But to create new value, the industry must push toward greater transparency and provide

consumers and providers with the data, insights and tools necessary to thrive in this complex environment. Emdeon is the largest healthcare network in the US, connecting payers, providers, pharmacies, and labs, carrying over \$1.2 Trillion worth of healthcare claims every year, and serving over 200 million unique individuals each year. Emdeon’s intelligent network enables all stakeholders to connect, transact efficiently, distribute payments, and make better decisions. Emdeon’s vision is to provide a pervasive, neutral network that can help make the healthcare experience more seamless and familiar for consumers by providing predictive insights to enable better decisions and helping foster persistent trust-based relationships across healthcare stakeholders. Kris Joshi was appointed Executive Vice President of Products at Emdeon in 2013. Prior to that, he was Global Vice President for Healthcare in Oracle Corporation’s Health Sciences Global Business Unit, where he directed the development of Oracle’s healthcare platform, and successfully led two major acquisitions for Oracle in the life sciences space. Before joining Oracle, Joshi was head of strategy for IBM’s global healthcare business, and served in senior strategy roles in IBM’s Global Sales and Distribution organization. Prior to that, he was a consultant with McKinsey and Co, where he served Fortune 500 clients on strategy issues. Joshi holds a bachelor’s degree in Mathematics from Caltech, and a Ph.D. in Physics from MIT.

Wednesday, 12:30pm - 2:00pm

■ WC01

01-Broadway A

PANEL: Utilizing Analytics to Drive Operational and Financial Decision-making in Healthcare

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Eric Stephens, Operations Analyst, Vanderbilt University Medical Center, 3319 West End Ave., Ste. 900, Nashville, TN, 37203, United States of America, eric.b.stephens@vanderbilt.edu

1 - Panel: Utilizing Analytics to Drive Operational and Financial Decision Making in Healthcare

Moderator: Eric Stephens, Operations Analyst, Vanderbilt University Medical Center, 3319 West End Ave., Ste. 900, Nashville, TN, 37203, United States of America, eric.b.stephens@vanderbilt.edu, Panelists: Ed Marx, Edmund Jackson, Ed Hickey, Damian Mingle, J. Tod Fetherling

Featuring several leading experts in healthcare analytics, this panel will focus on the practical application of analytics and data science to drive operational and financial outcomes. In addition, the future of healthcare analytics within an environment of expanded regulation, rising costs, and increasingly complex data will be discussed.

■ WC02

02-Broadway B

Driving Quality Improvement I

Cluster: Association of Anesthesia Clinical Directors

Invited Session

Chair: Paul St Jacques, Quality and Patient Safety Director, Department of Anesthesiology, Vanderbilt University School of Medicine, 1501 21st Avenue South, 4648 TVC, Nashville, TN, 37232, United States of America, Paul.stjacques@vanderbilt.edu

1 - Graph-Theory Optimization of OR Teams: Breaking Bad Heuristics through the House of Cards?

Patrick Tighe, Assistant Professor, University of Florida, 1600 SW Archer Road, P.O Box 100254, Gainesville, FL, 32610, United States of America, ptighe@ufl.edu

Social network analysis (SNA) uses graph theory to quantify the relationships amongst individuals. Following a brief overview of SNA principles, we report on our progress in using SNA to describe the structure and implicit behavior of operating room (OR) networks, as well as explore the feasibility of using SNA-based recommender engines to select OR teams optimized for enhanced patient care.

2 - OR Analytics: Lessons in Translation

David Edwards, Director, Acute Pain Service, Massachusetts General Hospital, 55 Fruit St, Boston, MA, 01742, United States of America, daedwards@mgh.harvard.edu

This panel will discuss our preliminary experiences in translating data science products from the realm of academic exploration to application at both the patient and population levels. We show applications of machine learning, graph theory and Markovian methods to acute postoperative pain management.

3 - High Operating Room Reliability

Mitchell Tsai, Associate Professor, University of Vermont Medical Center, Department of Anesthesiology, 111 Colchester Avenue, Burlington, VT, 05401, United States of America, Mitchell.Tsai@uvmhealth.org

Effective operating room (OR) management requires a multi-disciplinary commitment and expertise. For most hospitals, the ORs account for up to 60% of a hospital's revenue and 40% of its expenses. Despite the supposition that an effective governance structure can have profound implications for the financial health of any hospital, Sieber showed that there is no definitive OR management structure or process. We believe that effective OR management and leadership hinges on technology, transparency and developing self-governing systems.

WC03

03-Broadway C

Big Data Analytics and Health Informatics

Cluster: INFORMS Data Mining Section

Invited Session

Chair: Hui Yang, University of South Florida, Tampa, FL, United States of America, huiyang@usf.edu

1 - In-Silico Modeling of Glycosylation Modulation Dynamics in K+ Ions Channels and Cardiac Signaling

Dongping Du, University of South Florida, 14329 Wedgewood Cr. Apt. 202, Tampa, FL, United States of America, dongpingdu@mail.usf.edu, Hui Yang

Cardiac ion channels are heavily glycosylated. However, little is known about how reduced glycosylation impacts the gating of K⁺ channels. Moreover, decomposing the joint K⁺ current is quite difficult because K⁺ channels activate at similar range of voltage, and share overlapping kinetics. The proposed decomposition method takes advantage of computer models of K⁺ channels, and describes the fine-grained details of specific currents. As such, it enables the interpretation of glycosylation modulation dynamics in the gating of each individual K⁺ channel.

2 - Identifying Severe Sepsis and Septic Shock Patients in the ED using Big Data Analytics

Hao Zhang, Assistant Professor, University of Maryland School of Medicine, 22 S Greene St., Baltimore, MD, United States of America, hzhan001@umaryland.edu

A practical decision support system to predict severe sepsis and septic shock in the emergency department using episodic data harvested from the electronic medical record (EMR) will be presented. Identifying pre-symptomatic cases could potentially reduce the clinical and financial burden on healthcare systems. After mining two years of emergency department visits, a predictive model that identifies sepsis with high sensitivity and specificity is developed and put into clinical use.

3 - Heterogeneous Elective Inpatient Flow Modeling and Scheduling

Chitta Ranjan, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, nk.chitta.ranjan@gatech.edu, Kamran Paynabar, Jonathan Helm

We develop a Clustering and Scheduling Integrated (CSI) approach to capture patient flows through a network of hospital services. CSI functions by clustering patients into groups based on similarity of trajectory using a Semi-Markov model-based clustering scheme. The methodology is validated by simulation and then applied to real data where it outperforms current methods, increasing elective admissions and utilization by more than double compared to traditional methods. Besides SMM-clustering is a novel approach applicable to any temporal-spatial stochastic data.

4 - Spatiotemporal Analytics of Heart Diseases

Chen Kan, University of South Florida, Tampa, FL, United States of America, chenkan@mail.usf.edu, Hui Yang

Cardiovascular diseases are the leading cause of death in the world. This paper presents a novel spatiotemporal warping approach to quantify the dissimilarity of disease-altered cardiac electrical activity. Furthermore, we optimize the embedding of each functional recording as a node in a high-dimensional complex network. This, in turn, significantly improves the recognition of disease patterns and advances the smart management of heart health.

WC04

04-Broadway D

Public Health Modeling

Cluster: Public Health and Emergency Medicine

Invited Session

Chair: Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, MA, 01003, United States of America, chaitrag@umass.edu

1 - Modeling Tuberculosis Transmission in the US Population

Dylan Shepardson, Assistant Professor, Mathematics and Statistics, Mount Holyoke College, 50 College St, South Hadley, MA, 01035, United States of America, dshepard@mtholyoke.edu

Globally, tuberculosis (TB) continues to be a major threat and is said by the World Health Organization to be second only to HIV/AIDS as the greatest killer worldwide due to a single infectious agent. Building on work by Hill et al. at the Centers for Disease Control and Prevention, we have developed a new model of TB transmission in the US population that allows for the inclusion of population heterogeneity, individual risk factors, and economic data. This new model allows us to address questions important to tuberculosis control policymakers, including identifying effective and cost-effective population-level TB-control interventions and projecting the future economic impact of TB in the U.S.

2 - Saving Lives: Building Capacities, Capabilities, and Real-time Operations

Andriy Shapoval, Georgia Tech, Atlanta, Georgia, ashapoval3@gatech.edu, Eva Lee

This work is joint with CDC. In this talk, we will share her experience in assisting with the U.S. response to the earthquake in Haiti, in Fukushima for the radiological emergency response, and with the recent Ebola outbreak in West Africa. We will discuss the system capabilities and the technical challenges.

3 - Ambulance Travel Time Estimation and Map-Matching using GPS Data

Bradford Westgate, Visiting Assistant Professor, Mount Holyoke College, 50 College Street, South Hadley, MA, 01075, United States of America, bwestgat@mtholyoke.edu, Dawn Woodard, Shane Henderson, David Matteson

We discuss a statistical method for estimating ambulance travel time distributions on a road network, using Global Positioning System (GPS) data. We include covariates such as the types of roads traveled and time of day. We evaluate our method using data from ambulance trips in Toronto. We also consider map-matching, i.e. estimating a vehicle's path from sparse and error-prone GPS data. In practice, successive GPS location readings are often biased in the same direction. We introduce a statistical map-matching method that models the distribution of GPS biases.

4 - Optimizing Spatiotemporal Antiviral Release Schedules in a Pandemic Influenza

Bismark Singh, The University of Texas at Austin, 204 E. Dean Keeton Street, Stop C2200 ET, Austin, TX, 78705, United States of America, bismark.singh@utexas.edu, Nediako Dimitrov, Lauren Meyers

To help the state of Texas plan influenza epidemic interventions, we build a stochastic MIP to compute time-based antiviral releases. The 2.25 million scenarios in the stochastic program are derived from an epidemic simulator that accounts for the large amount of uncertainty in the disease progression. We present techniques to solve this problem, even though a direct-solve is intractable.

WC05

05-Broadway G

Economic and Disease Modeling

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Yeongin Kim, PhD Student, University of Texas at Dallas, Jindal School of Management, Information Systems, Richardson, TX, 75080, United States of America, yxk130930@utdallas.edu

1 - Optimizing a Multi-Unit Staffing Plan under Uncertainty for Partially Cross-Trained Nurses

Sanjay Mehrotra, Northwestern University, The Technological Institute, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, mehrotra@northwestern.edu

Limited budget for full-time equivalent nursing positions compels hospital operations managers to efficiently utilize nursing staffs without compromising care quality. We present a nurse-staffing model to find the optimal staffing levels and patterns of full-time/part-time nurses for different care units and nurse float pool. We further analyze the cost implications of using part-time nurses and float pool nurses.

2 - Predictive Analytics for the Outbreak of Hospital Acquired Clostridium Difficile Infection

Biao Wang, PhD Candidate, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, b67wang@uwaterloo.ca, Kenneth McKay, William Ciccotelli, Josh Morel

The prediction of an infectious disease outbreak is at two levels: population and individual. Network statistics as predictors are introduced for the prediction of the transmission of hospital acquired Clostridium difficile infection (HA CDI) at the population level. A "multiple modeling methods approach" is introduced to identify patients at risk of HA CDI at individual level.

3 - Evaluating the Effectiveness of Reverse Referrals in a Chinese Two-Way Referral System

Nan Kong, Associate Professor, Purdue University, 206 S. Martin Jischke Dr., West Lafayette, IN, 47907, United States of America, nkong@purdue.edu, Quanlin Li, Na Li

Two-way referral coordination has been promoted in China to alleviate healthcare resource limitation. Compared to forward referrals, reverse referrals, i.e., referring patients back to community hospitals for subacute or long-term care, are difficult to implement within hospital alliances. We model reverse referrals using a queueing network and evaluate several system performances. We characterize hospitals at different levels that are suitable to share care resource and facilitate coordination.

WC06

06-Broadway H

Applications of Healthcare Information Systems

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Jung Changmi, Assistant Professor, Johns Hopkins University, 100 International Dr., Office 1323, Baltimore, MD, 21202, United States of America, changmi.jung@gmail.com

1 - On Learning and Visualizing Clinical Pathways from Electronic Health Records

Yiye Zhang, PhD student, Carnegie Mellon University, 4800 Forbes Ave., Pittsburgh, PA, 15213, United States of America, yiyez@andrew.cmu.edu, Rema Padman

The visit history of patients from EHR is modeled as Markov chains of office visits containing information on visit purpose, date, procedure, diagnosis and medication. Clinical pathways are learned for multiple underlying patient subgroups. For patients, insights from this study may result in new evidence to support patient-centered treatment approaches, and empower CKD patients to better manage their diseases. For healthcare providers and organizations, our method offers an opportunity for efficient practice review, innovation in care models, and potential cost reduction.

2 - Modeling Evolution of Risk of Cardiorespiratory Instability

Lujie Chen, PhD student, Carnegie Mellon University, 4800 Forbes Ave., Pittsburgh, PA, 15213, United States of America, karenchen@cmu.edu, Artur Dubrawski, Marilyn Hravnak, Gilles Clermont, Michael Pinsky

We developed a method characterizing risk to develop cardiorespiratory instability (CRI) in the future from continuously monitored vital signs in step-down unit patients as an evolving process. We identified four patient equivalence classes with consistent patterns of risk evolution (no risk, consistently low risk, escalating risk from low to high, consistently high risk). Findings can inform future CRI forecasting models and robust real-time early warnings to mitigate adverse patient outcomes.

3 - Electronic Health Records for Decision Support – Meaningful use of Complex Medical Data

Eva Lee, Professor & Director, Industrial And Systems Engineering, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

This work is joint with Grady Memorial Hospital and the Children's Healthcare of Atlanta. We focus on identifying reasons behind the recurrence of patient admissions, and designing classification models to predict potential readmissions. Large scale data analysis and results will be presented. This is critical given the Affordable Care Act is beginning to implement readmission penalties. The algorithmic approach could detect readmission triggers without human monitoring.

WC07

07-Broadway J

Emergency Care

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Sanket Bhat, McGill University, 1001 Sherbrooke Street West, Room 520, Montreal, QC, H3A 1G5, Canada, sanket.bhat@mcgill.ca

1 - Analysis of Triage Systems in Emergency Rooms

Ozlem Yildiz, Ph.D. Candidate, University of Rochester, Simon Business School, 252 Elmwood Avenue, Carol Simon Hall 4-333., Rochester, NY, 14627, United States of America, ozlem.yildiz@simon.rochester.edu, Tolga Tezcan, Michael Kamali

We study triage method decisions in emergency departments and provide a policy for determining when to apply provider triage (PT) based on operational and financial considerations using a queueing framework. We obtain closed-form expressions for the range of arrival rates in which PT economically outperforms traditional nurse triage using a steady-state many-server fluid approximation. We show via simulation experiments that the proposed policy performs within 0.82% of the best solution.

2 - Simulating a Medical Observation Unit for a Pediatric Emergency Department

Mark Grum, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, mgrum@umich.edu, Amy Cohn, Gabriel Zayas-Caban

Observation units (OU) provide an alternative disposition decision for ED patients who may benefit from further observation, such as those are not ill enough to be admitted, but not well enough to be discharged. The pediatric ED at University of Michigan wants to determine whether adding an OU can facilitate patient flow. In this talk, we discuss our approach of using discrete-event simulation to address this question.

3 - Investigating Admission/Discharge Criteria for Patients in Emergency Department Observation Units

Sanket Bhat, McGill University, 1001 Sherbrooke Street West, Room 520, Montreal, QC, H3A 1G5, Canada, sanket.bhat@mcgill.ca, Beste Kucukyazici, Rick Mah

We investigate the process of diagnosing patients in Emergency Department Observation Units (EDOU). Diagnosing in EDU is required to be effective and efficient, since it impacts both the clinical and financial aspects of the health care service. Using dynamic programming based model, we determine the optimal admission/discharge criteria while considering the trade-offs between accuracy in diagnosis and quick decision making.

WC08

08-Broadway K

Health Interventions

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Anahita Khojandi, University of Tennessee, 851 Neyland Drive, 521 Tickle Building, Knoxville, TN, 37996, United States of America, khojandi@utk.edu

1 - Optimizing Dynamic Interventions in Sleep Studies

Maryam Zokaenikoo, University of Tennessee, 851 Neyland Drive, Knoxville, TN, 37902, United States of America, m.zokaenikoo@gmail.com, Oleg Shylo, Anahita Khojandi

We discuss a mathematical framework that takes advantage of the technological advances in wearable neuro-headsets to provide an objective, reliable, inexpensive and scalable approach to sleep interventions. This framework is based on semi-Markov decision models that rely on general signal processing methods for continuous sleep assessment.

2 - A 72-Hours RED Prediction Model: Identifying Patients at Risk for Post-Discharge Adverse Events

Deepak Agrawal, Graduate Research Assistant, Pennsylvania State University, 801 Southgate Drive A4, State College, PA, 16801, United States of America, dual43@psu.edu, Cheng-Bang Chen, Soundar Kumara, Ronald Draventott, Jonathan Darer

Patient-level data from all adult patients admitted from June 2012-2014 from a multi-center hospital system was used to develop a RED (Readmission, Emergency department visit or Death within 72-hours of the earlier discharge) prediction model. We used ensemble techniques to build a stronger model by combining weaker prediction models. The model was implemented in EHR at the hospital, where a medical team is designing an intervention for high risk patients identified by the model.

3 - A Goal Programming Approach for Nurse Scheduling in the Neonatal Intensive Care Unit

Muge Capan, Value Institute, Christiana Care Health System, 4755 Ogletown-Stanton Road, Newark, NJ, United States of America, Muge.Capan@ChristianaCare.org, Robert Locke

Nurse scheduling is the process of constructing work timetables for nurses. A suboptimal schedule can impact the nurses' well-being, job satisfaction and quality of care. Nurse scheduling in the Neonatal Intensive Care Unit is particularly challenging due to the complexity of the health care environment. We present a goal programming approach to allocate nurses to periods of shifts while considering institutional requirements, workload equity and fairness.

WC09

09-Cumberland 1

Economics of Healthcare IT

Cluster: Health Information Technology and Management

Invited Session

Chair: Hilal Atasoy, Assistant Professor, Temple University, 445 Alter Hall, Fox School of Business, Philadelphia, PA, 19102, United States of America, hilal.atasoy@temple.edu

1 - Reduced Healthcare Spending and Health Information Exchange: Aligned Provider and Insurer Incentives

Idris Adjerid, University of Notre Dame, Notre Dame, IN, Idris.Adjerid.1@nd.edu

Health information exchanges (HIEs) promise to reduce the cost of healthcare through improved information availability, yet there is little evidence that speaks to the extent to which these gains are realized. Leveraging a national panel dataset of HIEs, we evaluate whether HIEs reduce spending for the largest insurer in the U.S. (Medicare). We find that operational HIEs resulted in reductions of \$134 per beneficiary per year, or about a 1.4% reduction. We also find that reductions are greater when providers' incentives are aligned with insurers.

2 - Forecasting Health using Electronic Health Record (EHR) Data

Jeffrey McCullough, Associate Professor, University of Minnesota, 420 Delaware St SE, 15-232 PWB, MMC 729, Minneapolis, MN, 55455, United States of America, mccu0056@umn.edu

EHR systems capture clinical detail with unprecedented detail. This information can help forecast future health states. The volume of complexity of EHR data present empirical challenges. Traditional techniques have difficulty modeling high-dimensional data but may be configured to reflect theory. Machine learning techniques are developed for high-dimensional but are usually atheoretical. These approaches are used to model cholesterol health. Monthly EHR data for more than 600,000 patients were studied. Models are estimated using traditional econometric and Machine learning techniques.

3 - The Spillover Effects of Health IT Investments on Regional Health Care Costs

Hilal Atasoy, Assistant Professor, Temple University, 445 Alter Hall, Fox School of Business, Philadelphia, PA, 19102, United States of America, hilal.atasoy@temple.edu

Electronic medical records (EMR) are often presumed to reduce the significant health care costs in the US. However, evidence on the impact of the EMR on costs is mixed, leading to skepticism about their effectiveness. We argue that the benefits EMR systems can go beyond the adopting hospital due to patient mobility. We find that although EMR increases the operational costs of the adopting hospital, it has significant spillover effects by reducing the health care costs of neighboring hospitals. Our results support the role of EMR investments in reducing macroeconomic health care costs.

WC10

10-Cumberland 2

Data-Driven Healthcare Systems Optimization

Cluster: Health Operations & Logistics

Invited Session

Chair: Omid Nohadani, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208-3119, United States of America, nohadani@northwestern.edu

1 - Incorporating Tumor Regression in IMRT Planning

Arkajyoti Roy, Northwestern University, 2145 N. Sheridan Rd., Evanston, IL, United States of America, Arkajyoti.roy@northwestern.edu, Omid Nohadani

Fractionated radiotherapy is optimized for repeated delivery. Repetition assumes invariant geometry. However, tumor regression may occur and can degrade outcomes significantly. We study the spectrum of regression data incorporation into treatment planning. The lower bound of this spectrum is when only initial data of the current patient is used. The upper bound is when the planner relies on the time-resolved dataset of a particular past patient. A combination of multi-patient datasets is employed to overcome uncertainties. The spectrum of data incorporation is demonstrated based on two clinical lung cancer cases.

2 - Recommended Goals in Multi-Criteria Radiation Treatment Planning

Omid Nohadani, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208-3119, United States of America, nohadani@northwestern.edu, Indra Das, Arkajyoti Roy

Radiation therapy planning is an inverse problem process. To guide the iterative process, institutional and standardized recommendations for planning and quality assurance are followed. In practice one or more goals cannot be satisfied, leading to trade-offs. We present the analysis of 100 clinical cases and identify issues in treatment planning that inherently prevent goals to be concurrently satisfied. Institutional protocols tend to divert from international recommendations, often due to unexpected infeasibilities. We discuss a multi-criteria optimization framework to address this issue.

3 - Marathon Course Design Problem

Mehmet Basdere, Northwestern University, The Technological Institute, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu, Karen Smilowitz, Sanjay Mehrotra

In this talk, we present a new type of tour finding problem in the marathon course design setting. The aim is to find a valid marathon course that minimizes the average distance to the medical facilities within the region of interest without preventing the public access to those facilities while visiting a predetermined subset of landmark streets. The underlying problem becomes a variant of selective travelling salesman problem.

WC11

11-Cumberland 3

Blood Supply Chain Management

Cluster: Medical Decision Making

Invited Session

Chair: Douglas Bish, Associate Professor, Virginia Tech, 250 Durham Hall, Blacksburg, VA, United States of America, drb1@vt.edu

1 - Cost-Effectiveness of Blood Donation Screening for Babesia Microti using Data from Investigational Studies

Erin Moritz, Scientist I, American Red Cross, 9315 Gaithersburg, Gaithersburg, MD, 20877, United States of America, erin.moritz@redcross.org, Ebru Bish, Hadi El-Amine, Douglas Bish, Susan Stramer

Babesia microti causes transfusion-transmitted babesiosis (TTB); there are no FDA-licensed blood donor screening assays. We assessed the comparative- and cost-effectiveness of B. microti blood donation screening strategies (nucleic acid testing [NAT] and antibody-detection [Ab]) using data from ongoing investigational studies. Waste was also evaluated. Universal NAT in endemic areas is a cost-effective strategy (<\$50,000/quality-adjusted life-years [QALY]). At a higher cost-effectiveness ratio (<\$85,000/QALY), universal Ab/NAT is most effective at preventing TTB.

2 - Approximation Policies for Platelet Inventory Control

Can Zhang, Georgia Institute of Technology, Atlanta, GA, United States of America, czhang2012@gatech.edu, Chelsea C. White III, Turgay Ayer

We study a perishable inventory control problem for products with fixed-lifetime, where demand is a general nonstationary process. We present several analytical approaches for determining easily computable approximation policies for such problems. In particular, we study the performance of our policies in a platelet inventory control problem based on surgery data obtained from a local hospital. We show that our policies which can capture forecasting information have a significant performance improvement over those policies which do not consider forecasting information.

3 - Determining a Robust Post-Donation Screening Strategy for the Detection of Infectious Agents

Hadi El-Amine, Virginia Tech, 214 Durham Hall, 1145 Perry St., Blacksburg, VA, 24061, United States of America, hadi@vt.edu, Ebru Bish, Douglas Bish

Blood product safety, in terms of being free of transfusion-transmittable infections, is crucial. Under prevalence rate uncertainty, mean-variance and maximum regret minimization objectives were considered in order to determine a "robust" post-donation blood screening strategy that minimizes the risk of releasing an infected unit of blood into the blood supply.

WC12

12-Cumberland 4

Clinical Care Delivery Operations

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Craig Froehle, Professor, University of Cincinnati, Lindner College of Business, 2925 Campus Green Dr., Cincinnati, OH, 45221-0130, United States of America, craig.froehle@uc.edu

1 - Redefining Patient Prioritization and Routing in the Emergency Department

Elham Torabi, University of Cincinnati, Lindner College of Business, 2925 Campus Green Dr., Cincinnati, OH, 45221-0130, United States of America, torabiem@mail.uc.edu, Craig Froehle, Christopher Miller

Most US emergency departments use the ESI triage system, which potentially contributes to sub-optimal patient routing and ED congestion. Using partitioning methods, we defined new prioritization policies to more appropriately stratify patients in order to improve system efficiency. Queueing analysis reveals the revised triage approach has significant operational benefits.

2 - SURGE: Smoothing Usage of Resources is Good for Emergencies

Alex Mills, Indiana University, 1309 E. 10th St., Bloomington, IN, United States of America, millsaf@indiana.edu, Jonathan Helm, Yu Wang

Hospitals periodically face unexpected batch arrivals, or surges, to the Emergency Department (ED), for example as the result of a multiple-casualty incident. To accommodate a surge, providers may conduct early disposition of existing patients, by expediting discharge or admission (to the hospital) of ED patients and/or the discharge of inpatients. The hospital can also exercise demand planning to shape the distribution of inpatient workload. We show that smoothing the inpatient workload provides a substantial benefit to surge response, even more than optimizing the early disposition decision.

3 - Improving Patient Flow in an Outpatient Chemotherapy Infusion Center

Pamela Martinez Villarreal, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, mvpamela@umich.edu, Matthew Rouhana

We study the full process experienced by infusion patients in the University of Michigan Comprehensive Cancer Center, identify key bottlenecks within this process, and develop engineering-based techniques aimed at reducing patient delays and nurse overtime.

WC13

13-Cumberland 5

Cost and Payment Models for Effective Healthcare

Cluster: College of Healthcare Operations Management, Production and Operations Management Society

Invited Session

Chair: Sriram Venkataraman, University of South Carolina, Department of Management Science, Moore School of Business, 1014 Greene St, Columbia, SC, 29208, United States of America, sriram.venkataraman@moore.sc.edu

1 - Panel Size, Office Visits and Care Coordination in Primary Care

Michael Rossi, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, United States of America, mrossi09@gmail.com, Hari Balasubramanian

To evaluate feasibility of panel size based on the daily and weekly volume of non face-to-face care-coordination events in addition to face-to-face patient appointments at primary care. Using the 2011 Medical Expenditure Panel Survey dataset we randomly sample patient panels. In a panel of 1500 patients, each week there are an average of 4.10 hospitalizations; 4.40 emergency room visits; and 107.58 specialty office visits. PCP will also have 13.66 face-to-face office-based appointments on average each day. Panel sizes of 2000 and above will generate unsustainably high workloads.

2 - The Absent Enabler in Population Health: Operations Management

Vicki Smith-Daniels, Professor, Indiana University, Kelley School of Business, 801 W. Michigan Street, Indianapolis, IN, 46202, United States of America, vsmithda@iupui.edu

Population Health Management (PHM) proactively applies strategies and interventions to defined groups of individuals across the continuum of care to improve the health of the individuals within the group at the lowest necessary cost. This research derives a conceptual framework of the critical operations management decisions around PHM.

3 - Achieving the Triple Bottom Line of Quality, Experience and Efficiency

Sriram Venkataraman, University of South Carolina, Department of Management Science, Moore School of Business, 1014 Greene St, Columbia, SC, 29208, United States of America, sriram.venkataraman@moore.sc.edu, Aleda Roth, Anita Tucker

We estimate the three measures of efficiency test the impact of three antecedents hypothesized to lead to a efficient productivity frontier, thus breaking the tradeoff between the three performance objectives: the effects of percent physicians employed, adoption of electronic health records, and utilization. Although we find a positive effect of percent physicians employed on average normalized efficiency, we find that adoption of electronic health records and utilization have a negative effect.

■ WC14

14-Cumberland 6

From Model to Reality: Barriers to Implementation in Healthcare

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Michael Ward, Assistant Professor, Vanderbilt University, Department of Emergency Medicine, 1313 21st Ave, Nashville, TN, 37232, United States of America, mward04@gmail.com

1 - Failure to Implement: Simulation in the ICU

Yue Dong, M.D., Research Scientist, Mayo Clinic College of Medicine, Department of Anesthesiology, 200 First Street SW, Rochester, MN, 55905, Dong.Yue@mayo.edu

Building a simulation model does not guarantee implementation in healthcare. Using an example simulation from an ICU environment, I will discuss how this model identified opportunities for operational efficiency gains at an academic hospital, yet were never implemented. The unique learning experiences of the study team will be summarized.

2 - Implementation Science for Operations Researchers

Laurie Novak, Assistant Professor, Vanderbilt University School of Medicine, 2525 West End Ave., Suite 1475, Nashville, TN, 37203, United States of America, laurie.l.novak@vanderbilt.edu

Healthcare has struggled for decades to translate discovery into practice. The emerging field of implementation science provides insight and an approach to reduce this time period. I will highlight what implementation science is and how operations researchers can draw upon it to implement projects in their research.

3 - A Practical Guide to Implementation in Healthcare

Ian Jones, Associate Professor, Department of Emergency Medicine, Vanderbilt University, United States of America, ian.jones@vanderbilt.edu, Stephan Russ

As a physician, computer scientist, and hospital administrator, I have gained insights as to what makes some projects selected for implementation over others. Also, I will discuss practical barriers to implementation.

Wednesday, 2:00pm - 3:30pm

■ WD01

Broadway Foyer

Posters

Contributed Session

1 - Development of a Data-Driven Demand Aggregation Framework for Ambulance Deployment

Sean Shao Wei Lam, Singapore General Hospital, 226 Outram Road Blk A Level 2, Singapore, 169039, Singapore, lam.shao.wei@sgh.com.sg, Ngoc Hoang Long Nguyen, Jing Ping Wong, Eng Hock Marcus Ong

The objective of this study is to develop a novel demand aggregation framework to detect natural clusters of ambulance calls based on actual historical data without relying on any a priori clustering assumptions. Using two years of ambulance calls data for the entire Singapore, we proposed the use of Gaussian Mixture Models with adapted K-Means algorithm for parameter estimation, and examined various goodness-of-fit criteria to determine the optimal number of clusters. In comparison to existing methods, such as those based on planning zones, postal districts or census tracts, the proposed framework not only enables better demand aggregation for ambulance deployment planning, it also facilitates the efficient detection of anomalies in real ambulance process time data.

2 - Predictive Accuracy of a Highly Granular Discrete Event Simulation of Emergency Dept. Patient Flow

Eric Goldlust, Dept of Emergency Medicine, Brown University/Rhode Island Hospital, 593 Eddy St., Providence, RI, 02903, United States of America, egoldlust@lifespan.org, Ola Batarseh, Eugene Day

In this large, academic level 1 trauma center, a rigorously implemented discrete event simulation model of a complex ED process was accurate at predicting the mean number of patients in intake queues, and of overall patient census, within clinically reasonable parameters, i.e., generally within 3 patients, at any hour of the day. This model was somewhat less accurate at predicting patients awaiting treatment beds, requiring resuscitation beds, or requiring hospital admission. This suggests the potential utility of DES to quantitatively predict patient load, in triage and in treatment beds, at most or all hours of the day. Further work is ongoing to improve accuracy of the model, and to determine the accuracy of such models in predicting the quantitative effects of process improvements, and to forecast hospital admissions in real time.

3 - Patient Flow in a Pediatric Emergency Department

Hassan Abbas, Center for Healthcare Engineering and Patient Safety - University of Michigan, 1075 Beal, Suite 3246, Ann Arbor, MI, United States of America, hlabbas@umich.edu, Brooke Szymanski, Amy Cohn, Allison Cator, Michelle Macy

In this poster, we present an ongoing initiative with Mott Children's Hospital at the University of Michigan. This is an interactive visual tool we developed in conjunction with clinicians at Mott. Intended for patients, relatives and providers, it depicts the hospital (e.g. number of beds in the emergency department, different inpatient units, etc.) and allows the patients to interactively experience the potential stages of the care being provided, while allowing the providers to understand the full system, not just the section they work in.

4 - An Online Appointment Scheduling Model

Ali Dogru, OM PhD Student, University of Alabama, Operations Management Dept Alston Hall, Tuscaloosa, AL, United States of America, akdogru@crimson.ua.edu

Incorporating patient centered medical home (PCMH) principles, we develop an online (dynamic) appointment scheduling system (OASS) for a primary care setting. We propose a simulation optimization solution approach that uses two models working in concert to provide high quality solutions (i.e., schedules) in short time. We aim to minimize: 1) weighted cost of expected patient waiting time and 2) doctor idle time and overtime. Key Words: Online Appointment Scheduling, Simulation Optimization, Patient Centered Medical Home.

5 - A Two-Stage Stochastic Programming Model for Vaccine Vial Distribution

Zahra Azadi, Clemson University, 854 Issaqueena Trl. Apt. #902, Central, SC, 29630, United States of America, zazadi@clemson.edu, Sandra Eksioglu

One of the challenges faced by health care providers is designing an inventory replenishment policy for vaccines to ensure a successful immunization of patients while minimizing purchasing, inventory and wastage costs. Wastage incurs when doses are disposed from opened vials after their safe use time. We propose an (s, S) policy which determines the vial size, the reorder quantity, and the order up to point which optimizes system-wide costs. The two stage stochastic model captures the timing of decisions; suppliers are selected prior to demand realization; and the uncertain nature of demand.

6 - A Bayesian Network Approach to Investigating Effects of Emotional Factors on Depression in the Elderly

Kun Chang Lee, Professor, Sungkyunkwan University, Myung Ryun 3-53, Chong No-Ku, Seoul, 110-745, Korea, Republic of, kunchanglee@gmail.com

By using six years of KNHANES (Korea National Health and Nutrition Examination Survey) dataset (2008-2013) about 60 ages older people, we analyzed how the depression in the elderly is influenced by a number of related explanatory variables such as demographic factors, objective & subjective health-related well-being factors. Especially, to add a sense of more reality, we adopted another emotional factor like "stress" to see how it affects the depression in the elderly. Total 1,066 elderly people in KNHANES from 2008 to 2013 were selected for our empirical analyses. Such 1,066 people is equivalent to about 1,306,870 people when weights in sampling are considered. Dependent variable is either 0 or 1 depending on whether the elderly people feel depression. Explanatory variables for our study were carefully selected out of extensive literature survey. Included explanatory variables are demographic variables, objective & subjective well-being factors, disease, stress and activity limit. -test was applied to the target dataset to identify a set of significant independent variables by using Bayesian Network analysis. Besides, logistic regression analysis was applied, and its results were compared with Bayesian Network results. We adopted six years of KNHANES dataset, indicating that our results were based on long period of time capable of considering temporal patterns in the depression in the elderly. According to the empirical results, stress factor is found to be significant in explaining the depression in the elderly. Statistical results were significant and robust. In the future studies, we need to consider another emotional factors like fear, etc.

7 - Unbiased Disease Stratification within the Imi U-BIOPRED Severe Asthma Program using TDA

Devi Ramanan, Head - Product Collaborations, Ayasdi, 4400 Bohannon Drive, Menlo Park, CA, 94025, United States of America, gwang@vocecomm.com, Dom Burg

The U-BIOPRED consortium is an EU-wide collective of academics (20 institutions), biopharma industry (12), SME's (3), and patient organisations (6) working collaboratively to improve understanding of severe asthma. Representing the largest study cohort recruited for this disease, a variety of sample types are currently being analysed in parallel using a range of 'omics technologies to map molecular and clinical phenotypes of severe asthma. The heterogeneity of the disease, combined with the complexity of the study cohort (e.g. participants on a combination of medications, and varying co-morbidities), the range of biofluids and tissues analysed (each with corresponding challenges), and the multiple analytes being measured (e.g. lipids, proteins, mRNA) have necessitated the development of multiple data analysis pipelines to mine these complex datasets. One of the approaches used by the consortium is Topological Data Analysis (TDA), implemented via the Ayasdi software platform. TDA generates topological networks that allow the scientist to explore, condense, visualise and extract useful information from these complex and multi-modal data. The subsequent sections show examples of how the Ayasdi platform is being used to combine and analyse proteomic data produced in the U-BIOPRED study, particularly highlighting the utility of the approach in exploring the biology of the data and as an unbiased feature selection tool. The datasets used to construct the example analyses represent only a small fraction of the final UBIOPRED cohort. As such, all results and interpretations must be viewed as exploratory and illustrative of approach and may not be representative of any final outcomes of the study. Traditional statistical analyses of data from high throughput proteomic analysis of serum from asthmatics, produces datasets with very few differentiating features. Using the Ayasdi software platform we were able to identify groups of participants based on these serum data, with specific group assignment guided by persistence of structure and contrasting clinical metadata. These topological groups were subsequently used as class labels in supervised machine learning approaches, implemented in InforSense4 (e.g. support vector machine, Figure 5), and resulted in an improved classification performance and predictive models over cohort information alone.

8 - Fixed Interval Order Set Optimization using Mathematical Programming

Daniel Gartner, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Yiye Zhang, Rema Padman

Order sets are a critical component of Computerized Provider Order Entry (CPOE) systems that aim to improve care delivery by allowing faster and easier physician order entry guided by evidence-based best practices. Despite the anticipated benefits of order sets, historical data indicates variability in order set usage by physicians, driven largely by the diversity in patient population and physician experience, among others. Our study addresses these challenges by proposing and testing an optimization-based approach to create order sets from usage data to minimize physician workload.

9 - Quality Compliance Score: Identification of Future Savings Potential Based on Compliance to Evidenced-Based Care Guidelines

Ogi Asparouhov, LexisNexis Risk Solutions|Healthcare, ognian.asparouhov@lexisnexis.com, Anton Berisha

Solutions that track EBM guideline compliance are important in today's healthcare market. LexisNexis' provides healthcare markets a strategic tool - the Quality Compliance Score - to target patients and prioritize interventions. This unique solution based on patient guideline compliance can assist care managers to identify the most impactful populations.

10 - Systems Dynamics Model and Interactive Tool to Predict Effectiveness of Health Interventions

Erica Zuhr, Booz Allen Hamilton, 1 Preserve Parkway, Suite 200, Rockville, MD, 20852, United States of America, zuhr_eric@bah.com, Anastasia Gentilcore, Todd Schmidt, Kayla Janos, Ernest Sohn

Obesity levels are on the rise throughout the U.S., causing an unprecedented rise in medical expenses. Potential interventions used to combat this problem can be expensive and time consuming, and their effectiveness is often unclear. To help solve this problem we developed a systems dynamics model of obesity to analyze and compare the effects of different interventions on a population's obesity rate over time. We also developed an interactive dashboard layer with the model simulations as a back end to allow health decision makers to experiment with potential interventions.

11 - A Scalable Informatics Platform for Human Genomics

Paul Hodor, Booz Allen Hamilton, 1 Preserve Parkway, Suite 200, Rockville, MD, 20852, United States of America, hodor_paul@bah.com, Andrew Clark, Christopher Gardner, Franklin Totten, Amandeep Chawla, Ahsan Huda, Sriram Sridhar, Priyanka Oberoi, Natasha Sefcovic, Aaron Sander

The accelerated rate at which complete human genomic sequences are produced has overwhelmed the capacity of traditional computational tools. Here we present a novel platform for human genomics, built on Hadoop technology, which addresses the needs of scalable computing. Benchmarks show its feasibility for querying large databases of complete human genomes, and performing downstream analysis such as genome-wide association studies.

12 - Data Integration of De-Identified Healthcare Databases to Support Improved Predictive Analytics

Yang Yang, Intern, Philips Research North America, 345 Scarborough Rd, Briarcliff Manor, NY, 10510, United States of America, yang.yang@uth.tmc.edu, Min Xue, Nandini Raghavan, Daniel Elgort, Reza Sharifi Sedeh

Patient level integration of de-identified healthcare databases is a challenging task that will allow researchers to bring together heterogeneous datasets and enable new and important research problems to be addressed. We propose a hierarchical approach for integration of de-identified databases, which was successfully applied to selected clinical and claims databases. We developed a machine learning pipeline that leveraged the integrated dataset to predict in-hospital expenditures of Heart Failure patients.

13 - Determining a Strategy for Routing Orthopedic Trauma Patients through Modeling and Simulation

Elliott Hughes, Performance Improvement Engineer, Hartford Hospital, 80 Seymour St, NA, Hartford, CT, 06102, United States of America, eliott.hughes@hhchealth.org, Maxim Garifullin

The orthopedics service line of a large tertiary care teaching medical center is relocating from the main hospital to a standalone building. The various elective in-patient orthopedic surgical procedures currently performed have relatively simple pathways from admission to discharge. However, orthopedic trauma patient pathways vary greatly based on acuity and other factors, and may include multiple transfers between different levels of care. This situation will be further complicated by the fact that the new standalone building will not include an emergency department or intensive care units, and will therefore have to rely on these services from the main hospital. Modeling and simulation were used to test various scenarios to determine a strategy to appropriately route trauma patients between and within the main hospital and the new orthopedics hospital.

14 - Improving Risk Prediction for Self-insured Health Groups: Identifying Health Claims Cost Drivers

David Richards, Business Information Technology Student, Tennessee Technological University, 117 Woodmont Ave., Lebanon, TN, 37087, United States of America, darichards44@students.ntech.edu, Thad Perry, Deborah Ballou

An investigation of chronic conditions as cost drivers for a self-insured health plan was based on two years of data that included 1,035,506 claims for this employer group. HCCs were used to identify the claims costs associated with employees and dependents whose codes indicated that they had chronic conditions. These claims accounted for a third of the total healthcare costs for this self-insured group. The most costly chronic conditions were identified and quantified. These descriptive statistics will help build reliable predictive risk models for self-insured groups.

15 - Investigating the Temporal-Spatial Cross-Correlation between the Flu Activity on Twitter and Clinical Health Records

Hamed Zolbanin, Oklahoma State University, 716 N. Husband St., Apt. 8, Stillwater, OK, 74075, United States of America, zolban@okstate.edu, Amir Hassan Zadeh, Ramesh Sharda, Dursun Delen

Contagious diseases pose significant challenges to public healthcare systems all over the world [4]. The rise in emerging epidemic and infectious diseases has led to calls for the use of new techniques and technologies capable of detecting, tracking, mapping and targeting such diseases [2]. Big data analytics, one such new technology, has been identified to have a great potential in analyzing health and patient data on social media [3]. As suggested by prior research, Surveillance Information Systems (SIS) can contribute significantly to coping with complex factors that influence the emergence, evolution, and spread of contagious diseases. In this study, we used big data technologies (Fig. 1) to analyze two sets of flu activity data. Twitter data were used to remotely monitor flu outbreaks in the US, and Cerner clinical records were used to track real-world clinical encounters. We used three approaches in our analytics initiative: temporal, spatial, and text mining. In the temporal analysis, we analyzed whether Twitter data could indeed be adapted for nowcasting of influenza outbreaks. We tracked

and compared clinical flu encounters and flu-related activities on Twitter during the outbreaks. In spatial analysis, by the use of mashup applications, we mapped flu outbreaks to geo-spatial property of Twitter data to identify influenza hotspots. Text mining was used to extract and summarize useful information from textual data, and to identify popular symptoms and treatments of flu that were discussed in Twitter messages. We expected that the integration of social media presence and real-world clinical encounters could be a potential and valuable addition to existing surveillance systems. Our results supported prior findings that flu-related traffic on social media is closely related with actual flu outbreaks [1]. However, rather than using the Pearson correlation, which assumes a zero lag between the online and real-world activities, we used a time-series analysis approach to obtain the cross-correlation between the two trends. We found that clinical flu encounters lag one month behind online posts (Fig. 2). Also, we identified several public locations from which a majority of posts were originated. These findings can help surveillance systems and healthcare delivery organizations to develop more accurate and efficient forecasting models for resource allocation during the outbreaks, and to inform individuals about the locations they should avoid during such outbreaks.

16 - Medical Data Analysis for Marathons: Challenges and Implications for Preparedness

Karen Smilowitz, Northwestern University, The Technological Institute, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, ksmilowitz@northwestern.edu, Sanjay Mehrotra, George Chiampas, Jennifer Chan, Michael Nishi

We present findings related to medical data and the value of this data in preparedness for mass gathering events, focusing on data analytics from the Chicago Marathon. Using medical data from multiple years of the Chicago Marathon obtained from a patient tracking system, we characterize the spatial and temporal distribution of injuries. We will also present findings on the adoption of the patient tracking system. Jointly with the event organizers, we redesigned patient tracking processes for the 2014 Chicago Marathon to better capture essential data fields. Our goal is to combine this data with data from other events to create the most comprehensive medical study of large-scale marathons.

17 - Secondary use of EHR Timestamp Data for Workflow Optimization

Michelle Hribar, OHSU, 3181 SW Sam Jackson Pk Rd, MC: BICC, Portland, OR, 97239, United States of America, hribarm@ohsu.edu, Sarah Read-brown, Leah Reznick, Lorinna Lombardi, Mansi Parikh, Thomas Yackel, Michael Chiang

Outpatient clinics today face increased patient loads and complex patient flows, which results in large patient wait times. Simulation models can identify better scheduling strategies and use of resources, but they require large amounts of data related to the timing and variance of the patient flow. In this study, we present the promising results of using secondary electronic health record (EHR) data for modeling clinical workflow in 3 outpatient ophthalmology clinics.

18 - Too Thick, Too Thin: An Intricate Blood Balance

Mauntell Ford, Cerner Corporation, 10236 Marion Park Dr, Kansas City, MO, 64137, United States of America, mauntell.ford@cerner.com

Anticoagulant therapy is an effective way to prevent venous thromboembolism (VTE). Unfortunately, bleeding complications during anticoagulant treatment are common. The study investigated the impact of a computerized clinical decision support (CDS) on pharmacologic prophylaxis bleeding complications, categorized as major and minor, recommended for patients at high risk for VTE. The study found that among the 50% of patients who were recommended anticoagulant therapy, approximately 10% had a minor bleed and 1% had a major bleed. Logistic regression was performed to investigate variables of interest involved in predicting bleed complications such as demographics, patient history, lab results and medications. Decision support for VTE prevention does not mitigate patient safety and a bleed risk model can be integrated into the clinical decision support system to reduce patient risk of bleeding complications.

19 - Identifying Strategies to Reduce Risk in Clinical Trials using Multi-Scale Modeling

Anastasia Gentilcore, Booz Allen Hamilton, One Preserve Parkway, Rockville, MD, United States of America, gentilcore_anastasia@bah.com, Alexander Freed, James Marshall, Kevin Shi, Barnett Kramer, Paul Coates, John Gohagan, Bruce Tidor, Mary Reid, Lori Minasian

Randomized controlled clinical trials are the gold standard for determining the effectiveness of medical, preventive and nutritional interventions but they are complex, resource intensive, and their outcomes are difficult to predict. Prior information from preclinical, metabolic, epidemiologic, and clinical studies informs clinical judgment as to the timeliness and design of clinical trials. However, combining these distinct levels of information is an uncertain process

and the uncertainty in the information available affects clinical trial outcomes. Therefore, large clinical trials sometimes produce unanticipated results, including those in the opposite direction of those expected. We developed a flexible architecture for multi-scale modeling of the biological and clinical aspects of a trial. As a case study, we examined research on selenium as a prostate cancer preventive agent. In previous work, we used a machine learning approach to analyze the relationship between model parameters and simulated trial outcomes, identifying the parameters that have the largest influence on trial outcomes [1]. Here, we demonstrate a multi-level modeling framework that applies information theory to propagate uncertainty at the molecular metabolic level to assess its impacts on clinical trial outcomes and thereby identify critical information needs and clinical trial design options that may mitigate critical uncertainties. Using the results of this analysis, we can guide future research in ways that will have the most impact on clinical trial outcomes. 1. I. Cui, Y., Murphy, B., Gentilcore, A., Sharma, Y., Minasian, L., Kramer, B. S., ... & Tidor, B. (2014). Multilevel modeling and value of information in clinical trial decision support. *BMC systems biology*, 8(1), 140.

20 - Simulating Operational Impact of Universal Screening for MRSA at the Emergency Department on Bed Wait Time for Admission in an Acute Hospital

Palvannan R.K., National Healthcare Group, Fusionopolis, Singapore, Singapore, rk.palvannan@gmail.com, Ethel Kan, Ong Poon Kin, Teow Kiok Liang, Ooi Chee Kheong

In 2011 universal screening for Methicillin-resistant *Staphylococcus aureus* (MRSA) colonization and cohorting (isolation) was implemented in Tan Tock Seng hospital to reduce in-hospital colonization acquisition and infection rate. It's a public hospital where the wards have 4 or more beds in each room, so active isolation is relevant. All patients including those admitted through the Emergency Department (ED) were screened for MRSA colonization. Once the patients were admitted to the wards, swabs were taken and cultured for MRSA. The laboratory test took 24-48 hours to cultivate the culture and return results. If the cultures were tested positive, the colonized patients were transferred to MRSA wards, to further reduce transmission of colonization through healthcare workers during the hospital stay. In 2011, the mean bed wait time for admission from the ED was 2.7 hours (median = 2.1 hours). There were 2 challenges with testing by culturing: long exposure during the 24-48 hours to healthcare workers and reduced transfer to MRSA wards of colonized patients due to refusal. To address these, in 2012 rapid screening before admission was done using Polymerase Chain Reaction (PCR) method at the ED before admission. PCR took 1.5 hours. The Bed Management Unit (BMU) looks for a suitable bed after the PCR test is complete, so bed request is done after PCR completion. It is natural that the total patient waiting time will increase by the PCR processing time when done this way, as it is a serial process. To reduce wait time it was suggested to work in parallel. That is, if BMU were to start processing the bed request, when the decision to admit is made at the same time when the PCR starts, then the impact on overall patient wait time will be less – so looking at waiting for bed in parallel with PCR processing. Method We will compare serial and parallel processing using Discrete Event Simulation (DES). Fig 1 is the flow model comparing the 2 streams using Simul8 2013. The top stream (current process) is the serial process where PCR is done followed by bed request. The bottom stream is the simulated parallel process where, while the patient is doing PCR, BMU has received and acts on the request for bed. In the model, the activity 'BMU finding bed' is modeled to require the 60 beds as resources. It is released at 'Patient discharged' node. 'Inpatient stay' is the stay in bed (mean 7 days). Both serial and parallel processes are simulated with copies of the same random stream to reduce variation in sampling. Results & discussion Using parallel processing was a good intuitive suggestion. Seen as a fork-and-join queue and assuming the 2 random variables X (PCR) and Y (waiting time) to be concurrent activities, we arrive at the conclusion that the worst case time will be $E[\text{MAX}(X,Y)] < E(X) + E(Y)$. With $X \sim \text{Deterministic}(1.5 \text{ h})$ and $Y \sim \text{Negative exponential}(\text{mean} = 2.7 \text{ h})$, the worst case time will be 3.0 h compared with 4.2 h respectively.

21 - Mining Patient-Generated Text for Adverse Medication Events

Sergey Blok, Booz Allen Hamilton, 1 Preserve Parkway, Rockville, MD, 20852, United States of America, blok_sergey@bah.com, Andrew Mathis

Text data, such as mobile diaries, regulatory reports, and social media conversations present an opportunity to improve patient care through rich analytics. Booz Allen Hamilton has developed a prototype solution for mining text data for medication adverse events. The algorithm compares several approaches, including medical ontologies, consumer vernacular, and existing adverse event lists. The prototype is applied to actual Web discussion forum posts. The user interface, targeted to the busy clinician, implements design concepts around ways of presenting and summarizing adverse events.

22 - An Artificial Pancreas Model

Sean Berkan Subasi, Freedom 7 Elementary, Cocoa Beach, FL

Type 1 diabetes is a chronic condition that occurs when the body's own immune system destroys the insulin-producing cells (called beta cells) of the pancreas and hence, it produces little or no insulin, a hormone needed to allow glucose to enter cells to produce energy. Mostly diagnosed in children or young adults, the disease cannot be prevented, but managed by regularly monitoring glucose-level in blood and taking insulin shots or pills. Currently, researchers investigate the ways of developing devices that automatically administer the right amount of insulin needed to manage high glucose levels; however, such devices are not available to diabetics yet. The most developed diabetic treatment is a pump that, other than requiring manual input, is fully automatic. The idea of developing a fully automatic artificial pancreas device is very promising and is an area of active research. The goal of my project is to develop an "Artificial Pancreas Model" mimicking an artificial pancreas device (auto-correcting insulin pump) that can be used by people with Type 1 diabetes, and hence to explore the challenges of getting such a device to work. I developed an automated system that uses the acid-base chemical reaction to simulate an auto-correcting device where the right amount of a basic solution (representing insulin) is added to an acidic solution (representing high blood glucose level) until the chemical reaction stops – the mixed solution is neutralized (representing normal glucose level in blood). I conducted three types of experiments to evaluate the performance of the "Artificial Pancreas" device I developed: (1) the pump is turned off manually; (2) the pump stops automatically; and (3) the model is tested on solutions with different amounts of baking soda solution (insulin) and vinegar (high-glucose level) mixed together, and then normalized to the different mixed solutions, one at a time (each one representing a different person). Experiments 1 and 2 showed that an automated pump can more accurately detect the right amount of insulin (baking soda) needed to manage the high glucose levels than a manual pump. The results of Experiment 3 presented the possibility of calibrating an automated pump based on the personalized settings of patients with different insulin needs.

Wednesday, 3:30pm - 5:00pm**WE01**

01-Broadway A

Surgeons' Perspective: Surgical Quality and Outcomes Research

Sponsor: Vanderbilt Center for Surgical Quality and Outcomes Research

Sponsored Session

Chair: Daniel Barocas, Vanderbilt University Medical Center, A-1302 Medical Center North, Nashville, TN, 37232, United States of America, dan.barocas@vanderbilt.edu

- 1 - Quality Measurement and Health Care Delivery System Reform**
Matthew Resnick, Assistant Professor, Vanderbilt University, A-1302 Medical Center North, Nashville, TN, 37232, United States of America, matthew.resnick@vanderbilt.edu

As a response to the call to improve health care value, the Medicare program and numerous commercial payers have experimented with novel models of reimbursement. Part and parcel to improvements in the quality of health care delivered to populations is the need for robust quality measurement strategies at the health care system level. This presentation will review the myriad quality measurement strategies associated with novel payment models, will review the challenges associated with quality measurement, and will discuss current strategies to mitigate these challenges.

- 2 - Strategies for Measurement and Sustainment of Quality and Safety in Hospitals and Systems**

Roger Dmochowski, Vanderbilt University, Nashville, TN, United States of America, roger.dmochowski@vanderbilt.edu

Measurement of healthcare quality is increasingly important as we transition to value-based reimbursement, and as hospitals coalesce into networks. This cluster will focus upon the role of quality measurement in healthcare delivery – its relationship to reimbursement, its complexity, and the challenges and opportunities at the institutional, cross-institutional and national levels.

- 3 - Leveraging Multi-Institutional Quality Collaboratives to Improve Care: The AHSQC Experience**

Benjamin Poulouse, Associate Professor of Surgery, Vanderbilt University Medical Center, D5203 MCN, 1161 21st Avenue South, Nashville, TN, 37232, United States of America, benjamin.poulouse@vanderbilt.edu

Wide variation exists regarding the management of abdominal wall hernias. This work establishes a national solution to improve value of care delivered to hernia patients. A prospective disease-based registry was created using the infrastructure and relationships of a professional clinical medical society to form a

comprehensive continuous quality improvement effort. The Americas Hernia Society Quality Collaborative was formed as a multi-stakeholder effort with the mission to provide health care professionals real-time information for maximizing value in hernia care.

WE02

02-Broadway B

Empirical Studies of Workload Effects in Acute Care

Cluster: INFORMS Behavior Operations Management Section

Invited Session

Chair: Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

- 1 - The Influence of Emergency Medical Services Load on Paramedics On-Scene Clinical Decisions**

Mohammad Delasay, Post-Doctoral Fellow, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Ave, GSIA 230C, Pittsburgh, PA, 15213, United States of America, delasays@cmu.edu, Armann Ingolfsson

We investigate the effect of emergency medical system load on paramedics' medical decisions. We hypothesize that paramedics' decisions about on-scene time and transporting a patient to hospital are influenced by the emergency system load. We test our hypotheses by analyzing a data set of emergency responses in Calgary, Canada.

- 2 - Impact of Severity-adjusted Workload on Health Status of Patients Discharged from an ICU**

Song-Hee Kim, USC Marshall, Bridge Hall, Los Angeles, CA, United States of America, songheek@usc.edu, Edieal Pinker, Joan Rimar, Elizabeth Bradley

Using a dynamic measure of patient acuity, we examine whether workload directly affects the health status of patients discharged from ICU. Also, we measure ICU workload in a novel way that takes into patient acuity in addition to census, and study this severity-adjusted workload's impact on ICU care.

- 3 - Discrete Work-Shifts in a Continuous World: An Empirical Study of Emergency Physician Productivity**

Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu, Bradley Staats, Brian Patterson, Diwas KC

We explore how emergency physician behavior changes over the course of the work shift. We show that as a result of doctors' efforts to reduce the number of patients handed off at shift change, the number of patients a doctor is simultaneously caring for follows an inverted-U shape over the course of the work shift. We show that this ramp-up-then-down behavior reduces doctor productivity and ED throughput as doctors spend very little time working at their full capacity.

WE03

03-Broadway C

Healthcare Informatics

Contributed Session

Chair: Xiaojin Liu, University of Minnesota, 321 19th Ave S, 3-150 CSOM, Minneapolis, 55455, United States of America, liux1591@umn.edu

- 1 - Process Models for Assessing Re-Identification Risks of Health Data**

Weiyi Xia, Vanderbilt University, 2201 West End Ave, Nashville, TN, 37235, United States of America, xwy0220@gmail.com, Yevgeniy Vorobeychik, Zhiyu Wan, Ellen Clayton, Adarsh Subbaswamy, Raymond Heatherly, Murat Kantarcioglu, Bradley Malin

Personal health data has become a critical resource in supporting various secondary uses, such as clinical research. At the same time, there are concerns that sharing such data can infringe upon patient privacy. The re-identification risk of a dataset is highly dependent on the data environment including the data recipient, the external data resources and the deterrence mechanisms. We introduce an approach to evaluate the re-identification risk of a de-identified dataset by modeling the data recipient's decision making process associated with re-identifying a record using a factored Markov Decision Process (MDP) model. We solve the factored MDP model using a linear programming strategy to discover the value of each state and the optimal action the attacker can take.

2 - Intuition and Successful EHR Adoption

Rebecca Quammen, CEO, Quammen Health Care Consultants, 151 Southhall Lane, Suite 150, Maitland, FL, 32751, United States of America, becky@quammengroup.com, Adriane Randolph

Human intuition has been the subject of countless research studies in management and the behavioral sciences. In a recent qualitative survey of healthcare industry participants ranging from IS consultants to executive management, results suggest that human intuition may be a factor in successful adoption of EHRs.

3 - Causes and Consequences of Telemedicine Adoption:**Bridging the Geographical and Socioeconomic Divide**

Xiaojin Liu, University of Minnesota, 321 19th Ave S, 3-150 CSOM, Minneapolis, MN, 55455, United States of America, liux1591@umn.edu, Karen Soderberg, Kingshuk K Sinha, Susan Goldstein

Telemedicine, the technology-enabled remote delivery of clinical care, is one potential means to improve patient access to health care services. Yet, little is known on antecedents and consequences of current adoption. We investigate how geographical, socioeconomic and organizational characteristics determine the adoption, and examine how telemedicine impacts clinical care effectiveness.

WE04

04-Broadway D

Disease Modeling

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Ozge Karanfil, PhD Candidate, MIT, karanfil@mit.edu

1 - Big Data Literature Analytics for Disease and Treatment Dynamics

Seifu Chonde, Graduate Student, The Pennsylvania State University, 310 Leonard Building, State College, PA, 16802, United States of America, sjc294@psu.edu, Joey Storer, Soundar Kumara

We explore temporal dynamics in biomedical literature using a case-study in chemotherapy. We start by using information extraction techniques on entities of interest in what we label the Reading problem. The collocation of entities within articles forms various network topologies in the Assembly problem. Finally, we cluster, describe, and analyze these networks for insights in the interactions between diseases and treatments.

2 - Statistical Metamodeling and Computer Experiments of Large-Scale Cardiac Models

Hui Yang, University of South Florida, Tampa, FL, United States of America, huiyang@usf.edu, Dongping Du, Chen Kan

Cardiac voltage-gated sodium (Nav) channel plays significant roles in cardiac electrical signaling. Model of Nav channels involves greater levels of complexity. Traditional optimization methods have encountered many difficulties, even infeasible, for model calibration. We developed a new statistical metamodeling approach for computer experiments and optimization of Nav channels. The approach achieves superior performance for modeling the glycosylated and controlled kinetics of Nav channels.

3 - Dynamics of Routine Health Screening

Ozge Karanfil, PhD Candidate, MIT, karanfil@mit.edu

Guidelines for routine health screening such as mammography, PSA testing and colonoscopy have changed significantly over time. Evidence-based guidelines are often not followed by clinicians and patients, with significant over or under screening. In this study we describe a dynamic simulation model to explain changes in action thresholds of practice guidelines. We use qualitative and quantitative data to document evidence of gaps between guidelines and practice. Qualitative data includes interviews with medical and health professionals. Quantitative data includes longitudinal screening data.

WE05

05-Broadway G

Understanding Patterns in Healthcare Data

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Shan Liu, Assistant Professor, University of Washington, Box 352650, Seattle, WA, 98195, United States of America, liushan@uw.edu

1 - Understanding Adherence and Prescription Patterns using Large-Scale Claims Data

Margret Bjarnadottir, University of Maryland, College Park, MD, United States of America, margret@rhsmith.umd.edu, Sophia Wu, Eberchukwu Onukwugha, Catherine Plaisant, Sana Malik

Traditionally summary statistics such as the Medication Possession Ratio have been the adherence measures of choice. With advanced computing capabilities and novel visual analytic tools, we are able to move beyond the traditional reporting of "average adherence" to gain further insight on patient and prescriber behavior, as reflected in large scale claims prescription data. We utilize EventFlow, a novel discrete event sequence visualization software. We illustrate the use of visual analytic tools in summarizing large scale claims data and gain detailed insights into prescription drug use.

2 - From Data to Insights

Nitesh Chawla, University of Notre Dame, nchawla@nd.edu

Procedures chosen by physicians are the result of years of research and practice. However, while some patients may require a specific procedure, others may benefit from a variety of options, the decision of which is at the discretion to the physician. This paper poses the question: Do influential experiences during medical school extend into the physician's practice decisions? We detail how multiple disparate data sources can be leveraged to gain insight into complex topics.

3 - Development and Analysis of Electronic Health Record-Based Depression Trajectory and Monitoring

Shan Liu, Assistant Professor, University of Washington, Box 352650, Seattle, WA, 98195, United States of America, liushan@uw.edu, Shuai Huang, Ying Lin

Depression affects 1 out of 10 Americans and is the most common mental illness seen in primary care. The objective is to investigate the dynamics of individuals' depression trajectory for diagnosis/prognosis, and develop smart monitoring strategies to adapt to population heterogeneity. We analyzed the electronic health record of longitudinal depression PHQ-9 scores of an on-going treatment group from the Mental Health Research Network. We found a five-group trajectory pattern using clustering, recursive partitioning, and collaborative degradation model. We then predict future trajectories.

WE06

06-Broadway H

Big Data and Analytics in the Modern Healthcare Enterprise

Cluster: Vanderbilt Anesthesiology & Perioperative Informatics Research Division (VAPIR)

Invited Session

Chair: Jonathan Wanderer, Assistant Professor Of Anesthesiology, Vanderbilt University Medical Center, 1301 Medical Drive, Nashville, TN, United States of America, jon.wanderer@vanderbilt.edu

1 - Creating Actionable Analytics to Drive Frontline Decision Making

Ed Marx, Director, Strategic & Operations Analytics, Vanderbilt University Medical Center, ed.marx@vanderbilt.edu

With all the data that is generated at a medical center, what are the analyses that can help frontline leaders make optimal decisions and how can those analyses be presented so that they can understand them? This is a question facing every medical center in the US. The goal of our Analytics department is to drive optimal decision making through the use of data. We need to be both quantitative enough to do the analyses but also skilled in the specific business problems to create powerful visualizations. We are a more analytic version of what Tom Davenport calls "light quants".

2 - Advancing Perioperative Medicine with Analytics

Jonathan Wanderer, Assistant Professor Of Anesthesiology,
Vanderbilt University Medical Center, 1301 Medical Drive,
Nashville, United States of America, jon.wanderer@vanderbilt.edu

Healthcare in the United States is experiencing radical change focused on value. Surgical care comprises the majority of costs and expenses for most large health systems. We will review the current context of health care, discuss infrastructure requirements and review perioperative systems at Vanderbilt to help facilitate excellent care.

3 - Leveraging Electronic Health Records to Support Precision Medicine

Wei-qi Wei, Instructor Of Medical Informatics, Vanderbilt
University, 2525 West End Ave, Nashville, TN, 37212,
United States of America, wei-qi.wei@Vanderbilt.Edu

The convergence of two rapidly developing technologies - high-throughput genotyping and electronic health records (EHRs) - gives scientists an unprecedented opportunity to utilize routine healthcare data to accelerate genomic discovery. In this talk, I will first summarize the advantages and challenges of repurposing EHR data for genetic research. I will then give an example of extracting statin dose-responses from EHRs and tested them for association with genetic variants.

WE07

07-Broadway J

Healthcare Policy

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Qiushi Chen, Georgia Institute of Technology, 755 Ferst Drive,
NW, H. Milton Stewart School of Industrial & Atlanta, GA, United
States of America, chenqiushi0812@gatech.edu

1 - Developing Optimal Biomarker-Based Screening Strategies using Reinforcement Learning

Christine Barnett, University of Michigan, 1205 Beal Ave,
Ann Arbor, MI, United States of America, clbarnet@umich.edu,
Daniel Underwood, Todd Morgan, James Montie, Brian Denton,
Scott Tomlins, John Wei

Recent advances in the development of new biomarker tests, which physicians use for the early detection of cancer, have the potential to improve patient survival by catching cancer at an early stage. We describe a Q-learning method to compute near optimal prostate cancer screening strategies that trade off the number of screening biopsies versus metastatic cases per 1,000 men. We present results based on Monte Carlo simulation to compare the policies developed using Q-learning methods with those recommended in the medical literature.

2 - Liver Transplant Waitlist Equilibria via Stochastic Games

Gordon Hazen, Professor, Northwestern University, Department of
Industrial Engineering, and Management Sciences, Evanston, IL,
60202, United States of America, gbh305@northwestern.edu

A 2007 Federal mandate requires an increase in marginal quality liver transplant offers. To investigate the response of the liver waitlist to increases/decreases in marginal quality organ offers, we construct stochastic game models in which players are waitlist members. We demonstrate the existence of Markov perfect equilibria, as well as oblivious equilibria for this system, devise methods for computing these, and report predictions of waitlist behavior under more/fewer marginal organ offers.

3 - Optimal Liver Cancer Surveillance in Patients with Hepatitis C

Qiushi Chen, Georgia Institute of Technology, 755 Ferst Drive,
NW, H. Milton Stewart School of Industrial & Atlanta, GA, United
States of America, chenqiushi0812@gatech.edu, Turgay Ayer,
Jagpreet Chhatwal

Current practice guidelines recommend every 6-month surveillance for liver cancer in cirrhotic patients with hepatitis C. However, the optimal surveillance policy remains unknown. In this study, we analyze the most cost-effective surveillance policies from a societal perspective using a mixed-integer programming (MIP)-based modeling framework. We find that the optimal surveillance interval should depend on patients' liver disease stage and age. Moreover, expanding surveillance to non-cirrhotic patients with advanced fibrosis improves the cost-effectiveness of HCC surveillance.

WE08

08-Broadway K

Modeling to Enhance Healthcare Delivery

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Julie S. Ivy, Associate Professor, North Carolina State University,
111 Lampe Drive, Raleigh, NC, 27695-7906, United States of America,
jsivy@ncsu.edu

1 - A Framework for Evaluating the Cost-Effectiveness of Safety Barriers in Radiation Therapy

Pegah Pooya, North Carolina State University, Raleigh, NC, 27695,
United States of America, ppooya@ncsu.edu, Julie S. Ivy, Lukasz
Mazur, Prithima Mosaly, Gregg Tracton, Katharin Deschesne,
Lawrence Marks, Chera Bhishamjit

The use of Safety Barriers (SB) is a widely recognized method to improve the reliability of Radiation Therapy (RT) process. In this study, we develop a cost-effectiveness framework to evaluate SBs in terms of their impact on patient safety and cognitive workload.

2 - A Framework for Modeling Multiple Chronic Conditions

Nisha Nataraj, PhD Student, North Carolina State University,
400 Daniels Hall, Campus Box 7906, Raleigh, NC, 27695,
United States of America, nnataraj@ncsu.edu, Julie S. Ivy

Comorbidity is the presence of two or more chronic conditions in an individual. A 2012 CDC report found that around 1 in 4 US adults live with two or more chronic conditions, contributing to almost two-thirds of healthcare spending. Diabetes, a chronic condition by itself, is associated with both concordant and discordant comorbidities. The goal of this research is to develop a framework for modeling multiple chronic conditions in women with diabetes at a population level so as to determine their prognosis and the impact of the interaction between two or more chronic conditions.

3 - Assessment of Promoting Telehealth Technology for Engagement and Self-Care of Heart Failure Patients

Linlin Ma, PhD Student, The Pennsylvania State University,
362Leonhard Building, University Park, PA, 16802, United States
of America, lxm1009@psu.edu, Harriet Nembhard, Harleah Buck

This paper explores the opportunity of telehealth technology in promoting Heart Failure (HF) patients' self-care engagement in rural areas. With the aid of Geographic Information System tools for visualizing health disparities and socioeconomic metrics, the need of engaging HF patients' self-care is established. From analyzing the correlations between the HF landscape in rural Pennsylvania and socioeconomic characters of the rural population, patient groups in the most need of HF healthcare services will be identified.

WE09

09-Cumberland 1

Health Information Technology and Patient Engagement I

Cluster: Health Information Technology and Management

Invited Session

Chair: Jiban Khuntia, Assistant Professor, Dr., University of Colorado
Denver, 1475 Lawrence St., Denver, CO, 80202, United States of
America, jiban.khuntia@ucdenver.edu

1 - Role of Message Frames in Driving Consumer Adoption of Health APPS

Sankara Subrama Srinivasan, Assistant Professor, Idaho State
University, Department of Informatics, Pocatello, ID, 83201,
United States of America, srinsank@isu.edu

In this research we examine the role of interventions in effecting consumer adoption of health IT systems. In particular we examine the effect of message frames (positive vs. negative) in influencing consumer perceptions and adoption of health apps.

2 - Knowledge Stakeholders in Healthcare Social Infomediaries

Dobin Yim, Assistant Professor, Fordham University, 113 West
60th Street, Lowenstein Building, New York, NY, 10023,
United States of America, dyim@fordham.edu, Jiban Khuntia

This study presents a new framework of understanding visitor behaviors in healthcare social infomediaries (online infomediaries that employ social technologies). Using a cross-sectional data set from a social infomediary where patients provide relational support for others, share personal knowledge about post-surgery experiences, and seek expert knowledge from doctors about elective medical procedures, we classify visitors according to their level of participation—high and low contributors—and further divide each type along their brokerage role, as either knowledge or relation brokers.

■ WE10

10-Cumberland 2

Optimal Decision Making using Stochastic Models in Healthcare

Cluster: Health Operations & Logistics

Invited Session

Chair: Burhaneddin Sandikci, Associate Professor of Operations Manamgenet, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, burhan@chicagobooth.edu

1 - Determining Optimal Cut-Off Points for RNA-Based Donated Blood Testing

Ebru Bish, Associate Professor, Virginia Tech, 213 Durham Hall (MC 0118), 1145 Perry St., Blacksburg, VA, 24061, United States of America, ebru@vt.edu, Hrayr Aprahamian, Douglas Bish

Safety of blood products, in terms of being free of infectious agents (e.g., human immunodeficiency virus, hepatitis viruses), is essential. We develop a mathematical model to determine the optimal cut-off points for RNA-based individual and pooled screening tests, and show, using real data, that our model improves upon current practices.

2 - Reducing the Age of Transfused Red Blood Cells in Hospitals

Hossein Mehrizi, University of Waterloo, Waterloo, ON, Canada, habouemehrizi@uwaterloo.ca, Wahid Sarhangian, Opher Baron, Oded Berman

Recently, a body of research suggests a correlation between the age of transfused blood and adverse clinical outcomes. Therefore, there is a need for effective inventory management policies which could reduce the age of transfused RBCs without compromising their availability or resulting in excessive outdated. We first analyze a stylized model and examine the potential of a family of allocation policies in reducing the age of transfused blood without significantly affecting its availability. Next, we analyze data from a hospital and design ordering and allocation policies for the hospital.

3 - Modeling Quality of Care in Hospice Operations

Leela Nageswaran, PhD Candidate, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, lnageswa@andrew.cmu.edu, Alan Scheller-Wolf, Aliza Heching

We study a hospice manager's problem of managing quality of care, factoring in the interplay between profits and patient census: the choice of quality impacts the rate at which new patients enroll with, and existing patients leave, the provider. We obtain sufficient conditions for the existence of intuitive optimal policies.

4 - Combined Advanced and Appointment Scheduling

Mehmet Begen, University of Western Ontario, 1255 Western Road, Ivey Business School, London, ON, N6G 0N1, Canada, mbegen@ivey.uwo.ca, Jonathan Patrick, Antoine SaurÉ

Appointment scheduling and advanced scheduling have generally been addressed as two separate problems despite being highly dependent on each other. We attempt to develop a framework that combines the two problems and present our findings.

■ WE11

11-Cumberland 3

The Challenges of using Industrial and Systems Engineering to Transform American Health Care

Cluster: Medical Decision Making

Invited Session

Chair: Paul Fishman, Scientific Investigator, Group Health Cooperative, 1730 Minor Ave, Suite 1600, Seattle, WA, 98101, United States of America, fishman.p@ghc.org

1 - What are the Challenges to using Industrial Systems Engineering to Improve American Health Care?

Paul Fishman, Scientific Investigator, Group Health Cooperative, 1730 Minor Ave, Suite 1600, Seattle, WA, 98101, United States of America, fishman.p@ghc.org, Joseph A. Heim, Zelda Zabinsky

Despite calls by the National Academy of Sciences and the Institute of Medicine for greater integration between industrial Systems engineering and health services improvement, little has been done to apply industrial best practices developed over many decades by operations researchers and industrial systems engineers. We highlight the challenges in achieving this integration through the experience of Group Health Cooperative, which although frequently cited as a model for the entire US system, demonstrates the challenges of transforming American health care.

2 - Bringing Industrial and Systems Engineering Methods into Healthcare Practice: Barriers and Challenge

Joseph A. Heim, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, jheim@uw.edu, Zelda Zabinsky, Paul Fishman

Operations research and more generally, industrial and systems engineering methods, have been employed in healthcare for decades. Many of these applications of management science and industrial engineering practices have been successful for a period of time. But too often, when we revisit the sites of previously completed work, we discover that for a variety of reasons the methods, algorithms, models and processes we developed were no longer in use. Examining these situations more closely we came to the conclusion that it was not that the tools were no longer useful for the purpose for which they were developed, but rather that the health care individuals with whom we had worked on those projects were no longer in the position of champion for their continued use and maintenance.

■ WE12

12-Cumberland 4

Predictive Modelling in Healthcare Operations II

Contributed Session

Chair: Monica Gentili, Institute for People and Technology (IPaT), Georgia Institute of Technology, 75 5th Street NW, Suite 600, Atlanta, GA, 30308, United States of America, mgentili3@mail.gatech.edu

1 - Development of a Predictive Bed Control Management System

Ivan G. Guardiola, Associate Professor, Missouri S&T, 700 W. 14th Street, Rolla, MO, 65409, United States of America, guardiolai@mst.edu, Elizabeth Cudney, Raymond Phillips, Debra Warner

Within the VHA, access to care is a critical focus; therefore, understanding patient flow, bed status, and service availability is essential to continuous improvement. The purpose of this research is to develop a bed usage prediction model through the analysis of trends in order to enable efficient and flexible admissions, transfers, and discharges. We present an effort to develop a single, real-time, predictive tool for bed control management with the direct goal of application in a VA health center.

2 - Spatial Access to Primary Care in Georgia: Will the Affordable Care Act Impact Access to Care?

Monica Gentili, Institute for People and Technology (IPaT), Georgia Institute of Technology, 75 5th Street NW, Suite 600, Atlanta, GA, 30308, United States of America, mgentili3@mail.gatech.edu, Pravara Harati, Nicoleta Serban

We evaluate how the Affordable Care Act (ACA) will impact spatial access to primary care from 2013 to 2025. We pilot this study for the state of Georgia and we compare spatial access under expansion and non-expansion of the Medicaid program. We use a stock-and-flow model to predict the number of available visits, regression models to project needed visits, and an optimization model with access constraints to match supply and demand and estimate served demand. The output of these models is used to estimate shortage, availability and accessibility of primary care for the period under study.

■ WE13

13-Cumberland 5

Hospital Operations

Cluster: College of Healthcare Operations Management, Production and Operations Management Society

Invited Session

Chair: David Zepeda, Northeastern University, 360 Huntington Avenue, Boston, MA, 02114, United States of America, d.zepeda@neu.edu

1 - Competition and the Operational Performance of Hospitals: The Role of Hospital Objectives

Dimitrios Andritsos, HEC Paris, 1 rue de la Liberation, Paris, France, andritsos@hec.fr, Sam Aflaki

We examine the effect of a hospital's objective in hospital markets for elective care. Using game-theoretic analysis and queuing models to capture the operational performance of hospitals, we compare the equilibrium behavior of three market settings in terms of criteria such as waiting times and patient costs from waiting and hospital payments.

2 - Hospital Operations in the Future

Davood Golmohammadi, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., Boston, MA, 02125, United States of America, davood.golmohammadi@umb.edu

Today's hospital is perceived as an expensive, crowded and inefficient enterprise. In the common practice of hospitals, they provide almost any service to a variety of patients. As a result, resource management, patient safety and costly operations are major challenges for management, and these are part of the inherent nature of such a business structure. Although many hospitals attempt to implement process improvement methodologies, we do not often see real and multidimensional success aligning with the overall visions of cost-effective and patient-centric care. A new look at the common model of hospital operations is needed and a new business model is proposed for hospital operations in the future.

3 - Managing Physician Preferred vs. General Medical Supplies: Reduce Costs and Improve Quality of Care

Claudia Rosales, Assistant Professor, Michigan State University, 350 North Business Complex, East Lansing, MI, 48824, United States of America, rosales@broad.msu.edu, Anand Nair

In healthcare the largest cost after labor is represented by medical supplies. Managing hospital expenses effectively is not trivial, but is essential for sound financial planning. Several factors complicate the task of managing hospital expenses, including number and variety of supplies that must be procured, different sourcing options available, players involved in purchasing decisions, and continued focus on patient care. Based on hospital data we analyze the effect of these different factors on hospital spending and provide recommendations to improve effectiveness of healthcare operations.

4 - Supply Chain Risk Management and Hospital Inventory: Effects of System Affiliation

David Zepeda, Northeastern University, 360 Huntington Avenue, Boston, MA, 02114, United States of America, d.zepeda@neu.edu, Gilbert Nyaga, Gary Young

We propose a supply chain risk management (SCRM) approach in health care supply chains by empirically investigating inventory cost in hospital operations under conditions of uncertainty in supply and demand and also examine moderating effects of hospital system affiliation that potentially affect a managers' confidence in their supply chain.

WE14

14-Cumberland 6

Healthcare Operations

Contributed Session

Chair: Sina Faridimehr, Wayne State University, 4815 4th St., Detroit, MI, United States of America, fb1562@wayne.edu

1 - Your Domain or Mine? Generalist and Specialist Physician Assignment for Common Pediatric Diagnoses

Mariam Krikorian, PhD Candidate, University of Southern California, 3670 Trousdale Parkway - BRI 306, Los Angeles, CA, 90089, United States of America, Mariam.Krikorian.2016@marshall.usc.edu

Research comparing generalist and specialist physicians' practice offers inconsistent results. Accordingly, this study looks at claims to physician expertise, and task-level factors that affect these claims. I administered a survey to hospitalist and subspecialist physicians at a children's hospital. Initial analysis shows variation in agreement among hospitalists and subspecialists about physician assignment for common pediatric diagnoses. Logit regression results describe the types of diagnoses pertaining to the specialist's or hospitalist's domain of expertise.

2 - How Business Cycle Affects Performance:

A Case of Pennsylvania Hospitals using DEA

Ya Chen, University of Science and Technology of China, 96 Jinzhai Road, Hefei, China, ychen10@mail.ustc.edu.cn

This paper aims to analyze how business cycles affect hospital performance in Pennsylvania during the period 2005-2012 by using data envelopment analysis (DEA). Specifically, we measure hospital efficiency from both county and hospital levels, and use several DEA models to calculate the global Malmquist index (GMI). The average Malmquist index is almost the same during the period. The analysis indicates that the economic downturn has only a minor impact on hospital performance. These results provide some useful information for hospital management.

3 - Healthcare Supply Chain Analytics: Lessons from other Industries

Tom Davis, Principal, End-to-End Analytics, 2595 E. Bayshore Rd., Suite 240, Palo Alto, CA, 94303, United States of America, tom@e2eanalytics.com

The advantages of a finely-tuned supply chain have not been fully realized in the healthcare world. This talk briefly describes key areas of opportunity, such as improved network design, demand forecasting, and inventory management, by studying cases both inside and outside the healthcare world. In each case the careful application of data-driven analysis will be emphasized, along with the impact both in terms of cost reduction and service improvement.

4 - Supply and Demand Alignment at Primary Care Facilities

Sina Faridimehr, Wayne State University, 4815 4th St., Detroit, MI, United States of America, fb1562@wayne.edu, Seung Yup Lee, Alper Murat, Ratna Chinnam, Evrim Dalkiran, Qingyu Yang, Azade Tabaei, Hakimuuddin Neemuchwala, Mike Lederle

We propose statistical models to improve timely access for patients while maintaining clinic capacity utilization in primary care facilities. The models leverage correlations between scheduling practice, panel size management, appointment slot grid design and access performance. Results from testing the models at VA facilities are promising.

Thursday, 8:30am - 10:00am

TA01

01-Broadway A

Award Winning Healthcare Analytics Organizations

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Tarun Mohan Lal, mohanlal.tarun@mayo.edu

1 - Mayo Clinic – Sustained Excellence through System and Management Engineering

Jodi Grimm, Unit Head, Mayo Clinic, 200 1st Street SW, Rochester, MN, 55905, United States of America, jgrimm@mayo.edu, Janine Kamath

For over 100 years, Mayo Clinic leaders have embraced systems and management engineering, analytics, and operations research to innovate and achieve sustained excellence in clinical care, research, education and administration. This presentation will share the Mayo legacy, sophisticated infrastructure, unique application, and key success factors for effectively leveraging engineering and analytics in healthcare delivery.

2 - Integration of the EHR and Transformational Analytic Solutions at Kaiser Permanente

Terhilda Garrido, VP HIT Transformation & Analytics, Kaiser Permanente, 1800 Harrison St, 24th Fl, Oakland, CA, 94612, United States of America, Terhilda.Garrido@kp.org

Kaiser Permanente is the nation's largest integrated healthcare system (\$60 billion/year). It has made a significant \$4B investment in an electronic health record. This comprehensive EHR clinical data source (10+ petabytes) provides a rich source for innovative analytics including predictive analytics, advanced monitoring of care gaps, NLP techniques, research design. Learn how analytics is transforming how Kaiser delivers care to its 10 million members.

3 - The Role of Metrics and Measurement in Healthcare:

Requirements for Reimbursement and Recommendation

Victoria Jordan, Executive Director, UT MD Anderson Cancer Center, 1400 Holcombe Blvd, FC2.3000 Unit 466, Houston, TX, 77030-4008, United States of America, vsjordan@mdanderson.org

There are a plethora of metrics being reported to CMS on professional practice, hospital quality, safety, outcomes, and other metrics. This presentation will highlight current and emerging reporting requirements, discuss the importance and value of public reported metrics, review how metrics are used for monitoring and improving performance (care processes and treatment outcomes), and demonstrate the link between "big data" and quality of patient care.

■ TA02

02-Broadway B

Driving Quality Improvement II

Cluster: Association of Anesthesia Clinical Directors

Invited Session

Chair: Paul StJacques, Quality and Patient Safety Director, Department of Anesthesiology, Vanderbilt University School of Medicine, 1501 21st Avenue South, 4648 TVC, Nashville, TN, 37232, United States of America, Paul.stjacques@vanderbilt.edu

1 - Optimizing Preoperative Handoffs

Rajnish Gupta, Vanderbilt University, Nashville, TN, United States of America, raj.gupta@Vanderbilt.Edu

Transitions of care between health care providers are significant sources of medical errors. In the operating room arena, the transition from the operating room to the recovery room or intensive care unit has been examined carefully and systematic improvements have improved quality and safety. However, when a patient arrives to the holding area before surgery, many factors converge before the patient is handed off to the intraoperative anesthesiology team and this transition has not been examined in quite the same detail. We propose a tool to improve this handoff.

2 - Implementing Enhanced Recovery Pathways via a Perioperative Consult Team

Matthew McEvoy, Vice-Chair for Education, Program Director, Associate Professor, Vanderbilt University, Dept of Anesthesiology - Vanderbilt, 2301 VUH, Nashville, TN, 37232, United States of America, matthew.d.mcevoy@vanderbilt.edu

The American Society of Anesthesiologists has endorsed the concept of the Perioperative Surgical Home (PSH) as a patient-centered model of perioperative care. This presentation will describe the systems-based practice improvement approach taken at Vanderbilt University as we created and expand our version of the PSH. Quantitative outcome data will be presented along with a description of ongoing PDSA cycles and process improvement.

3 - Driving Quality Improvement: The Anesthesia Incident Reporting System

Patrick Guffey, Clinical Director, Children's Hospital Colorado, 13123 East 16th Avenue, Box 090, Aurora, CO, 80045, United States of America, Patrick.guffey@childrenscolorado.org

The national anesthesia incident reporting system is an electronic means by which any anesthesia provider in the US can report cases of harm, or near-misses of the same. To date, the system has 1400 reports across 20 different categories, in an anesthesia specific taxonomy. We will review background of medical error, design of the system, current results, and future implications. Each month a newsletter article with a circulation of 30,000 anesthesia providers is published highlighting a case and discussion on how to prevent the error from recurring.

■ TA03

03-Broadway C

Data Analytics for Healthcare

Cluster: INFORMS Data Mining Section

Invited Session

Chair: Qingpeng Zhang, Assistant Professor, City University of Hong Kong, P6606, 6/F, Academic 1, City University, 83 Tat Chee Avenue, Kowloon Tong, 00001, Hong Kong - PRC, qingpeng.zhang@cityu.edu.hk

1 - Health Web Observatories: Creating Preferable Health Outcomes through Health Web Science

Joanne S. Luciano, Visiting Research Scholar, Rensselaer Polytechnic Institute, Center for CCC, 110 8th St, Troy, NY, 12180, United States of America, jluciano@gmail.com, Tara French, Eva Kahana, David Molik, Grant Cumming

Health Web Science (HWS), which studies impact of the Web on health and wellbeing, aims towards a preventative, participatory, personalized, and predictive (P4) model of healthcare. HWS posits this can be achieved by the leveraging of Web's data, resources and nature. In studying the Web, it is impossible to ignore the evolving social, political, economic, policy questions that emerge as a result of the use of the Web. Health Web Observatories play a role by enabling the study of these data, make available the metadata, and thereby enable it as a feedback mechanism for preferable futures.

2 - Vertical Knowledge Graph and its Application in Healthcare

Haofen Wang, Assistant Professor, East China University of Science and Technology, No. 130 Meilong Road, Shanghai, 200237, China, whfcarter@ecust.edu.cn, Tong Ruan

We present a tool to construct and explore a vertical knowledge graph in healthcare. We integrate data from a HIS system with external domain ontologies. We provide a collaborative editing interface to add knowledge. Medical entities in EMRs are automatically annotated. On top, semantic search and assisted diagnosis are implemented.

3 - Discussions on Challenges of Big Data for Healthcare in China

Donglei Feng, Director of Smart Healthcare, Wonders Information Co. Ltd., No. 1518 Lianhang Road, Shanghai, China, fengdonglei@wondersgroup.com, Tong Ruan

The big data of healthcare has become a hot topic in both theoretical research and applications. Since the launch of regional health system in 2006, Shanghai has accumulated over 150 TB health data. However, how to make use of these data is still in its early stage. In this presentation, we first discuss different needs of health big data, then list several issues when building big data center and big health data platforms, and finally provide a possible solution from the technology perspective.

4 - The Trust between Patients and Doctors in Online Health Community: A Case from haodf.com

Jiang Wu, Wuhan University, Luojia Mountain, Wuhan, China, jiangwu.john@qq.com

The online health community is booming in China. OHC can help deal with the serious shortage of medical resources and ease the long-standing conflict between doctors and patients. After reading doctors' basic information and consumers' comments, patients are able to choose preferred doctors to diagnose their diseases without the limitation of time and space. In this study, we will use the dataset from haodf.com, one of the largest medical websites in China, to study trust building, trust retention and trust transfer in the online health community.

■ TA04

04-Broadway D

Economic Evaluation and Financial Incentives in Healthcare

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Cheng Zhu, McGill University, Desautels Faculty of Management, Montreal, QC, H3A 1G5, Canada, cheng.zhu@mail.mcgill.ca

1 - Reimburse Obstetricians to Avoid Unnecessary C-Sections

Cheng Zhu, McGill University, Desautels Faculty of Management, Montreal, QC, H3A 1G5, Canada, cheng.zhu@mail.mcgill.ca, Beste Kucukyazici

Rate of C-section, which exposes potential harms on mothers and newborns as well as heavy economic burdens, has been increasing constantly and this growth raises some concerns of the policy makers. This research focuses on optimizing the financial incentives, i.e. choosing best payment scheme and optimizing how to reimburse obstetricians under this scheme, in order to reduce the C-section rates without sacrificing birth quality while alleviating economic burden for overall health care system.

2 - Do Mandatory Overtime Laws Improve Quality? Staffing Decisions and Operational Flexibility of Nursing Homes

Susan Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu

During the 2000s, a number of U.S. states passed laws that restrict the use of mandatory overtime and cap the maximum work hours for nurses. Using nursing homes data from 2004 to 2012, we find that these mandatory overtime laws reduce the service quality of nursing homes. This outcome can be explained by several undesirable staffing changes made by nursing homes: decreased registered nurse staffing and increased use of contract nurses.

■ TA05

05-Broadway G

Strategic Investment Appraisal

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Alec Morton, University of Strathclyde, George St, Glasgow, United Kingdom, alec.morton@strath.ac.uk

1 - Assessing the Value of Investments in Non-Clinical Primary Prevention

George Miller, Institute Fellow, Altarum Institute, 3520 Green Court, Suite 300, Ann Arbor, MI, 48105, United States of America, George.Miller@altarum.org, Charles Roehrig

We describe an analysis tool for characterizing the value of an investment in nonclinical primary prevention from the multiple perspectives of organizations that can influence the investment. Application of the tool to prenatal and early childhood interventions is used to illustrate a life course approach in which an intervention alters the year-by-year life path of age-specific cohorts from birth through the duration of the lifespan.

2 - Integrating Laboratory, Pharmacy and Financial Data to Evaluate Unnecessary Pharmaceutical Use

Bradley Brimhall, Senior Consultant, EDW & Medical Analytics, University of Mississippi, 2500 North State Street, Jackson, MS, United States of America, brimhall6@stanfordalumni.org

There has been considerable interest in quantifying the cost of unnecessary laboratory testing through integration of clinical laboratory and financial data. Even greater potential cost savings might be achievable through the addition of pharmacy data to laboratory and financial data. We identified potential annual variable cost savings of \$649,665 for unnecessary use of two expensive antibiotics in one healthcare system as well as another \$344,219 for use of one expensive anticoagulant in two hospital systems. We also measured the quality impact of unnecessary antibiotic use on patient care.

3 - Decision Rules for Allocation of Finances to Health Systems Strengthening

Alec Morton, University of Strathclyde, George St, Glasgow, United Kingdom, alec.morton@strath.ac.uk, Ranjeeta Thomas, Peter Smith

A key dilemma in global health is how to allocate funds between disease-specific “vertical programs” on the one hand and “horizontal programs” which aim to strengthen the entire health system on the other. We approach this problem by formulating a mathematical program which captures the complementary benefits of investing in both vertical and horizontal programs. We show that our the solution to this math program has an appealing intuitive structure and demonstrate how it is readily possible to computationally solve two specialized versions of this problem.

■ TA06

06-Broadway H

Implementation of Predictive Models for Surgical Patients

Cluster: Vanderbilt Anesthesiology & Perioperative Informatics Research Division (VAPIR)

Invited Session

Chair: Jesse Ehrenfeld, Associate Professor, Vanderbilt University, 1301 Medical Center Drive, Suite TVC 4648, Nashville, TN, 37212, United States of America, jesse.ehrenfeld@vanderbilt.edu

1 - Machine Learning to Forecast Failed Back Surgery: Translating the Data to Patient Care

David Edwards, Director, Acute Pain Service, Massachusetts General Hospital, 55 Fruit St, Boston, MA, 01742, United States of America, daedwards@mgh.harvard.edu

The ultimate goal of analyzing medical data is to use it to benefit the patient. Dr. Edwards will explain the process of using large, multidimensional medical datasets to identify patient predictors of failed back surgery and how the data can be used to intervene in patient care to improve their outcome class.

2 - Machine Learning to Forecast Pain: Exploratory Platform Development

Patrick Tighe, Assistant Professor, University of Florida, 1600 SW Archer Road, P.O. Box 100254, Gainesville, FL, 32610, United States of America, ptighe@ufl.edu

An anesthesiologist manages a patient’s pain during and after surgery. However each individual’s experience of pain is subjective and can be affected by several patient and surgical factors. Here, we will discuss the use of machine learning to forecast post-operative pain and the feasibility of using healthcare data to improve outcomes.

3 - Implementing Procedural Decision Support: Emerging Lessons

Creagh Milford, Partners HealthCare, cmilford1@partners.org

Improving the patient journey through an episode of care that includes a procedure begins with an assessment of procedural appropriateness, including discussion of personalized procedural risks and benefits. Dr Milford will discuss the process of implementing a decision support application, which includes risk prediction models used at the point of care.

■ TA07

07-Broadway J

INFORMS Health Application Society: Best Student Paper Competition Finalists

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Vikram Tiwari, Professor, Vanderbilt University, Vanderbilt University Medical Center, Nashville, TN, United States of America, vikram.tiwari@Vanderbilt.Edu

Co-Chair: Baris Ata, Professor, University of Chicago, 5807 South Woodlawn Avenue, Booth School of Business, Chicago, IL, 60637, United States of America, Baris.Ata@chicagobooth.edu

1 - Modeling Yellow and Red Alert Durations for Ambulance Systems

Amir Rastpour, Alberta School of Business, University of Alberta, PhD office, Alberta School of Business, University o, Edmonton, AB, T6G 2R6, Canada, amir.rastpour@ualberta.ca, Armann Ingolfsson, Bora Kolfal

We model and analyze ambulance shortage periods, time windows during which few or no ambulances are available to cover new emergency calls. We model these shortage periods as partial busy periods for Erlang B systems and validate our model using empirical data from Calgary and Edmonton (almost 100,000 observations in each data set). Furthermore, we model and analyze the impact of two actions: requesting additional ambulances from neighboring cities and expediting the service, on two performance measures: the duration of shortage periods and the number of lost calls.

2 - Evidence Of Strategic Behavior In Medicare Claims Reporting

Hamsa Bastani, Stanford University, 10 Comstock Circle, Apt 304, Stanford, CA, 94305, United States of America, hsridhar@stanford.edu, Joel Goh, Mohsen Bayati

Recent Medicare legislation has stopped reimbursement of hospital-acquired conditions in order to improve quality of care. We find evidence that, in response, some providers may be engaging in upcoding, a practice where providers alter claims data to receive increased reimbursement. We present a novel approach using instrumental variables and a double regression to determine the extent of upcoding of hospital-acquired conditions in the United States. We show that upcoding may have eroded the effectiveness of current legislation, and we make several policy recommendations to mitigate upcoding.

3 - The Roadside Healthcare Facility Location Problem

Harwin de Vries, MSc, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, hdevries@ese.eur.nl, Joris Klundert, Albert Wagelmans

African truck drivers carry a high burden of HIV and are believed to significantly fuel its spread. We consider the problem to select locations for roadside healthcare facilities, so as to maximize their impact in terms of truck driver patient volume and health services effectiveness. We develop and analyze a MIP model for this problem, present numerical experiments for the North-South corridor network, and discuss policy implications.

4 - The Diseconomies of Queue Pooling: An Empirical Investigation of Emergency Department Length of Stay

Hummy Song, PhD Candidate, Harvard University, Wyss House, Soldiers Field Road, Boston, MA, 02163, United States of America, hsong@hbs.edu, Anita Tucker, Karen Murrell

We conduct an empirical investigation of the impact of queue management on patients’ average wait time and length of stay (LOS). Using data from an emergency department, we find that patients’ average wait time and LOS are longer when physicians are assigned patients under a pooled queuing system with a fairness constraint compared to a dedicated queuing system with the same

fairness constraint. Interviews and observations suggest that the improved performance stems from physicians' increased ownership over patients, which enables improved flow management of patients into and out of beds.

■ TA08

08-Broadway K

Case Studies in Healthcare

Contributed Session

Chair: Abraham Seidmann, Professor, Simon School of Business, University of Rochester, Rochester, NY, 14623, United States of America, avi.seidmann@simon.rochester.edu

1 - Risk-Sharing Agreements for Medical Implantables

Guy Shechter, Sr. Director, Medical Affairs, Philips Healthcare, 3000 Minuteman Rd, Andover, MA, 01810, United States of America, guy.shechter@philips.com, Michael Ferguson

A majority of healthcare risk-sharing agreements have focused on pharmaceuticals, with a small number created for medical devices, including diagnostic tests. In this paper, we investigate risk-sharing agreements for medical implantables, which differ from the pharmaceutical model in that payers contract with providers (i.e. physicians, hospitals), who then subcontract with device manufacturers. We explore the incentives and challenges that arise when a manufacturer of a cardiac resynchronization therapy device offers providers a rebate for a next generation device, in the event that a patient develops one of four complications during the first year post-implant.

2 - Configuring Surgical Instrument Tray Sets to Reduce OR Costs

Abraham Seidmann, Professor, Simon School of Business, University of Rochester, Rochester, NY, 14623, United States of America, avi.seidmann@simon.rochester.edu, Greg Dobson, Anthony Froix, Vera Tilson

The kitting of surgical instruments into trays has many benefits, yet the actual tray design is a complex combinatorial problem. We propose an efficient mathematical programming formulation to decide on the composition of trays to minimize the costs of owning, maintaining, and using the trays and the instruments. Using real-world data, we demonstrate that optimizing trays can result in substantial cost savings for the hospital while increasing surgeons' satisfaction.

■ TA09

09-Cumberland 1

Health Information Technology and Patient Engagement II

Cluster: Health Information Technology and Management

Invited Session

Chair: Jiban Khuntia, Assistant Professor, Dr., University of Colorado Denver, 1475 Lawrence St., Denver, CO, 80202, United States of America, jiban.khuntia@ucdenver.edu

1 - Consent to Sharing Personal Health Information: A Field Experiment

Mohamed Abdelhamid, University at Buffalo, School of Management, Amherst, NY, 14228, United States of America, mabdelha@buffalo.edu, Ram Bezawada, Raj Sharman

Education may empower patients to be more pro-active in how they give consent. They may participate more actively leading to more dynamic consent behavior. It may lead to better informed consent. At the outset this research explores the impact the factors that impact sharing of patient health information (PHI). This research also investigates the following research question: How does a more holistic education as opposed to a one-sided message impact patient consent behavior? Does it empower patients and make them more participative? Does it make the consent giving/revoking process more dynamic?

2 - Psychological Empowerment of Patients with Chronic Diseases: The Role of Information Technology

Xiaodong Deng, Dr., Oakland University, School of Business Administration, Rochester, MI, 48309, United States of America, deng@oakland.edu, Jiban Khuntia, Kaushik Ghosh, Mohan Tanniru

Chronic diseases account for a huge cost burden in the United States. Information technology (IT) is enabling better healthcare delivery and care. However, IT's role in managing chronic diseases is still unclear. This presentation is focused on the research question of how information technology can help enhance a patient's psychological empowerment to manage a chronic disease. A sample of forty-nine responses is collected and used to pilot-test the reliability and validity of the measurement instruments and to assess the preliminary predictability of the research model.

3 - The Impact of eRX on Clinician's Performance

Yazan Alnsour, University of Colorado, 1475 Lawrence St., Denver, CO, 80202, United States of America, Yazan.alnsour@ucdenver.edu, Jiban Khuntia

The Institute of Medicine found that medication errors lead to several thousands of deaths each year (iom.edu). Pharmacists commit mistakes due to bad handwriting or ambiguous terminology. Mistakes could also happen due to the prescriber's lack of knowledge of drug-drug interactions or the accurate drug dosage. It is not surprising the medication errors are considered to be one of the most common type of medical errors (Aronson 2009).

■ TA11

11-Cumberland 3

Modeling Cancer Progression, Screening and Treatment

Cluster: Medical Decision Making

Invited Session

Chair: Ayca Erdogan, Assistant Professor, San Jose State University, Davidson School of Engineering, One Washington Square, San Jose, CA, 95192, United States of America, ayca.erdogan@sjsu.edu

1 - Individualized Decision Analysis for Personalized Cancer Treatment

Jennifer Lobo, Assistant Professor, University of Virginia, 1215 Lee Street, P.O. Box 800717, Charlottesville, VA, 22908, United States of America, jenn.lobo@virginia.edu, Sean Carr, Timothy Showalter

Genomics-driven cancer medicine offers the potential to make personalized treatment decisions. Genomic classifier (GC) tests provide individual estimates of the risk of cancer progression or recurrence. We present a decision analysis model to estimate the value of using a GC test to make treatment decisions. We use Monte Carlo simulation to estimate QALYs, cancer outcomes, and costs for a cohort of prostate cancer patients using a GC to inform post-prostatectomy treatment decisions.

2 - Nonlinear Programming for Estimation of Transition Probabilities in Natural History Modeling

Jing Voon Chen, University of Southern California, Daniel J. Epstein Department of Industri, Los Angeles, CA, 90089, United States of America, jingvoo@usc.edu, Julia Hagle

The quality of model-based disease screening analyses often hinges on the quality of the natural history (NH) model. We examine the relationships between NH models and the types of data available. We formulate and solve a nonlinear program that selects parameters for a Markovian NH model of a hypothetical disease. We observe a broad array of model instances that fit the data equally well and significant differences in the representations of undetected states.

3 - Why is PSA Screening so Common when Evidence is so Uncertain?

Ozge Karanfil, PhD Candidate, MIT, karanfil@mit.edu

Guidelines for routine health screening such as mammography, PSA testing and colonoscopy have changed significantly over time. Evidence-based guidelines are often not followed by clinicians and patients, with significant over or under screening. In this study we describe a dynamic simulation model to explain changes in action thresholds of practice guidelines. We use qualitative and quantitative data to document evidence of gaps between guidelines and practice. Qualitative data includes interviews with medical and health professionals, quantitative data includes longitudinal screening data.

4 - Optimization of Individualized Imaging Guidelines for Men with Early-Stage Prostate Cancer

Selin Merdan, University Of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, smerdan@umich.edu, Brian Denton, David Miller, Christine Barnett, James Montie

In the early detection and diagnosis of disease, multiple diagnostic tests are often employed to discriminate between diseased and nondiseased individuals. In the context of cancer, there are often several risk factors that are associated with the presence of the disease, which can be used to predict the likelihood of positive or negative test outcomes. We present an optimization model for determining the optimal combination of diagnostic tests, based on individual risk factors, to balance health outcomes and cost. We present results in the context of prostate cancer diagnosis.

■ TA12

12-Cumberland 4

Modeling Contract & Payment Policies in Healthcare

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Michael Magazine, Professor and Ohio Eminent Scholar, Carl H. Lindner College of Business, OBAIS, Cincinnati, OH, 45221, United States of America, mike.magazine@uc.edu

1 - Decisions for Participation in the CMS Bundled Payment for Care Improvement Initiative

Brenda Courtad, University of Cincinnati, 2925 Campus Green Dr., Cincinnati, OH, United States of America, courtabl@mail.uc.edu, Michael Magazine

A Markov Decision Process will be utilized to help frame decisions as the patient moves through the care settings. Based on these decisions, clinical conditions and time frame of responsibility will be evaluated for opportunities and risks if included in the initiative for the post-acute care provider.

2 - Payment Policy Impact on Reducing Hospital Readmissions

Jon Stauffer, Indiana University, Kelley School of Business, Bloomington, IN, United States of America, stauffer@indiana.edu, Jonathan Helm, Kurt Brethauer

We model how payment policies impact hospital readmissions. We consider accountable care organizations, fee-for-service, and four bundled payment plans in addition to Hospital Readmissions Reduction Program (HRRP) penalties. We analyze how groups in the healthcare provider system (hospitals, physicians, post-discharge follow-up care) would adjust their readmission avoidance procedures depending on the payment policy and if any misalignment of incentives between healthcare providers will occur.

3 - Bundled Payment vs. Fee-for-Service: Impact of Payment Scheme on Performance

Elodie Adida, University of California at Riverside, 900 University Ave., Riverside, CA, United States of America, elodie.goodman@ucr.edu, Hamed Mamani, Shima Nassiri

Healthcare reimbursements are usually based upon a fee-for-service (FFS) scheme, providing incentives for high volume of care, rather than efficient care, and leading to rising costs. The new healthcare legislation tests payment models that remove such incentives, such as the bundled payment (BP) system. We analyze the effect of payment schemes on the presence of patient selection, the treatment intensity, the provider's cost and financial risk, and the total social welfare. We design two payment systems that alleviate the shortcomings of FFS and BP and induce socially optimum decisions.

4 - Bundled Payments for Healthcare Services: Proposer Selection and Information Sharing

Diwaker Gupta, Professor, National Science Foundation and University of Minnesota, 130B Mechanical Engineering, Minneapolis, MN, United States of America, gupta016@umn.edu, Mili Mehrotra

We model the proposer-selection and information-sharing problems that arise when implementing CMS' bundled payment for care improvement initiative. Possessing private information, proposers compete for beneficiaries but not for selection. We show that depending on market characteristics, CMS may keep the selection process uncertain. We also characterize parameters of an optimal menu of contracts, and implications for policy makers.

■ TA13

13-Cumberland 5

New Frontiers in Operations Management Research

Cluster: College of Healthcare Operations Management, Production and Operations Management Society

Invited Session

Chair: Mohan Tatikonda, Indiana University, 801 W. Michigan St., Indianapolis, IN, United States of America, tatikond@indiana.edu

1 - Online Footprint for Disease Outbreak Tracking

Abhinav Shashank, Co Founder & CEO, InnovAccer, Stanford Financial Square, 2600 El Camino, Suite 403, Palo Alto, CA, 94306, United States of America, abhinav@innovaccermail.com

Early tracking of disease outbreaks and associated risk factors is imperative. We propose a granger causality model wherein search traffic/social media time-series with an assumed weight and lag correlate with actual trends. This model can aid in faster detection of disease outbreaks, as fast as 1 - 5 days from the rising slope.

2 - Beyond the First Decade: Sustaining and Growing Enterprise Process Improvement Programs

Mohan Tatikonda, Indiana University, 801 W. Michigan St., Indianapolis, IN, United States of America, tatikond@indiana.edu

Health systems have implemented lean, six sigma and related initiatives to improve quality, costs and satisfaction. But what happens after the initial energy of program initiation dissipates? Do programs wither, maintain or adapt? We present a model of quality improvement program sustainment and growth. The model, derived from longitudinal analysis of mature programs, identifies: (1) potential evolutionary paths of health system quality improvement programs beyond their first decade and (2) managerial factors enabling program sustainment and increased program scope, sophistication and impact.

3 - Enabling Healthcare with High Tech Innovation:**A Longitudinal Field Study of Robot Assisted Surgery**

Kingshuk K Sinha, Chair and Professor, Supply Chain and Operations, University of Minnesota, 321 19th Avenue S, Minneapolis, MN, 55455, United States of America, ksinha@umn.edu, Ujjal Kumar Mukherjee, Shoubhik Sinha, Scott Bosch

In this research we do a longitudinal field study of a da Vinci surgical robot in understanding the role of high-tech innovation in reducing outcome variation in healthcare delivery given input heterogeneity in the form of surgeons' experience and skill, patient profiles, team composition and team familiarity. Through an empirical analysis we find that high-tech innovation (surgical robot) mediation reduces the effect of many sources of input heterogeneity on outcome variation in robot assisted surgical procedures. This is consequential in terms of availability of complex surgical procedures.

■ TA14

14-Cumberland 6

Policy in Healthcare

Contributed Session

Chair: John Baras, Professor, Univ. of Maryland, 2247 A.V. Williams Bldg, Un. of Maryland, College Park, MD, 20742, United States of America, baras@umd.edu

1 - Optimal Individual Long-Term Care Insurance Decisions to Maximize Certainty Equivalent of Bequest

Samuel Bodily, John Tyler Professor of Business Administration, Darden School, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, bodily@virginia.edu, Bryan Furman

We do a decision analysis of the long-term care (LTC) insurance purchase decision for an individual. It is a daunting lifetime choice with many uncertainties: mortality, morbidity, timing and length of LTC, and portfolio investment risk. We use Monte Carlo simulation with detailed, experience-based distributions for uncertainties and their correlations, to project individual savings by the time of death for levels of LTC insurance. Insurance is optimal only when low risk tolerance, low levels of retirement savings, high expectations of LTC cost increases, and young age combine.

2 - Reducing Costs by Preventing Complications for Hepatitis C and HIV Patients

Brittany Hagedorn, SIMUL8 Corporation, 225 Franklin Street Floor 26, Boston, MA, 02110, United States of America, brittany.h@simul8.com

Without diagnosis, 98% of Hepatitis C and 30% of HIV patients are developing preventable complications including infection, organ failure, and early mortality. With discrete event simulation, we modeled both disease pathways over 5 years to test the impact of early diagnosis on the burden of disease, cost per patient, clinical outcomes, and capacity requirements. Age-banded population and disease prevalence data were used to forecast demand. Process maps represent the pathways for undiagnosed, untreated and treated patients. Results quantify the impact on costs, outcomes, and access to care.

3 - A New Advanced Analytic and Data Visualization Innovation to Support Public Health Decision Making

Emily White, Sr. Data Modeling Manager - Market Access, GE, 3131 Easton Turnpike, Fairfield, CT, 06828, United States of America, emily.white@ge.com

We describe a decision making tool integrating agent-based modeling (ABM) with data visualization to evaluate the impact of investments to inform public health planning. The ABM platform simulates regional disease epidemiology, population characteristics, behaviors, and health resources. Investments include new facilities, staffing, technology or public health policy. Impact on clinical and economic outcomes is projected up to 20 years. A gaming interface visualizes the region with heat mapping and allows users to "drag and drop" investment options while graphically displaying outcomes.

4 - A Modeling, Health IT, Analytics Framework for Healthcare Management and Application to Diabetes II

John Baras, Professor, Univ. of Maryland, 2247 A.V. Williams Bldg, Un. of Maryland, College Park, MD, 20742, United States of America, baras@umd.edu, Iakovos Katsipis

We develop a framework using modern Model-Based System Engineering methodologies and apply it to Diabetes 2. We include a Controlled Hidden Markov Chain model for diabetes, three diagnostic tests, ten interventions, three types of patients. We develop three methods for computing tradeoffs between cost and health care quality. One is an exhaustive Monte Carlo simulation and the other two use multi-criteria optimization with full and partial state information. The latter obtain similar results at a fraction of the time of the first. We demonstrate the powerful capabilities of such a framework.

Thursday, 10:30am - 12:00pm

■ TB01

01-Broadway A

Panel: Roundtable on Healthcare Policy and Analytics

Cluster: Vanderbilt School of Medicine, Department of Health Policy
Invited Session

Chair: Melinda Buntin, Professor and Chair, Department of Health Policy, Vanderbilt University School of Medicine, 2525 West End, Suite 1207, Nashville, TN, 37203, United States of America, melinda.buntin@vanderbilt.edu

1 - Roundtable on Healthcare Policy and Analytics

Moderator: Melinda Buntin, Professor and Chair, Department of Health Policy, Vanderbilt University School of Medicine, 2525 West End, Suite 1207, Nashville, TN, 37203, United States of America, melinda.buntin@vanderbilt.edu, Panelists: Aaron McKethan, Mark Frisse, Spencer Jones

Melinda Buntin, PhD will moderate a discussion of how the growing volume of healthcare data can inform healthcare policy and provider decisions at the local and national level can facilitate improving the quality, efficiency, and patient-centeredness of care. Topics will include how health policy efforts can use "big data" to reform payment structures and procedures, manage clinical quality, improve efficiency, and drive improvements in public health.

■ TB02

02-Broadway B

Influencing Provider and Patient Behavior

Cluster: INFORMS Behavior Operations Management Section
Invited Session

Chair: Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

1 - Optimal Allocation of Physician's Time when Patient Utility is Heterogeneous

Balaraman Rajan, Assistant Professor, California State University East Bay, 25800 Carlos Bee Blvd, Hayward, CA, United States of America, balaraman.rajan@csueastbay.edu, Abraham Seidmann, Tolga Tezcan

We analytically investigate the strategic decisions of a medical specialist who treats a heterogeneous set of patients. Comparing the optimal service characteristics of revenue-maximizing and welfare-maximizing specialists we see that the former will overall serve a smaller patient population, have shorter waiting times, and will operate at a lower utilization. We also analyze the impact of the newly introduced telemedicine technology on patient utility and the specialists' operating decisions.

2 - Evaluating m-Health Services for User Engagement and Health Promotion: A Randomized Field Experiment

Yi-Chin Lin, Carnegie Mellon University, Pittsburgh, PA, United States of America, yichinl@andrew.cmu.edu, Julie Downs, Rema Padman, Vibhanshu Abhishek

Mobile technologies have the potential to engage patients and change their healthy behaviors, yet little evidence has been documented. We evaluate three novel mobile-enabled interventions for promoting healthy eating: image-based self-monitoring, image-based professional support, and peer support. The results provide strategic insights and may be generalized to other healthy behaviors.

■ TB03

03-Broadway C

Hospital Readmissions: Modeling, Strategies, and Future Challenges

Cluster: INFORMS Data Mining Section

Invited Session

Chair: Lior Turgeman, University of Pittsburgh, 278A Mervis Hall, Pittsburgh, PA, 15260, United States of America, tur.lior@gmail.com

1 - A Predictive Model for Inpatient Readmission of Congestive Heart Failure (CHF) Patients

Lior Turgeman, University of Pittsburgh, 278A Mervis Hall, Pittsburgh, PA, 15260, United States of America, tur.lior@gmail.com, Jerrold H. May

We present a novel hospital readmission predictive model, by integrating a C5.0 tree as the base ensemble classifier, and a support vector machine (SVM) as a secondary classifier. The suggested approach is applied for the prediction hospital readmissions of Congestive Heart Failure (CHF) patients. Although our findings suggest that substantial portion CHF readmissions are inherently difficult to predict, an impressive improvement in prediction performance is obtained, not only for the majority class, but also for the minority class.

2 - Implementation of a Readmissions Reduction Initiative in a Large Complex Health Care System

David Renfro, Chief Nurse at Veterans Affairs, VA Palo Alto Health Care System, 3801 Miranda Ave, Palo Alto, CA, 94555, United States of America, David.Renfro@va.gov, Emily Stallings, Benjamin (Eric) Gillens

Our initiative addresses a patient safety concern: preventable readmissions. We address challenges faced by patients as they transition from hospital to home and other post-discharge care settings. At baseline the 30-day all-cause readmission rate was 14% for acute care. The most common discharge diagnoses resulting in readmission were: CHF, septicemia, UTI and pneumonia. To address these critical issues, we embarked on a community collaborative with a Nurse driven initiative, Project RED, to improve discharge processes. We have enhanced this project with daily management and standard work.

3 - Reducing Readmissions through Multi-Disciplinary Bundle

Lisa Denk, Nurse Case Manager, VA Pittsburgh Hospital, University Drive C, Pittsburgh, PA, 15240, United States of America, lisa.denk@va.gov, Gaetan Sgro, Ashley Ketterer, Sydney Aikin-Smith, Beth Marciniak

Hospital readmissions are costly to the healthcare system, decreases access to care, and decreases patient satisfaction. To address these problems, VA Pittsburgh Hospital has implemented many strategies utilizing a multi-disciplinary team. These strategies include creating diagnosis specific patient education, scheduling negotiated primary care appointments prior to discharge, involving pharmacy in completing medication reconciliation, creating a hand-off tool between inpatient and outpatient nurse case managers, and creating a discharge team that involves intensive case management.

■ TB04

04-Broadway D

Joint Session Disease Modeling/Public Health:Economic Evaluation in Medicine and Public Health

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Greg Zaric, University of Western Ontario, 1255 Western Rd., London, N6G 0N1, Canada, gzaric@ivey.uwo.ca

1 - A Cost-Utility Analysis of Screening and Brief Intervention for Heavy Alcohol use in Canada

Richard Zur, The Hospital for Sick Children, 555 University Ave, Toronto, ON, M5G1X8, Canada, richard.zur@gmail.com, Greg Zaric

The objective of this study was to estimate the cost-effectiveness of implementing universal alcohol screening and brief interventions (SBI) in primary care in Canada. We developed a microsimulation model of alcohol consumption and its effects on 18 alcohol-related causes of death. SBI with Alcohol Use Disorders Identification Test (AUDIT) had an incremental cost-effectiveness ratio of \$5,145/QALY. Sensitivity analyses suggest the results are robust under a variety of assumptions. We found screening and brief intervention to be cost-effective for men and women.

2 - Atrial Fibrillation in Patients with Neuropathological Diagnosis of Primary Alzheimer's Disease

Estefania Ruiz Vargas, University of Western Ontario, 1151, Richmond St., London, ON, Canada, eruizvar@uwo.ca

Recent evidence shows that AF patients are at a higher risk of developing cognitive impairment and dementia, irrespective of their stroke history. We compared demographic data, vascular risk factors, functional status, and neuropsychological functioning of neuropathologically confirmed cases of AD with (AFAD) and without (nAFAD) AF diagnosis. We used network analyses to identify neuropathology findings related with AF. We found that AFAD has a more "vascular" and profile than nAFAD. Dementia seems to be mediated by brain infarcts rather than by neurodegeneration.

3 - HIV and STI Testing among YMSM: Cost-Effectiveness in the Context of Testing Uptake Behavior

Ekkehard Beck, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, ekkehardbeck2015@u.northwestern.edu, Michelle Birkett, Brian Mustanski, Benjamin Armbruster

Using a previously presented stochastic agent-based network simulation model of HIV and STI (i.e., gonorrhea and chlamydia) spread among young men who have sex with men (YMSM) we study the cost-effectiveness of HIV and STI testing strategies among YMSM. Evaluated testing strategies differ by the targeted disease (i.e., HIV only, STI only, HIV and STI combined), as well as differences in testing uptake behavior among individuals and healthcare providers.

■ TB05

05-Broadway G

Online Analytics Applications in Healthcare

Contributed Session

Chair: Jiang Wu, Wuhan University, Luojia Mountain, Wuhan, China, jiangwu.john@qq.com

1 - Electronic Visits in Primary Care Delivery

Jingshan Li, Professor, University of Wisconsin-Madison, 1513 University Ave, Madison, WI, 53706, United States of America, jingshan@engr.wisc.edu, Xiang Zhong, Philip Bain, Albert Musa

Many healthcare organizations have introduced electronic visits, i.e., e-visits, to provide patient-physician communication through securing messages. E-visits can lead to significant savings with improved access to care, increased provider efficiency and patient satisfaction. In this talk, we introduce a quantitative model to study e-visits in primary care clinics. Analytical formulas to evaluate the system performance of primary care operation with e-visit are derived. System properties are investigated, comparisons of different operation policies between office and e-visits are carried out, and the impacts of e-visits on primary care delivery are discussed.

2 - Telemedicine Diffusion in Haiti

Olayele Adelakun, DePaul University, 243 S. Wabash Ave., Chicago, IL, 60604, United States of America, yele@cs.depaul.edu

Telemedicine mediated consultation and education programs can promote delivery of high quality patient care. Telemedicine can connect medical personnel and scarce diagnostic to distant patients. This paper reports on a current study that examines the adoption of telemedicine for improving diabetic foot care in Haiti and the United States.

3 - Depression Expressed in Online Communities

Qingpeng Zhang, Assistant Professor, City University of Hong Kong, P6606, 6/F, Academic 1, City University, 83 Tat Chee Avenue, Kowloon Tong, 00001, Hong Kong - PRC, qingpeng.zhang@cityu.edu.hk

Mental health problems have become more and more prevalent recent years, in both developed countries and developing countries, like China. With the advance of Internet and Web 2.0 technologies, online social media provides a new and effective way to study mental illnesses. In this work, we focus on depression, one of the most popular fundamental mental disorders, with data from a popular social media platform in China. We want to answer the following questions: How is depression expressed in Chinese? What are the social conditions that drive their communications? What are the language patterns of their communication?

4 - The Trust between Patients and Doctors in Online Health Community: A Case from haodf.com

Jiang Wu, Wuhan University, Luojia Mountain, Wuhan, China, jiangwu.john@qq.com

The online health community is booming in China. OHC can help deal with the serious shortage of medical resources and ease the long-standing conflict between doctors and patients. After reading doctors' basic information and consumers' comments, patients are able to choose preferred doctors to diagnose their diseases without the limitation of time and space. In this study, we will use the dataset from haodf.com, one of the largest medical websites in China, to study trust building, trust retention and trust transfer in the online health community.

■ TB06

06-Broadway H

Case Studies in Healthcare via Analytics

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Department, 800 N State College Blvd., Fullerton, CA, 92831, United States of America, smitra@exchange.fullerton.edu

1 - Consumer Behavior for Adopting Social and Mobile Media for Health Management: A Case Study

Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Department, 800 N State College Blvd., Fullerton, CA, 92831, United States of America, smitra@exchange.fullerton.edu, Rema Padman

Advances in technology and increased availability of large amounts of data in the recent decade has made it possible to use extensive analytical methods for effective decision-making, particularly in the healthcare industry. Based on a member survey of a large health plan, we identify factors (demographic, clinical and technological) that are significantly associated with member interest in adopting social and mobile media for obtaining health information from the health plan via analytics and visualization techniques.

2 - Changes in Health Plan STARS Require Increased Reliance on Analytics

Bhushan Kapoor, Professor and Chair, California State University, Fullerton, 800 N. State College Blvd., Fullerton, CA, United States of America, bkapoor@fullerton.edu, Rahul Bhaskar

STARS Ratings for hospitals and Health Plans are one of the corner stones of ACA. One research questions arises: Does the usage of hospital correlate to the star ratings. From our preliminary research, we do not see any correlation between hospital rating and its usage. We expect, over time, this correlation to change for some specialties.

3 - Designing m-Health Services for User Engagement and Health Promotion: An App for Healthy Eating

Rema Padman, Carnegie Mellon University, The H. John Heinz III College, Pittsburgh, PA, 15213, United States of America, rpadman@cmu.edu, Yi-Chin Lin, Vibhanshu Abhishek, Julie Downs

Mobile technologies have the potential to engage patients in managing their healthy behaviors, such as healthy eating. However, few advanced functionalities have been employed in practice for promoting healthy eating. This study proposes novel mobile-enabled interventions by upgrading three interventions commonly used in practice: self-monitoring, professional support, and peer support. Surveys reveal user satisfaction and heterogeneous preferences among subpopulations. This study provides strategic insights that are generalizable to other healthy behaviors.

■ TB07

07-Broadway J

Linking Hospital Emergency Department Information and Workflow to Public Health

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Howard Burkom, Johns Hopkins Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD, 20723, United States of America, Howard.Burkom@jhuapl.edu

1 - Surveillance, Diagnosis And Management Of Influenza In The Emergency Department

Andrea Dugas, Assistant Professor, Johns Hopkins University, 5801 Smith Ave, Davis Building, Suite 3220, Baltimore, MD, 21209, United States of America, adugas1@jhmi.edu

Although accurate and timely influenza surveillance is critical for diagnosis and treatment, as well as public health and hospital preparedness, current surveillance mechanisms struggle to provide accurate surveillance information in a timely fashion. We sought to demonstrate the feasibility and validity of a novel electronic surveillance system utilizing a cloud-based interface that consolidates laboratory test results and geographical information in real-time, and evaluate the utility and acceptability of this surveillance tool amongst emergency department (ED) providers.

2 - The Emergency Department and the Public Health: Front Line Opportunities and Challenges for Responding to Infectious Disease Epidemics

Richard Rothman, Johns Hopkins University, Department of Emergency Medicine, Baltimore, MD, United States of America, rrothma1@jhmi.edu, Nate Irvin

Emergency departments (EDs) serve as the front line of the health care system and are a sentinel site for infectious disease detection, both emergent and indolent. Models, drivers and best practice approaches for when, and how to implement screening in this high volume, episodic care sites will be discussed with examples of challenges and successes.

3 - A Term-based Approach to Asyndromic Determination of Significant Case Clusters

Howard Burkom, Johns Hopkins Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD, 20723, United States of America, Howard.Burkom@jhuapl.edu, Yevgeniy Elbert

Authors devised and tested a statistical test for detection of anomalous clusters of emergency department (ED) visit records based on frequencies of terms in the free-text chief complaint field, independent of syndromic or other classification. Study data consisted of 7 years of records from 15 hospitals, with method evaluation based on detection of common and uncommon single-phrases and on injected sets of records from realistic, stochastic scenarios.

■ TB08

08-Broadway K

Joint Session HealthOp/Public Health: Optimization of Screening and Vaccination for Infection Prevention

Cluster: Health Operations & Logistics

Invited Session

Chair: Joris Klundert, Department Chair, Erasmus University Rotterdam, Burg Oudlaan 50, iBMG, Rotterdam, 3000 DR, Netherlands, vandeklundert@bmg.eur.nl

1 - Optimizing Population Screening For Infectious Diseases: The Case of HAT Disease Control In The DRC

Harwin de Vries, MSc, Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, harwindv@hotmail.com, Albert Wagelmans, Joris Klundert

We consider the following planning problem: given the expected evolution of an epidemic in a given set of villages, which villages should be screened when? We present descriptive models for the disease burden corresponding to a planning, and use these to develop, analyze and optimize several classes of planning policies.

2 - Designing Vaccines that are Robust to Virus Escape

Swetasudha Panda, Graduate Student, Vanderbilt University, FGH 304, 2301 Vanderbilt Place, Nashville, TN, 37235, United States of America, swetasudha.panda@vanderbilt.edu, Yevgeniy Vorobeychik

Many viruses, e.g., HIV can escape the effect of vaccines by rapid mutations. We propose to design antibody sequences that make such evasion difficult. We frame this as a bilevel optimization problem of maximizing the minimum number of virus mutations to evade an antibody. We use 1) Rosetta to calculate binding, 2) local search, 3) machine learning to predict binding, and 4) poisson regression to predict escape costs. We exhibit an antibody with a far higher escape cost (7) than the native (1).

3 - Optimal Vaccine Allocation over Multiple Populations

Evelot Duijzer, Econometric Institute, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR, Netherlands, duijzer@ese.eur.nl, Rommert Dekker, Willem van Jaarsveld, Jacco Wallinga

We apply analytical methods to vaccine allocation to gain insights into the structure of the optimal allocation. Using implicit function analysis, we prove the existence of an optimal vaccination fraction. This result yields a high-level understanding of the inequitable and seemingly counter-intuitive outcomes of different models.

■ TB09

09-Cumberland 1

Healthcare Information Technology and Healthcare Outcomes

Cluster: Health Information Technology and Management

Invited Session

Chair: Sezgin Ayabakan, Assistant Professor, University of Baltimore, Baltimore, MD, United States of America, sayabakan@ubalt.edu

1 - Impact of Regulations and Policies on EHR Usability

Karoly Bozan, Assistant Professor, Idaho State University, Pocatello, ID, 83209-8020, United States of America, bozakaro@isu.edu

Regulations and policies are central to securely collect, store and manage patient health information. It is especially central nowadays as more providers are using electronic health records (EHR). This study aims to investigate the effects these regulations have on usability of the system across multiple stakeholder groups.

2 - Operational Efficiency in Online Medical Consultation:

A Study of Primary Care Practice eVisit

Changmi Jung, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, cjung9@jhu.edu, Rema Padman

This study presents a preliminary model and analysis focused on the effect of learning by doing on the operational efficiency of the eVisit service at the primary care practices. Ultimately, learning should reduce measurable cost–non-value added activities by staff and physicians, and patient wait time—which results in increased efficiency. The results show that patients' wait times are affected by other factors rather than the eVisit experience. However, we found the significant evidence of organizational learning in reducing non-value added activities in handling the eVisits.

3 - Impact of EHRs on Adherence to Infection-Prevention Process of Care Measures and Surgical Infections

Jaeyong Bae, Assistant Professor, Northern Illinois University, College of Health and Human Services, School of Nursing and Health Studies, DeKalb, IL, 60115, United States of America, jaeyong.bae@niu.edu, Jason Hockenberry, Kimberly Rask, Edmund Becker

This study examines whether the use of electronic health records (EHRs) improves process of care, as measured by adherence to infection-prevention guidelines for surgical patients, and influences healthcare quality, as measured by postoperative infections. Using large, patient-level administrative data, we find that hospitals with basic EHRs were more likely to adhere to infection-prevention guidelines for surgical patients. An increase in adherence to the surgical guidelines was also associated with lower postoperative infection rates.

■ TB10

10-Cumberland 2

Joint Session Health Operations/Public Health: Organ Allocation/Exchange Models

Cluster: Health Operations & Logistics

Invited Session

Chair: Yichuan Ding, UBC, 2053 Main Mall, Vancouver, BC, V6T0A7, Canada, Daniel.Ding@sauder.ubc.ca

1 - Redistricting Liver Transplantation

Sommer Gentry, Associate Professor, United States Naval Academy, 1027 S. Clinton Street, Baltimore, MD, 21224, United States of America, gentry@usna.edu, Megan Lewis, Eric Chow, Dorry Segev

Redistricting is poised to resolve the largest controversy in liver transplantation: the enormous geographic disparity in livers available for transplantation across the U.S. Working closely with the Liver Committee that oversees liver allocation policy, we designed an integer program to capture clinical concerns about redistricting. We used simulation optimization to correct a bias in the Liver Simulated Allocation Model that would have significantly understated lives saved by redistricting. edistricting would save hundreds of lives, make transplantation more equitable, and reduce costs.

2 - FutureMatch: Combining Human Value Judgments and Machine Learning to Match in Dynamic Environments

John Dickerson, Ph.D. Candidate, Carnegie Mellon University, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Tuomas Sandholm

Kidney exchange enables patients with kidney failure to swap willing but incompatible donors. Typically, a committee of experts directly creates a matching policy that tries to optimize some objective (e.g., "maximize matches"). We present a framework that takes as input a high-level objective determined by humans, then automatically learns based on data how to make this objective concrete and learns the means to accomplish this goal. We validate our method on real fielded exchange data.

3 - Addressing U.S. National Geographic Disparity in Kidney Transplantation by Creating Sharing Partnerships

Vikram Kilambi, Northwestern University, Evanston, IL, United States of America, VikramKilambi2012@u.northwestern.edu

Shortages of kidney organs and low utilization of marginal-quality organs have contributed to divergent waiting times for patients seeking transplantation in the US. We develop a MILP based on heavy-traffic queuing approximations that identifies a sharing partner for each locality and redirects organs to localities with greater need. We implement a discrete-event simulation of the US kidney allocation system with a heuristic to assess the quality of the solution and find better partnerships.

4 - Incorporating DPI into the Cadaver Kidney Allocation Scoring Scheme

Baris Ata, Professor, University of Chicago, 5807 South Woodlawn Avenue, Booth School of Business, Chicago, IL, 60637, United States of America, Baris.Ata@chicagobooth.edu, Yichuan Ding, Stefanos Zenios

In the US, candidates on the cadaver kidney transplant waitlist are ranked using a scoring scheme that takes into account characteristics of the donor and the candidate. This paper undertakes a modeling based analysis of a general class of scoring systems that uses the DPI (donor-profile-index). We use a fluid model to approximate the transplant waitlist, and show that using DPI enables the acceptance of a larger range of kidneys when compared to a donor-independent ranking system. We use the simulation model to compare the current policy and our policy.

■ TB11

11-Cumberland 3

IS&T for Improving the Healthcare Process and System

Cluster: Association for Information Systems SIG-Health
Invited Session

Chair: Jim Ryan, Associate Professor of IS & QM, Troy University, One University Place, Phenix City, AL, 36869, United States of America, jeryan@troy.edu

1 - Critical Success Factors, Key Performance Indicators and Activities for Perioperative Improvement

Barbara Doster, Director of Perioperative Services, University of Alabama Birmingham Hospital, Birmingham, AL, United States of America, bdoster@uabmc.edu, Sandra Daily, Rosemary Ryan, Jim Ryan, Carmen Lewis

Based on a 136-month longitudinal study of an academic medical center, this study investigates how integrated information systems and business analytics can improve perioperative efficiency and effectiveness across patient quality of care, stakeholder satisfaction, clinical operations, and financial cost effectiveness. This case study examines process management practices of balanced scorecards and performance dashboards to monitor and improve the perioperative process, aligned to overall hospital goals at strategic, tactical, and operational levels.

2 - Perioperative Workflow Balancing through Data-Driven Process Management

Jim Ryan, Associate Professor of IS & QM, Troy University, One University Place, Phenix City, AL, 36869, United States of America, jeryan@troy.edu, Barbara Doster, Sandra Daily, Rosemary Ryan, Carmen Lewis

The identification of existing limitations, potential capabilities, and the subsequent contextual understanding of perioperative workflow events tightly coupled to integrated information systems are contributing factors that yield opportunities for measured perioperative process improvement to achieve workflow balance. Based on a 136-month longitudinal study of a 1,046 registered-bed academic medical center, this case study identifies the impact of perioperative performance measures to yield workflow balance, patient care accountability, and patient flow efficiency.

3 - Can Inaccurate Problem Code Assignment at Dispatch Indicate Inaccurate Prioritization of EMS Calls?

Mike Dohan, Lecturer, Lakehead University, 955 Oliver Rd., Thunder Bay, ON, P7B 5E1, Canada, msdohan@lakeheadu.ca, Kai Huang, Joseph Tan, Norm Gale

Prioritizing an ambulance dispatch call at a lower level than warranted can deny emergency medical care to those who need it. Similarly, calls prioritized higher than warranted can contribute to problems. This research seeks to reduce the number of false positive high priority paramedic calls. It has been demonstrated that more information at dispatch could improve accuracy in prioritization. Our current research question is: can inappropriately assigned problem codes indicate a false positive with respect to the priority assigned to the call?

■ TB12

12-Cumberland 4

Scheduling and Optimization in Healthcare

Contributed Session

Chair: Michelle Alvarado, Postdoctoral Research Associate, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, alvarado.michelle.m@gmail.com

1 - Scheduling for Elective Surgery under Uncertainty Considering Patient Health Condition

Joonyup Eun, PhD Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, eunj@purdue.edu, Yuehwern Yih, Sang-Phil Kim

This paper describes an operating room planning problem in which patients have different severity levels when they are diagnosed, and patient health condition deteriorates with the increase of waiting time. In addition, uncertainty in surgery durations is incorporated in this problem. A stochastic mixed integer program is proposed to optimize the assignment of surgeries considering the worst patient health condition among all patients waiting for surgeries and total overtime that exceeds the available time durations allotted for surgeries.

2 - Mixed Integer Programming-Based Heuristics for the Patient Admission Scheduling Problem

Aykut Turhan, Student, Dokuz Eylul University, Tinaztepe, Izmir, Turkey, aykutturhan@gmail.com, Bilge Bilgen

The patient admission scheduling (PAS) problem is a combinatorial optimization problem where elective patients are automatically assigned to beds for the duration of their stay considering not only the medical necessity but also the patient preferences. Due to its nature, solving the previously published problem instances to optimality is a difficult task. In this paper, we present two mixed integer programming (MIP) based heuristics namely fix-and-relax (F&R) and fix-and-optimize (F&O). Results show that proposed heuristics provide promising results towards the solution of the problem.

3 - Staff Scheduling and Fair Workload Problem

Kamil Ciftci, PhD Candidate, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Ave., Bethlehem, PA, 18015, United States of America, kac208@lehigh.edu

One of the major problems for the healthcare system is the heavy workload of hospital nurses. In order to solve this problem healthcare organizations should create a flexible and fair job environment. To address this problem, we develop an integer programming model that to find staggered nurse scheduling while balancing workload in an outpatient center. Our method and heuristic approach are evaluated with current practice in a local hospital.

4 - Mean-Risk Stochastic Integer Programming Model for Chemotherapy Appointment Scheduling

Michelle Alvarado, Postdoctoral Research Associate, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, alvarado.michelle.m@gmail.com, Lewis Ntaimo

Chemotherapy patients require a series of appointments and the timing of these appointments is critical to the treatment's effectiveness. The appointment duration, acuity levels, and the availability of nurses are stochastic. We develop a set of mean-risk stochastic integer programming (SIP) models for the problem of scheduling chemotherapy patient appointments and resources. A risk-neutral formulation and two risk-averse models are presented. Computational experiments indicate that the mean-risk SIP models improve system performance for the oncology clinic.

■ TB13

13-Cumberland 5

Patient Flow

Cluster: College of Healthcare Operations Management,
Production and Operations Management Society

Invited Session

Chair: Shannon Harris, University of Pittsburgh, 241 Mervis Hall,
Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu

1 - Appointment Scheduling with No-Shows and Cancellations

Shannon Harris, University of Pittsburgh, 241 Mervis Hall,
Pittsburgh, PA, 15213, United States of America,
sharris@katz.pitt.edu, Jerrold H. May, Luis G. Vargas

Appointment no-shows and cancellations can be disruptive to clinic operations. Scheduling strategies such as overbooking or overtime slot assignments can assist with mitigating these disruptions. We propose a scheduling model that accounts for both no-show and cancellation rates, and show that scheduling decisions change when cancellation rates are added.

2 - Priority and Predictability

Jillian Berry Jaeker, Assistant Professor, Boston University School
of Management, 595 Commonwealth Avenue, Boston, MA,
02215, United States of America, jjaeker@bu.edu

We examine how the admission type of incoming surgical patients (scheduled or emergent) impacts the care these and other hospital patients receive, particularly under periods of high workload. We find that emergency patients are less likely to be cancelled but more likely to experience delays in care than scheduled patients. Our results show that clinicians are using scheduled patients as levers for increasing capacity.

3 - Modeling Shared Medical Appointments

Zlatana Nenova, University of Pittsburgh, 241 Mervis Hall,
Roberto Clemente Drive, Pittsburgh, PA, 15260,
United States of America, zdn3@pitt.edu, Jerrold H. May

About 8.3% of Americans have been diagnosed with Type 2 diabetes, a number projected to double by 2030. To meet the increasing demand for care, hospitals look for new ways to treat patients. One strategy is to institute shared medical appointments (SMAs), which include a group and an individual consultation with a multidisciplinary medical team. The SMA structure allows doctors to provide care to more patients. SMAs help patients exchange information and find a support group. We examine the development of SMAs, and suggest modeling methods for optimizing their structure.

■ TB14

14-Cumberland 6

Healthcare Operations I

Contributed Session

Chair: Kingshuk K Sinha, Chair and Professor, Supply Chain and
Operations, University of Minnesota, 321 19th Avenue S, Minneapolis,
MN, 55455, United States of America, ksinha@umn.edu

1 - Improving Societal Outcomes in the Organ Donation Value Chain

Priyank Arora, PhD Student, Georgia Institute of Technology, 800
W Peachtree St NW, Atlanta, GA, 30308, United States of
America, priyank.arora@scheller.gatech.edu, Ravi Subramanian

This paper studies the operational actions of supply-side players in an organ donation value chain, namely, the Organ Procurement Organization that coordinates organ recovery activities, and the hospital, where potential cadaver-donors arrive. Our analysis captures a variety of interactions within the complex and important activity of organ recovery for transplantation.

2 - Applying Survival Analysis to Healthcare Durations: Another Way to Look at Length of Stay

Jeffery Vande Berg, Lean Management Engineer, University of
Iowa Hospitals & Clinics, C51-K GH, 200 Hawkins Drive,
Iowa City, IA, 52242, United States of America,
jeff-vandenberg@uiowa.edu, Divya Madala, Geeta Lal

Engineers in healthcare must generate analyses that are accepted by process owners to be effective. Survival analysis has a long history in medical research and is understood by staff working in cancer, transplant and other specialties. Applying survival analysis to process has significant differences from clinical research in seeking SHORTER process durations and in using minutes or days instead of years. My presentation will cover: statistical aspects, biases, regression with Cox Proportional Hazards, graphics, using R and Minitab software to perform, and some examples from our hospital.

3 - Queuing Models of Case Managers

Robert Shumsky, Tuck School at Dartmouth, 100 Tuck Drive,
Dartmouth College, Hanover, NH, 03755, United States of
America, shumsky@dartmouth.edu, Fernanda Campello,
Armanna Ingolfsson

Many health care delivery systems use case managers, servers who are assigned multiple customers and have frequent, repeated interactions with each customer until the customer's service is completed. Examples include emergency department physicians and hospital social workers. We propose a stochastic model of a baseline case manager system and formulate tractable approximations. The models allow us to develop insights on the impact of case-load limits and point us towards the most effective methods to improve case manager system performance.

4 - Enabling Healthcare with High Tech Innovation: A Longitudinal Field Study of Robot Assisted Surgery

Kingshuk K Sinha, Chair and Professor, Supply Chain and
Operations, University of Minnesota, 321 19th Avenue S,
Minneapolis, MN, 55455, United States of America,
ksinha@umn.edu, Ujjal Kumar Mukherjee, Shoubhik Sinha,
Scott Bosch

In this research we do a longitudinal field study of a da Vinci surgical robot in understanding the role of high-tech innovation in reducing outcome variation in healthcare delivery given input heterogeneity in the form of surgeons' experience and skill, patient profiles, team composition and team familiarity. Through an empirical analysis we find that high-tech innovation (surgical robot) mediation reduces the effect of many sources of input heterogeneity on outcome variation in robot assisted surgical procedures. This is consequential in terms of availability of complex surgical procedures.

Thursday, 12:00pm - 1:30pm

Broadway F

Thursday Lunch Plenary

Sponsor: Plenary

Sponsored Session

Chair: Jonathan B. Perlin, MD, PhD, MSHA, FACP, FACMI, is
President, Clinical Services and Chief Medical Officer of Nashville,
Tennessee-based HCA (Hospital Corporation of America).

1 - The Healthcare Information Ecosystem and Improvement: The (Big) Data -Dividend of Meaningful Use

Jonathan B. Perlin, MD, PhD, MSHA, FACP, FACMI, is President,
Clinical Services and Chief Medical Officer of Nashville

"Big data" are characterized by volume, variety and the velocity of creation. Certainly, the ecosystem of healthcare continuously spawns data with these characteristics, especially since the advent of the "HITECH Act," that sought to accelerate the "meaningful use" of health information technology. In "The Healthcare Information Ecosystem and Improvement: The (Big) Data Dividend of Meaningful Use," Dr. Perlin will describe and discuss with the audience how payers and providers are increasingly using emerging data assets for higher-value, safer, and higher-performing healthcare.

Thursday, 1:30pm - 3:00

TC01

01-Broadway A

Panel Discussion with Leading Healthcare Organizations

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Christopher Strömblad, Senior Modeler - Operations Research, Geisinger Health System, 100 N. Academy Ave, Danville, PA, 17822, United States of America, chris.stromblad@gmail.com

1 - Panel Discussion With Leading Healthcare Organizations, Moderated by Dr. Diwakar Gupta

Christopher Strömblad, Senior Modeler - Operations Research, Geisinger Health System, 100 N. Academy Ave, Danville, PA, 17822, United States of America, chris.stromblad@gmail.com, Victoria Jordan, Diwakar Gupta, Smriti Neogi, Tarun Mohan Lal

Leading healthcare organizations including the Mayo Clinic, Geisinger Health System, Cincinnati Children's Hospital, and MD Anderson Cancer Center have benefited from utilizing OR/OM and present approaches from idea generation to implementation. The panel will share examples that have benefited their organization, highlight tools and applied technologies, as well as present challenges and successes that can be translated for both academics and practitioners.

2 - Mathematical Modeling and Simulation to Optimize Care Delivery at MD Anderson Cancer Center

Victoria Jordan, Executive Director, UT MD Anderson Cancer Center, 1400 Holcombe Blvd, FC2.3000 Unit 466, Houston, TX, 77030-4008, United States of America, vsjordan@mdanderson.org

As part of the above panel discussion, Dr. Jordan will share recent projects at MD Anderson Cancer Center that use mathematical modeling and simulation to optimize operational processes such as materials management, Pharmacy inventory, patient flow and room utilization, and nurse scheduling as well as optimizing clinical care such as cancer screening methods.

TC02

02-Broadway B

Biometric Signal Process for Clinical Decision Making

Cluster: The Center for Research and Innovation in Systems Safety (CRISS)

Invited Session

Chair: Dan France, Vanderbilt University School of Medicine, Medical Arts Bldg. Suite 732, 1211 21st Avenue South, Nashville, TN, 37212-1212, United States of America, dan.france@vanderbilt.edu

1 - An Overview of Acoustic Indicators of Suicide Research at Vanderbilt

Mitch Wilkes, Associate Professor of Electrical Engineering, Vanderbilt University School of Engineering, 326 Featheringill Hall, Nashville, TN, 37212, United States of America, Mitch.Wilkes@vanderbilt.edu

Nearly 2 decades ago Vanderbilt was approached by a husband and wife team of psychiatrists who reported that they could tell that a patient was in imminent danger of attempting suicide based on the sound of the patient's voice, independent of speech content. They believed it was possible to discover the acoustic features containing this information and enable a computer to detect this suicidal state. This talk will provide an overview of Vanderbilt's history and current research on suicidal speech.

2 - Using Speech Analysis for TBI Detection

Christian Poellabauer, Associate Professor of Computer Science and Engineering, University of Notre Dame, 384 Fitzpatrick Hall, Notre Dame, IN, 46556, United States of America, cpoellab@gmail.com, Nikhil Yadav, Patrick Flynn, Sandra Schneider

Recent research results indicate that speech analysis has great promise as biomarker for various neurological conditions, including mild forms of TBI such as concussions. The University of Notre Dame collected speech recordings from over 2,500 athletes (including recordings from more than 100 athletes with concussions) and identified 38 acoustic features as candidates for use as speech biomarkers for TBI. In this work, we present our preliminary results in the evaluation of a subset of these acoustic features.

3 - Cry Acoustic Features as Objective Measures of Pain in Newborns

Dan France, Vanderbilt University School of Medicine, Medical Arts Bldg. Suite 732, 1211 21st Avenue South, Nashville, TN, 37212-1212, United States of America, dan.france@vanderbilt.edu, Laura Kaufman, Stephan Bruehl, Nathalie Maitre, Mitch Wilkes, Carrie Menser

Validated instruments for assessing pain in newborns are available but underutilized in clinical practice because they are generally incompatible with nursing workflow and staffing. Failure to accurately discriminate pain cries from other cries may result in the pharmacological mismanagement (over or under treatment) of pain in this patient population. In this presentation, we will present preliminary findings from a 1-year pilot study to evaluate infant cry acoustic features as objective and discriminating measures of pain in newborns. Our analysis compares cry and brain activation data.

4 - An Intelligent Wellness Care System with Speech and Language Processing Functionality

Lakshman Tamil, University of Texas at Dallas, Richardson, TX, 75080, United States of America, laxman@utdallas.edu, John H. L. Hansen

Technology seems to offer the most promising solution to managing the healthcare of the increasing aging population as the support ratio continues to decline. The University of Texas' Quality of Life Technology Lab (QoLT-UTDallas) has partnered with the Center for Robust Speech Systems (CRSS-UTDallas) to develop an intelligent wellness care system that incorporates audio data capture using the LENA Digital Language Processor (DLP). This system offers continuous measurement of speech and language in conjunction with periodic measurement of vital signs and predictive analytics to provide more information about a person's health and impending problems.

TC03

03-Broadway C

Optimization in Healthcare I

Contributed Session

Chair: Soheil Davari, School of Mathematics, Cardiff University, Senghennydd Road, Cardiff, CF24 4AG, United Kingdom, DavariS@cardiff.ac.uk

1 - Performance Evaluation of Operating Room Scheduling across the Perioperative Process

Wei Li, University of Kentucky, 414J CRMS Building, 147 Graham Ave, Lexington, KY, 40506, United States of America, wei.mike.li@uky.edu, Barrie R. Nault, Victoria L. Mitchell

The performance of operating rooms (ORs) is a critical input to OR scheduling, which drives the perioperative (peri-op) process accordingly. However, some key performance indicators (KPIs) in OR scheduling are inconsistent with each other. This work shows the inconsistencies and provides alternative solutions for OR scheduling across the peri-op process.

2 - Location of Medical Diagnostic Services across Public Hospitals in an Inter-Institutional Network

Rodolfo Mendoza Gómez, PhD Student, Tecnológico de Monterrey, Eduardo Monroy Cárdenas 2000, San Antoni, Toluca de Lerdo, Mx, 50110, Mexico, rodolfo.mendoza@hotmail.com, Roger Z. Rios Mercado, Karla B. Valenzuela Ocaña

A problem of providing specialized medical services is addressed. The main idea is to integrate both services from public and private inter-institutional hospital networks to ensure total service coverage for patients and a better allocation of the medical equipment. A mixed-integer programming model aiming at minimizing the total investment and operating costs considering monthly demand with different levels of urgency, equipment models and allocation policies is introduced and assessed.

3 - The Problem of Redesigning the Preventive Health Care Network: A Real-World Case Study in Wales

Soheil Davari, School of Mathematics, Cardiff University, Senghennydd Road, Cardiff, CF24 4AG, United Kingdom, DavariS@cardiff.ac.uk, Paul Harper

Preventive health care is one of the most significant services governments provide to people. Many costly and disabling problems such as cancer and chronic respiratory problems can be prevented or diagnosed in early stages by regular checkups or changes to lifestyle such as smoking cessation. The paper deals with a real case study of relocating preventive health care centres throughout Wales to increase the participation levels considering budget constraints, and capacity limitations. To this end, a mixed-integer mathematical programming model and a simulation procedure was used.

■ TC04

04-Broadway D

Incentives in Healthcare Supply Chains

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Fernanda Bravo, MIT, 100 Main Street, E62-459, Cambridge, MA, 02139, United States of America, fbravo@mit.edu

1 - Value of Inventory Information in Allocation of Flu Vaccine in Limited Supply

Zihao Li, Ph.d. Student, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, zli66@gatech.edu, Julie Swann, Pinar Keskinocak

We derive allocation strategies based on inventory information when the uptake rates vary geographically, and compare them to population based strategies on the number of cases prevented and the amount of inventory saved. The results emphasize the need for greater visibility in public health supply chains.

2 - Copayment Restructuring for a Heterogeneous Patient Population

Gregory Schell, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, schellg@umich.edu, Mariel Lavieri

Targeted incentives have the potential to improve patient adherence to optimal treatment guidelines. To determine the optimal allocation of incentives across a heterogeneous patient population at risk for cardiovascular disease, we formulate a bilevel optimization problem with constraints on resource availability as well as maximum inequality.

3 - A Risk-Sharing Pricing Contract in B2B Service Supply Chains: An Application to Healthcare

Fernanda Bravo, MIT, 100 Main Street, E62-459, Cambridge, MA, 02139, United States of America, fbravo@mit.edu, Retsef Levi, Gonzalo Romero, Georgia Perakis

We study the pricing of HC referrals. Service provider and service requester have opposing risks relative to demand volume. Leveraging this, we design a two-price contract. We characterize the unique equilibrium in closed-form assuming loss-averse utilities, and general demand distributions. The equilibrium contract induces risk-sharing, and reduces payment uncertainty.

■ TC05

05-Broadway G

Workflow Methods and Analytics

Cluster: Vanderbilt School of Medicine, Department of Biomedical Informatics

Invited Session

Chair: Daniel Fabbri, Vanderbilt University, Nashville, TN, United States of America, daniel.fabbri@vanderbilt.edu

1 - Using Daily Progress Note Data to Predict Discharge Date from the Neonatal Intensive Care Unit

Michael Temple, Vanderbilt University, Nashville, TN, United States of America, michael.temple@vanderbilt.edu

We designed a model using clinical features from daily progress notes to predict when NICU patients will be medically ready for discharge. The system achieved AUCs ranging from 0.729 – 0.865 at 10 and 2 days until discharge, respectively. This model provides an accurate method to reduce NICU length of stays.

2 - Methods and Models for Understanding Clinical Workflow

Kim Unertl, Vanderbilt University, Nashville, TN, United States of America, kim.unertl@Vanderbilt.Edu

Understanding clinical workflow is crucial to designing technology and process innovations to improve healthcare efficiency and effectiveness. However, many clinician and healthcare teamwork activities are difficult to quantify and model. Qualitative methods can assist with capturing “invisible” work and, paired with quantitative data analytics, can produce in-depth workflow knowledge.

3 - Efficient EMR Access Monitoring

Daniel Fabbri, Vanderbilt University, Nashville, TN, United States of America, daniel.fabbri@vanderbilt.edu

Open EMR access environments trade clinician efficiency for patient privacy. Monitoring EMR accesses for inappropriate use is challenging due to access volumes and hospital dynamics. This talk presents the Explanation-Based Auditing System, which uses machine learning to quickly identify suspicious accesses, improving compliance officer efficiency and patient privacy.

■ TC06

06-Broadway H

Health Care Operations and Analytics

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Indranil Bardhan, Professor, The University of Texas at Dallas, 800 West Campbell Road, Jindal School of Management, SM 33, Richardson, TX, 75025, United States of America, bardhan@utdallas.edu

1 - The Impact of Insurance Coverage and Unobservable Health Status on Readmission Rates

Sezgin Ayabakan, Assistant Professor, University of Baltimore, Baltimore, MD, United States of America, sayabakan@ubalt.edu, Zhiqiang (Eric) Zheng, Indranil Bardhan

Hospital readmission rate is viewed as a hospital quality metric in which non-clinical factors such as patients' insurance coverage and unobservable health status are neglected. We develop a Hidden Markov Model to account for this missing information that can impact readmissions. We utilize a comprehensive panel dataset of inpatient visits in North Texas and reveal that focusing solely on readmission rates can be misleading, without regard to patients' health status and insurance coverage.

2 - Analysis on Healthcare Quality Measures and Efficiency

Jeong-ha (Cath) Oh, Assistant Professor, Georgia State University, jhoh@gsu.edu, Abhay Mishra, Youyou Tao, Mark Keil

As part of a systematic effort to improve the quality healthcare system, information transparency has been critical, and a number of quality measurements have been developed. However, few studies have investigated the efficiency of care simultaneously with the effectiveness of multiple quality measures across chronic diseases. In this paper, we analyze inpatient hospital discharges with chronic conditions related to circulatory and respiratory systems. We analyze multiple quality measurements against these chronic diseases and compare the resource usages, which is a proxy of efficiency.

3 - The Effect of Operational Practices on Outcomes of Cardiothoracic Surgery

Jingyun Li, Doctoral Student, The University of Texas at Dallas, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, jingyun.li@utdallas.edu, Steves Ring, Indranil Bardhan

Coronary Bypass Artery Grafting (CABG) patients experience significant variations in healthcare outcomes after surgery. We study operational practices related to cardiac surgeries on a large panel of CABG patients, using archival data collected across 27 hospitals in North Texas, and their impact on patient outcomes.

4 - Measuring the Impact of Electronic Patient Portals on Patient Health

Harpreet Singh, Assistant Professor, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, United States of America, Harpreet@utdallas.edu, Indranil Bardhan, Kirk Kirksey

In this paper we examine whether the use of patient web portal (PWP) is associated with a reduction in the hospital admissions of patients with chronic diseases. In particular, we focus on patients diagnosed with congestive heart failure (CHF). Our results indicate that use of PWP usage lead to 22% reduction in hospital admissions of CHF patients. We also find that influence of PWP depends on patients' gender and their insurance type. Specifically, we find that use of PWP usage is associated with a significant reduction in hospital visits for female patients, and Managed care patients.

■ TC07

07-Broadway J

Operational Models in Outpatient Setting

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Yichuan Ding, UBC, 2053 Main Mall, Vancouver, BC, V6T0A7, Canada, Daniel.Ding@sauder.ubc.ca

1 - Missed Opportunities in Preventing Hospital Readmissions: Redesigning Post-Discharge Checkup Policies

Xiang Liu, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, liuxiang@umich.edu,
Mariel Lavieri, Jonathan Helm, Ted Skolarus, Michael Hu

Hospital readmissions affect hundreds of thousands of patients, placing a tremendous burden on the healthcare system. Post-discharge checkup policies can reduce readmissions through early detection of health conditions; however, the methods behind designing effective checkup policies are poorly studied. Our work develops optimal checkup plans to monitor patients following hospital discharge using checkup methods including phone calls and office visits. By analyzing the structure of optimal policies, we develop checkup schedules that mitigate 32% more readmissions than current practice.

2 - Managing Appointment-Based Health Services under Patient Choices

Nan Liu, Assistant Professor, Columbia University, New York, NY, United States of America, nl2320@cumc.columbia.edu, Bo Zhang, Peter van de Ven

We consider dynamic offering decisions of appointment slots within a day, explicitly taking heterogeneous patient preferences into account. We demonstrate that, by factoring patient choice behavior into the design of appointment scheduling systems, providers can significantly improve their efficiency in care delivery with only minimal changes to their current practice.

3 - Appointment Scheduling with Strategic Patients

Lawrence W. Robinson, Professor, Cornell University, Johnson Graduate School of Management, 433 Sage Hall, Ithaca, NY, 14853, United States of America, lwr2@cornell.edu, Tava L. Olsen

Most of the appointment scheduling literature to date has assumed that patients will arrive promptly. In this paper we instead assume that patients are Stackelberg followers, who choose a target arrival time after being given an appointment time. Patients minimize their expected waiting time, recognizing that tardiness may result in their being bumped to a later time slot, rescheduled to a different day, or being assessed a fine. We examine different physician responses to tardiness, and investigate the effect that strategic patient behavior has on the physician's optimal appointment schedule.

4 - Outpatient-Clinic Capacity Management when Continuity of Care Matters

Yichuan Ding, UBC, 2053 Main Mall, Vancouver, BC, V6T0A7, Canada, Daniel.Ding@sauder.ubc.ca, Diwaker Gupta, Xiaoxu Tang

We study how to manage capacity when continuity of care (COC) affects a health system's payments, but doctors are paid on a fee-for-service (FFS) basis. We model the following strategy that doctors may use to improve COC: recommend some patients to book a follow-up appointment (FUA) before they leave the clinic at the end of their appointments, which is called the same-day follow-up (SDFU) strategy. We develop a principle-agent model and propose a simple, transparent, and outcome-dependent incentive scheme, which gives a second best solution to the capacity-control problem.

■ TC08

08-Broadway K

Operations Research Approaches to Medical Decision Making

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Pooyan Kazemian, PhD Candidate, University of Michigan-Ann Arbor, 1205 Beal Ave., Ann Arbor, MI, 48105, United States of America, pooyan@umich.edu

Co-Chair: Elliot Lee, University of Michigan, Ann Arbor, MI, United States of America, elliotdl@umich.edu

1 - Quantitative Modeling of Behavior Change for Personalized Weight Loss Interventions

Anil Aswani, UC Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720-1777, United States of America, aaswani@berkeley.edu,
Yoshimi Fukuoka, Elena Flowers, Philip Kaminsky, Yonatan Mintz

Seventy percent of American adults are overweight/obese, and related costs are estimated at \$147 billion annually. Programs combining exercise and caloric restriction can lead to weight loss, but the challenge is ensuring continued participation in these labor-intensive and often expensive programs. This talk describes two (a machine learning and a utility maximization) quantitative models for modeling behavior change using individual-level mobile health data from a weight loss intervention. We believe such models can be used to personalize interventions to improve adherence and lower costs.

2 - Dynamic Personalized Monitoring and Treatment Control of Glaucoma

Pooyan Kazemian, PhD Candidate, University of Michigan-Ann Arbor, 1205 Beal Ave., Ann Arbor, MI, 48105, United States of America, pooyan@umich.edu, Joshua Stein, Mark Van Oyen, Jonathan Helm, Mariel Lavieri

We develop an innovative modeling framework for chronic disease patients to help guide clinicians to quickly detect disease progression and adjust the treatment plan over time to limit disease progression. The model is able to (1) optimize the time interval between sequential monitoring tests; (2) specify the best set of tests to take during each patient's office visit; and (3) provide target values for the controllable disease risk factors. Glaucoma is discussed as a case study.

3 - Screening for Hepatocellular Carcinoma: A Restless Bandit Model

Elliot Lee, University of Michigan, Ann Arbor, MI, United States of America, elliotdl@umich.edu, Mariel Lavieri, Michael Volk

All patients at risk for liver cancer in the US are currently screened at fixed six month intervals. This is inefficient because at each screening, the doctor learns new information regarding the patient's risk for liver cancer. We model the problem of learning and allocating a limited number of screenings as a restless bandit problem. The corresponding optimality equation is derived, and structural properties of the screening problem are presented. We conclude by proving an optimal policy exists under certain conditions.

■ TC09

09-Cumberland 1

Healthcare and Data Analytics

Cluster: Health Information Technology and Management

Invited Session

Chair: Lucy Yan, Assistant Professor, Indiana University, Kelley School of Business, Business 570C, Bloomington, IN, 47401, United States of America, yanlucy@indiana.edu

1 - Online Social Networking and Weight Loss

Behnaz Ghahestani Bojd, PhD Student, University of Washington, 5240 University Way NE Apt 616, Seattle, WA, 98105, United States of America, behnaz@uw.edu, Yong Tan, Lucy Yan

Obesity is one of the most prevalent health problems in the world. Here, using a unique data set, we examine the effects of an online social networking on individual weight-loss behavior.

2 - Bayesian Multi-Task Learning for Risk Profiling in Chronic Care

Yu-Kai Lin, University of Arizona, MCCL 430, 1130 E. Helen St., Tucson, AZ, United States of America, yklin@email.arizona.edu, Hsinchun Chen, Randall Brown, Shu-Hsing Li, Hung-Jen Yang

Accurate risk profiling can provide clinical intelligence for physicians and patients to prevent, detect and manage sequelae of chronic diseases. We develop a novel Bayesian multi-task learning approach for risk profiling in chronic care. Using detailed clinical data from a cohort of 14,748 diabetic patients, we demonstrate the feasibility, utility and generalizability of our approach in the predictions of three adverse health events: stroke, acute myocardial infarction, and acute renal failure.

3 - Competing to Lose Weight: Evidence from an Online Weight-Loss Community

Xiangbin Yan, Prof., Harbin Institute of Technology, No.13, Fayuan Street, Nangang District, Harbin, China, xbyan@hit.edu.cn, Yong Tan, Xiaolong Song

Whether online competition promotes individual health improvement is not clear. This study leverages a quasi-experimental research design to estimate the effect of online competition on weight change. The results show that competition has a positive impact on motivating users to make a greater effort in weight loss.

TC10

10-Cumberland 2

Health Optimization

Cluster: Health Operations & Logistics

Invited Session

Chair: Banafsheh Behzad, Assistant Professor, California State University, Long Beach, 1250 Bellflower Blvd., Long Beach, CA, 90840-8501, United States of America, banafsheh.behzad@csulb.edu

1 - Inpatient Bed Capacity Management by 2-stage Queueing-based Optimization Models

Eva Lee, Professor & Director, Industrial And Systems Engineering, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu, Andriy Shapoval

We aim to partition hospital clinical services into groups with the goal of allocating inpatient beds efficiently. Our approach utilizes the similarity principle for possible advantages of economies of scale coupled with queueing-based optimization models. Our 2-stage systematic model offers flexibility between complete pooling and specialization. We apply the model to 3 hospital examples to highlight managerial insights for different utility optimization goals and queueing systems.

TC11

11-Cumberland 3

Models for Post-Operative Care Resource Analysis and Management

Cluster: Medical Decision Making

Invited Session

Chair: Sibel Sonuc, Postdoctoral Research Associate, Northeastern University, 360 Huntington Avenue, 253 Richards Hall, Boston, MA, 022115, United States of America, s.sonuc@neu.edu

1 - Exact PMF of System-Wide Unconstrained Bed Demand

Samuel Davis, Northeastern University, 253 Richards Hall, Boston, MA, United States of America, davis.sam@husky.neu.edu, James Benneyan

Significant costs in healthcare come from paying for under-utilized resources and paying a premium for obtaining short-term resources. The demand for resources is the product of bed demand and the ratio of how much each resource is needed per filled bed. Thus, predicting bed demand can lead to improved patient care and cost effectiveness through adjusting staff and equipment and by avoiding non-clinical transfers and diversions. This paper develops a probability model to calculate the exact probability distribution of unconstrained bed demand at any time and location within a health system.

2 - Predicting Operating Room and Recovery Unit Utilization with Excel-Based Simulation

Jessica Cleveland, Healthcare Systems Engineering Institute at Northeastern University, Boston, MA, United States of America, cleveland.j@husky.neu.edu, Benjamin Maslow, James Benneyan, Sibel Sonuc, Brian Green, Kendall Sanderson, Iulian Ilies

In a New England hospital, many patients must wait in the operating room after their surgery is complete because there is no space for them in the recovery unit. The aim of the tool created for this hospital is to provide front-line schedulers real-time assistance in determining an optimal operating room schedule so as to minimize over-utilization of the recovery units.

3 - An Integer Programming Approach to Improve Operating Room Staff Satisfaction with Schedules

Kyle Cunningham, Research Assistant, Northeastern University, 253 Richards Hall, Boston, MA, 02115, United States of America, cunningham.k@husky.neu.edu, Dominic Breuer, James Benneyan

This work focuses on applying integer programming to maximize employee satisfaction with staff scheduling assignments in operating rooms while simultaneously balancing nurse skillset requirements and hourly constraints. The effectiveness of this scheduling algorithm is studied at a large medical center in Massachusetts where a user-friendly electronic employee preference survey has been developed and implemented to collect input for the optimization model.

TC12

12-Cumberland 4

Modeling Healthcare Operations

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Carri Chan, Columbia Business School, 3022 Broadway, Uris Hall 410, New York, NY, United States of America, cwchan@columbia.edu

1 - Optimal Issuing Policies for Hospital Blood Inventory

Alireza Sabouri, Postdoctoral Fellow, University of Toronto, 105 St. George Street, Rotman School of Management, Toronto, ON, Canada, Alireza.Sabouri@rotman.utoronto.ca, Tim Huh, Steven Shechter

We propose a model for allocating red blood cells for transfusion to patients, which is motivated by recent evidence suggesting that transfusing older blood is associated with increased mortality rate. We study the properties of blood issuance policies that balance the trade-off between “quality” measured in average age of blood transfused and “efficiency” measured in the amount of shortage. Based on our analysis, we design efficient issuance policies and evaluate their performance.

2 - Queues with Time-Varying Arrivals and Inspections with Applications to Hospital Discharge Policies

Carri Chan, Columbia Business School, 3022 Broadway, Uris Hall 410, New York, NY, United States of America, cwchan@columbia.edu, Jing Dong, Linda Green

A physician must first verify a patient is stable enough before he is discharged. Requiring an inspection of a patient’s “readiness for discharge” introduces an interesting dynamic where patients may occupy a bed longer than medically necessary. We introduce and study a queueing system with time-varying arrival rates in which servers who have completed service cannot be released until an inspection occurs. We examine the impact of such a dynamic and how to optimize the timing of inspections.

3 - Impact of Breast Density on Designing Mammography Screening Policies

Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu, Burhaneddin Sandikci

There are ongoing debates about the cost-effectiveness of the use of supplemental tests in detecting breast cancer and recent medical literature identifies a patient’s estimated breast cancer risk along with the patient’s breast density as key factors influencing the decision to use these tests. In this study, we use a discrete-time partially observable Markov decision process (POMDP) model to evaluate the benefits of supplemental screening tests through incorporating breast density information and identify the screening policies that maximize a patient’s total quality-adjusted life years.

■ TC13

13-Cumberland 5

Process View of Quality in Healthcare

Cluster: College of Healthcare Operations Management,
Production and Operations Management Society

Invited Session

Chair: Carrie Queenan, University of South Carolina,
1014 Greene St, Columbia, SC, 29208, United States of America,
carrie.queenan@moore.sc.edu

1 - Design of Patient-Centric Standardized Discharge Instructions for Kidney Transplant Process

Aravind Chandrasekaran, Ohio State University, 2100 Neil
Avenue, Columbus, OH, 43210, United States of America,
chandrasekaran.24@osu.edu

This project investigates the impact of engaging patients and caregivers in the design of standardized discharge instructions on readmission rates and quality of life upon discharge for the kidney transplant process. We have collected data from both 100+ patients and all the care coordinators to understand the current discharge process at a large academic hospital. We will develop a standard discharge process based on patient and caregiver input. Pre- and post-discharge performance will be compared to demonstrate the efficacy of involving patients in the design of discharge work.

2 - Role of Bottom-Up Decision Processes in Improving the Quality of Health Care Delivery

Claire Senot, Assistant Professor, Tulane University,
7 McAlister Dr, New Orleans, LA, United States of America,
csenot@tulane.edu, Aravind Chandrasekaran, Peter Ward

In the context of healthcare delivery, this study investigates the effectiveness of bottom-up decision processes in promoting a balanced progression along conformance and experiential quality. Hypotheses are developed using qualitative data from a multiple-case study and tested using secondary data for 3,124 hospitals across six years. Results suggest that the effect of bottom-up decision processes is contingent upon the level of top-down decision processes present in the hospital.

3 - Patient, Heal Thyself! A Technology Enabled Intervention to Promote Patient Activation

Carrie Queenan, University of South Carolina,
1014 Greene St, Columbia, SC, 29208, United States of America,
carrie.queenan@moore.sc.edu

Chronic disease costs are soaring and in many cases, patients have significant control over their health condition. Building on the well-known costs of quality framework, we argue that prevention costs for chronic disease patients are less expensive than "failure costs," i.e., hospital readmissions. We propose that telemonitoring with nurse interaction can improve patient activation and reduce hospitals readmissions. We present results of a randomized experiment showing support for the efficacy of our telemonitoring with nurse interaction intervention.

■ TC14

14-Cumberland 6

Healthcare Operations II

Contributed Session

Chair: Ajit Appari, Assistant Professor, UT Health Science Center,
School of Public Health, 1200 Pressler St, RAS W-310, Houston, TX,
77030, United States of America, ajit.appari@uth.tmc.edu

1 - Deployment of Clinical Technologies: A Human Factors and Systems Engineering Approach

Eliezer Kotapuri, Chief Clinical Technology Officer, LifeLine
Clinical Engineering Solutions, 4712 N. Paseo De Los Cerritos,
Tucson, AZ, 85745, United States of America,
ekotapuri@lifelinececs.com, Joseph Hardisky, Samuel Sandoval

Often inefficiency in healthcare is due to deficiencies' in the deployment of clinical technologies. Many hospitals have unsuccessfully incorporated various process and clinical engineering experts. The talk presents the perspective of practicing Clinical Engineers that incorporated Industrial and Systems engineering principles to generate an additional \$0.5 million dollars a day and \$125 million dollars a year just in one department of a hospital not counting the many other benefits which this concept introduced.

2 - Setting "Optimal" Utilization Targets for Elective Operating Theatres

Palvannan R.K., National Healthcare Group, Fusionopolis,
Singapore, Singapore, rk.palvannan@gmail.com, Heidi Rafman,
Edmund Teo, Bee Ling Ng, Boon Yong Lau, Kesavan
Esuvaranathan, Joe Sim

In Singapore, public hospitals' elective operating theatres are usually allocated to separate departments. Overall utilization is around 85%. We explore if there is an "optimal" utilization target for each department. Intuitively we know that departments with a narrower variation in surgical durations can operate at a higher utilization. In this paper we develop a model relating operational factors. Our contributions are (1) the use of a quantitative approach to set custom utilisation targets for the departments using routine data for the same probability of overtime across departments, and (2) suggesting a suitable measure of variation using square root law. This is useful in setting custom targets accounting for variation as well as for capacity planning.

3 - Multi-objective Resource Allocation and Outpatient Appointment Scheduling by Simulation Optimization

Carrie Ka Yuk Lin, Associate Professor, City University of Hong
Kong, Dept. of Management Sciences, 83 Tat Chee Avenue,
Kowloon Tong, Hong Kong, China, mslinky@cityu.edu.hk,
Teresa WaiChing Ling

We consider integrating strategies to increase capacity of outpatient clinics by reallocating resources and improving patient scheduling in an appointment session. Multiple objectives are considered in minimizing staff overtime, patient waiting time and waiting room congestion. Problem complexity includes patient classes with different flow paths through a multi-phase multi-server queuing system with uncertainties. An iterative 2-phase simulation optimization algorithm is developed. Experiments are designed based on a study of an eye clinic in a public hospital.

4 - Health Care Utilization for Patients with Multiple Chronic Conditions in Deprived Communities

Ajit Appari, Assistant Professor, UT Health Science Center, School
of Public Health, 1200 Pressler St, RAS W-310, Houston, TX,
77030, United States of America, ajit.appari@uth.tmc.edu

Improving care delivery to individuals with multiple chronic conditions, a dominant determinant of healthcare cost and population health, is a national priority in the US. The panel data on 3074 US counties over period 2008-2012 was analyzed using nested mixed effects generalized linear model with AR1 errors to examine the impact of county's socioeconomic factors on risk adjusted standardized Medicare spending, readmission rates, and ED visits for different MCC levels. My results show spending and ED visits rise exponentially across MCCs and strongly associated to socioeconomic factors.

Thursday, 3:30pm - 5:00pm

■ TD01

01-Broadway A

Predictive Modeling

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: John Andrews, Lead Data Scientist, WealthEngine, 4330 East
West Highway, Ste 950, Bethesda, MD, 20814, United States of
America, jandrews@wealthengine.com

1 - How Grateful is Your Patient? Predictive Modeling for Health Care Philanthropy

John Andrews, Lead Data Scientist, WealthEngine, 4330 East West
Highway, Ste 950, Bethesda, MD, 20814, United States of
America, jandrews@wealthengine.com

The nonprofit hospital foundation has access to a variety of predictors of patient giving, such as patient care information, satisfaction, and wealth. Using these attributes, historical or experimental outcomes, and institutional objectives and constraints, the analyst can treat the Grateful Patient Program as an optimization problem under uncertainty to determine the approach (ranging from CEO visit to email) per patient. We discuss procedures and early results from a university hospital system as well as legal and ethical considerations for fundraising in a

health care setting.

2 - The Utility of an Integrated Knowledge Management Approach for Analytics and Decision Making in Healthcare

Kiran Garimella, President, XBITALIGN, 1921 Norhardt Dr, Brookfield, WI, 53045, United States of America, kiran@xbitalign.com, Daniel Conway

Analysis and decision-making in healthcare demands consideration of information with full context and connectivity to various components of the ecosystem. Typical approaches constrain analysis to specific domains while ignoring potentially relevant items of knowledge. This increases the risk of incomplete analysis and inclusion of judgmental biases. An integrated knowledge management approach provides information with full context efficiently that can be applied to any decision-making method.

TD02

02-Broadway B

Healthcare Modelling in Europe: Assignment and Optimization

Cluster: EURO Working Group on Operational Research Applied to Health Services (ORAHHS)

Invited Session

Chair: Sally Brailsford, University of Southampton, Southampton Business School, Southampton, United Kingdom, S.C.Brailsford@soton.ac.uk

1 - A Surgical Case Assignment Problem in a Block Scheduling Strategy

Inés Marques, Universidade de Lisboa, Campo Grande, Faculdade de Ciências, Lisboa, 1749-016, Portugal, ines.marques@fc.ul.pt, Maria Eugénia Captivo

This work emerges from a close collaboration with the administration of a publicly funded Portuguese hospital and is concerned with an advance elective scheduling problem using a block scheduling strategy. Two versions (the administration's intention and the surgeon's current practice) are modeled using (mixed) integer programming. In preliminary results, CPLEX provided a feasible solution with a gap smaller than 1% in negligible time.

2 - Flexible Nurse Staffing based on Hourly/Bed Census Predictions

Nikky Kortbeek, Dr., University of Twente / Rhythm, Center for Healthcare Operations Improve, P.O. Box 217, 7500 AE, Enschede, Netherlands, n.kortbeek@utwente.nl, Aleida Braaksm, Richard J. Boucherie, Piet J.M. Bakker, Mark Van Houdenhoven

Workloads in nursing wards depend highly on variable patient arrivals and lengths of stay. Predicting workloads and staffing nurses accordingly is essential for cost-effectively guaranteeing quality of care. We present a stochastic method that uses hourly census predictions to derive efficient nurse staffing policies, and its application to the surgical inpatient clinics of AMC Amsterdam and St Maartenskliniek (the Netherlands). It addresses the complex interaction between staffing requirements and interrelated decisions like case mix, ward partitioning/size, and surgical planning.

TD03

03-Broadway C

Optimization in Healthcare II

Contributed Session

Chair: Junfeng Zhu, University of Minnesota, Industrial/Systems Engineering, 111 Church St SE, Minneapolis, MN, 55455, United States of America, zhuxx793@umn.edu

1 - Robust Response-Guided Dosing

Jakob Kotas, University of Washington, Box 353925, Seattle, WA, 98195, United States of America, jkotas@uw.edu, Saumya Sinha, Archis Ghate

Response-guided dosing (RGD) is a paradigm for adaptively dosing a patient over multiple sessions according to its evolution of disease condition. We recently proposed a dynamic programming (DP) framework for making dosing decisions in RGD, which balances the disutility of doses administered with the final disease condition reached. The evolution of disease condition is modeled using a one-parameter stochastic dose-response function. Here, we study a robust counterpart of this stochastic DP, where the distribution of this parameter is unknown to the decision maker.

2 - Optimizing Liver Functionality in Stereotactic Body Radiotherapy Treatment Planning

Victor Wu, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, vwuu@umich.edu, Marina Epelman, Yue Cao, Mary Feng, Martha Matuszak, Edwin Romeijn, Randall Ten Haken, Hesheng Wang

We propose a radiotherapy treatment planning optimization model for liver cancer cases. In this work, we compare our model, which accounts for liver functionality information, with a gold standard that does not account for such information. We plan treatment using voxel-based dose response information: post-treatment liver functionality depends on its pre-treatment functionality and the dose delivered. Our model's objective is to maximize post-treatment liver functionality with respect to dose. We apply these models to 2D examples as proof-of-concept and retrospectively to 3D real patient cases.

3 - Strategic Planning for Response Disabled and Elderly Populations in Short-Notice Disasters

Rana Azghandi, Northeastern University, 27 Park Dr., Apt 1, Boston, MA, 02215, United States of America, azghandi.r@husky.neu.edu, Jacqueline Griffin

In this research, a mixed integer programming model simultaneously accounts for the different protection strategies for the elderly and disabled population in short-notice disasters. The modeling poses a split-delivery vehicle routing problem with time windows and multiple uses of heterogeneous vehicles. We examine the effect of multiple objectives for this disaster response application.

4 - Optimal Treatment Plan with Multiple Drugs in Chronic Myeloid Leukemia

Junfeng Zhu, University of Minnesota, Industrial/Systems Engineering, 111 Church St SE, Minneapolis, MN, 55455, United States of America, zhuxx793@umn.edu, Jamine Foo, Qie He, Kevin Leder

We develop a mathematical model for the evolution of normal cells, and CML cells that are sensitive and resistant to the therapy with toxicity constraints over a fixed number of periods T. Our strategy is to reduce tumor burdens by using a combination of available TKIs thereby. We obtain a good treatment plan by solving an approximate mixed integer linear program.

TD04

04-Broadway D

Markov Models in Treatment Choices and Agent-Based Model of Ebola Spread

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Vera Tilson, Simon Business School, University of Rochester, Rochester, NY, United States of America, vera.tilson@simon.rochester.edu

1 - Markov Cost-Effectiveness Analysis for Cancer Treatment

Jiaru Bai, PhD Student, University of California Irvine, 6464 Adobe Circle, Irvine, CA, 92617, United States of America, jiarub@uci.edu, Robin Keller

We present a way to build a Markov decision tree to model cancer progression and cost-effectiveness analysis for two or more cancer treatments. We propose several problems researchers can encounter in this kind of research and provide possible solutions. The method is used for a clinical study comparing two cervical cancer treatments.

2 - Agent-Based Modeling of Ebola Spread in a Large Urban Area

Charles Macal, Senior Systems Engineer, Argonne National Laboratory, 9700 S. Casse Avenue, Bldg. 221, Lemont, IL, 60439, United States of America, macal@anl.gov

In an effort to understand the state of our preparedness for an Ebola or pandemic-related outbreak, we are developing infectious disease models focusing on Ebola, which vary in their degrees of aggregation and granularity, and we are applying the models to the Chicago area as a case study.

3 - Use of an MDP for Risk-Sensitive Treatment Selection of an Asymptomatic Disease

Vera Tilson, Simon Business School, University of Rochester, Rochester, NY, United States of America, vera.tilson@simon.rochester.edu, David Tilson

We discuss the use of an MDP model to analyze treatment decisions for asymptomatic chronic diseases where a patient's condition cannot improve. We discuss the use of the MDP software as a decision support tool to help make individualized treatment during a short office visit. Using asymptomatic intracranial aneurysm as an example, we demonstrate that incorporating risk aversion can lead to different treatment selection.

■ TD05

05-Broadway G

The Dark and Light Side of Healthcare IT

Cluster: INFORMS Information Systems Society

Invited Session

Chair: Idris Adjerid, University of Notre Dame, 358 Mendoza College of Business, Notre Dame, IN, United States of America, iadjerid@nd.edu

1 - The Market Effect of Healthcare Security: Do Patients Care about Data Breaches?

Juhee Kwon, City University of HK, Tat Chee Avenue, Hong Kong, Hong Kong - PRC, juhee.kwon@cityu.edu.hk, M. Eric Johnson

This paper investigates how data breaches affect subsequent outpatient visits and admissions. The results show that while data breaches do not affect patients' short-term choices, the cumulative effect of breach events and affected records over a three-year period significantly decreases the number of outpatient visits and admissions in competitive markets. Our findings provide policy insights on effective security programs that induce providers to invest in security as they would for other market-based, brand-building initiatives.

2 - Provider Incentives and the Value of EMR: Hospitals using EMR to Increase Outpatient Charges

Idris Adjerid, University of Notre Dame, 358 Mendoza College of Business, Notre Dame, IN, United States of America, iadjerid@nd.edu

The anticipated benefits of electronic medical records (EMR) are compelling. However, reimbursement contracts between hospitals and payers may create incentives for hospitals to employ EMR for revenue optimization. Using data on all inpatient and outpatient claims data from the state of Florida over the period 2005-2011, we examine the effect of EMR adoption on physician billing intensity (i.e. charges) across inpatient and outpatient care settings. Contrary to existing research, we find that EMR adoption is correlated with a 5.2% increase in charges in outpatient care settings.

3 - Online Health Community in China

Haijing Hao, Assistant Professor, University of Massachusetts Boston, 100 Morrissey Blvd #404, Dorchester, MA, 02125, United States of America, Haijing.Hao@umb.edu

Since the Web 2.0, more and more consumers have used the Internet for healthcare information. Many studies have been done in the U.S. and Europe on this phenomenon. But no study has been done in China, even China has the largest Internet population. The present study examines the online health community practice in China based on data from Good Doctor website, the earliest and largest online healthcare community in China. Like patients in the west, Chinese consumers have started to use online health community to seek help, with over 1 million online reviews and 200 thousand online forum posts.

■ TD06

06-Broadway H

Healthcare Analytics and Operations Management

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Daniel Gartner, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu

1 - Machine Learning for Predicting Patients' Waiting Time Estimation Behavior at Emergency Departments

Daniel Gartner, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Rema Padman

Recent research revealed significant factors associated with patient satisfaction in Emergency Departments (ED). In this study, we predict patients' waiting time estimation behavior in EDs using machine learning methods. Our results inform the ED where and when patients should wait to reduce perceived waiting times and potentially increase patient satisfaction.

2 - Hepatocellular Carcinoma and Meld Exception Scores for Liver Transplantation

Mustafa Akan, Associate Professor of Operations Management, Carnegie Mellon University, 5000 Forbes Avenue Posner Hall 381C, Pittsburgh, PA, 15213, United States of America, akan@andrew.cmu.edu, Zachary Leung, James Markmann, Sridhar Tayur, Heidi Yeh

Patients on the waitlist for liver transplantation are prioritized according to MELD scores, a measure of disease severity. Hepatocellular carcinoma (HCC) patients have significantly higher transplant rates than non-HCC patients. We recommend alternative MELD score policies based on a fluid queueing model and an optimization model balancing efficiency and equity.

3 - Analyzing Medication Compliance using Laboratory Data from Dialysis Patients

Rhucha Paranjape, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, rparanja@andrew.cmu.edu, Rema Padman, A. Karambelkar, N. Patel, P. Teredesai, Q. Xie, D. Rifkin

High pill burden, increasing drug costs, and Medicare coverage gap challenge medication compliance in End Stage Renal Disease population undergoing hemodialysis treatments. Using 9 years of dialysis data on 2,500 patients, this study identifies non-compliance trends by modeling progression of their laboratory data which are affected by the prescribed medications.

■ TD07

07-Broadway J

Models of Disease Prevention through Improved Behaviors

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Maria Mayorga, Associate Professor, North Carolina State University, Daniels 376, Raleigh, NC, 27695, United States of America, memayorg@ncsu.edu

1 - A Predictive Model of Smoking Prevalence based on Individual Dynamics

Zinan Yi, North Carolina State University, 3138A Avent Ferry Road, Raleigh, NC, United States of America, zyi@ncsu.edu

We constructed a Markov model for individual adults' smoking dynamics. Transition matrices were developed for the two age groups: 18-34 and 35+, respectively. A discrete event simulation model was built to forecast smoking prevalence through 2020. Then, we showed the applications of the simulation model.

2 - The Role of Mindfulness in Physical Activity and Conscious Avoidance of Secondhand Smoke

Lu Shi, Assistant Professor, Clemson University, 525 Edwards Hall, Clemson, SC, 29634, United States of America, lus@clemson.edu, Yu Gao

We surveyed 1516 college freshmen in Shanghai and measured their mindfulness, physical activity and conscious avoidance of secondhand smoke, with socio-demographic covariates. A higher level of mindfulness was associated with more conscious avoidance of secondhand smoke. A higher level of mindfulness was associated with more metabolic equivalent hours per week.

3 - Agent-Based Mediation Modeling of a Controlled Trial to Reduce Transmission of Resistant Organisms

Sean Barnes, Assistant Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu, Daniel Morgan, Lisa Pineles, Anthony Harris

In 2012-2013, the University of Maryland School of Medicine led a cluster trial to assess the benefits of universal gloves and gowns in reducing transmission of multidrug-resistant organisms in hospitals. We develop an agent-based model to simulate transmission, validate the model against the original study, and perform a factorial design to quantify the direct benefit of this intervention.

■ TD08

08-Broadway K

Joint Session Disease Modeling/Public Health: Disease Modeling

Cluster: Disease Modeling and Economic Evaluation/
Public Health

Invited Session

Chair: Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, MA, 01003, United States of America, chaitrag@umass.edu

1 - Optimized Oral Cholera Vaccine Distribution Strategies to Minimize Disease Incidence

Julie Swann, Georgia Institute of Technology, United States of America, julie.swann@isye.gatech.edu, Pinar Keskinocak, Hannah Smalley

In addition to improved sanitation, hygiene, and better access to safe water, oral cholera vaccines can help control the spread of cholera in the short term. We present a mixed integer programming model (MIP) for optimally allocating vaccines in a region under varying levels of demographic and incidence data availability. Considering fixed vaccine efficacies as well as those which vary based on age and the number of years since vaccination, we analyze distribution strategies which allocate vaccines over multiple years. The MIP allows for testing various vaccine distribution strategies by providing the ability to easily vary parameters such as regional risk levels and vaccine efficacy.

2 - Vaccination or Social Distancing: A Public Health Dilemma

Shuyu Chu, United States of America, cshuyu@vt.edu, Achla Marathe

Epidemics such as influenza are the major cause of deaths in the US and cause a significant social and economic burden. This research explores the trade-offs between social distancing and vaccination as two possible intervention strategies. Specifically, we study whether epidemics can be effectively contained by the typical rates of vaccination, or whether a certain level of social distancing is required, especially when the vaccine is not fully effective. Our results indicate that the latter is true, and social distancing provides non-linear benefits for reducing the overall outbreak. We study different combinations of vaccination rates and self isolation rates, combined with different vaccine efficacy rates, to understand the trade-offs between the two interventions in realistic large-scale urban populations, as well as random graph models. Our results have implications for public health policies and the incentives that need to be designed for controlling epidemics.

3 - Estimating Distribution of New HIV Infections in the United States using a Modified-Network Model

Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, MA, 01003, United States of America, chaitrag@umass.edu

Network models are infeasible for simulating HIV in the US population because of the low prevalence of HIV and high computation times of network models required to simulate a large sample. Network models in the literature have simulated only high-risk groups in the United States and have not considered mixing between low- and high-risk groups, which are important for HIV-intervention policy decisions. We present sexual transmissions of HIV among individuals within and across different risk groups, estimated by developing a modified-network model to reduce computation complexity.

■ TD09

09-Cumberland 1

Networks and Platforms in the Healthcare Sector

Cluster: Health Information Technology and Management

Invited Session

Chair: Nirup Menon, Associate Professor, George Mason University, 4400 University Dr, MS 5F4, Fairfax, VA, 22030, United States of America, nmenon@gmu.edu

1 - Collective Leadership in Healthcare Innovation Teams: A Longitudinal Social Network Analysis

Shannon Provost, University of Texas at Austin, 115 East 5th Street, No. 300, Austin, TX, 78701, United States of America, sprovost@utexas.edu, Reuben McDaniel, Francesca Grippa, Luis Martins, Thomas Sager, Peter Gloor, Sirkka Jarvenpaa, Peter Margolis

There is a need to spawn innovative behaviors in healthcare organizations. Over 30 months we observed leadership dynamics around ten teams in a multidisciplinary collaborative chronic care network. We used digital archives of email correspondence to characterize team communication networks. Initial

findings suggest that team performance is enhanced when dialogue is proportionate and the prominent individuals shift over time. We propose that distributed communication and centrality signal a team's capacity for effective self-organization and collective leadership.

2 - Is Digital Addiction Rational? Investigating Excessive Dependence on Mobile Social Apps

Sang-Pil Han, Assistant Professor, Arizona State University, BA 301D, Tempe, AZ, 85287, United States of America, sangpil.han@asu.edu, Hyeokoo Eric Kwon, Wonseok Oh, Hyunji So

This study investigates whether addiction to mobile social apps (e.g., SNS and social games) should be viewed as a rational behavior rather than an uncontrollable disorder. We analyze 13-month, individual-level panel data on the app usage of thousands of smartphone users. The findings suggest that mobile social app users conduct themselves in a forward-looking manner and rationally adjust consumption over time horizons to derive optimal utility. Additionally, both social apps more considerably foster dependency than do cocaine and alcohol but are less addictive than caffeine and cigarettes.

3 - Network Externality from Information Technology Investments and Its Consequences in Medical Fraud

Nirup Menon, Associate Professor, George Mason University, 4400 University Dr, MS 5F4, Fairfax, VA, 22030, United States of America, nmenon@gmu.edu

The use of interoperable electronic health records could increase benefits derived by each hospital from its IT investments, as many hospitals connect to each other. The evidence on network externality of IT investments is mixed. This study addresses the network externality of hospital IT in preventing fraud for insurance companies.

■ TD10

10-Cumberland 2

Appointment Scheduling

Cluster: Health Operations & Logistics

Invited Session

Chair: Van-Anh Truong, 500 W 120th St, New York, NY, United States of America, vt2196@columbia.edu

1 - Online Appointment Reservation with Patient Preferences

Xinshang Wang, Columbia University, 116 Street and Broadway, IEOB, New York, NY, United States of America, xw2230@columbia.edu, Van-Anh Truong

In this paper, we propose dynamic appointment-scheduling models that capture web- and mobile-based applications, such as Epic's MyChart, that are used to make advance medical appointments. We give online, data-driven algorithms with performance guarantees that can be used to power such applications.

2 - Reducing Wait Times for New Patient Chemotherapy Consults

Martin Puterman, Professor Emeritus, Sauder School of Business - UBC, 2053 Main Mall, Vancouver, BC, Canada, martin.puterman@sauder.ubc.ca, Leah Weber, Claire Ma

We describe our study of the impact of scheduling rules and oncologist capacity on wait times for new patient consults. We show that in a highly capacitated system scheduling rules have little impact on service levels. In view of this, we determine the number of additional new patient consults needed by specialty to achieve target service levels. Furthermore, we investigate the impact of oncologist specialization mix on service levels and capacity utilization.

3 - Multi-priority Online Scheduling with Cancellations

Van-Anh Truong, 500 W 120th St, New York, NY, United States of America, vt2196@columbia.edu

We study a fundamental model of resource allocation in which a finite amount of service capacity must be allocated to a stream of jobs of different priorities arriving randomly over time. Jobs incur costs and may also cancel while waiting for service. To increase the rate of service, overtime capacity can be used at a cost. This model has application in healthcare scheduling, server applications, make-to-order manufacturing systems, general service systems, and green computing.

■ TD11

11-Cumberland 3

Smart Monitoring and Delivery

Cluster: Medical Decision Making

Invited Session

Chair: Shan Liu, Assistant Professor, University of Washington, Box 352650, Seattle, WA, 98195, United States of America, liushan@uw.edu

1 - Risk-Adjusted Phase-I Monitoring of Patient Readmission in COPD Care

Smriti Neogi, Senior Analyst (Quality & Transformation), Cincinnati Children's Hospital, 3333 Burnet Ave, MLC 5040, Cincinnati, OH, 45229, United States of America, Smriti.Neogi@cchmc.org, Li Zeng

Risk-adjusted monitoring is very important in the healthcare industry. In this research a systematic approach for Phase I monitoring of patient readmission in (COPD) care is proposed. In the first task, two types of models are studied, including the logistic regression model and the logistic regression tree model. In the second task, change detection procedures based on the generalized likelihood ratio test are developed for both types of models. Finally, the proposed method is applied to a real data set from the UTMB, Galveston, TX.

2 - Large-Scale Personalized Health Surveillance by Selective Sensing

Shuai Huang, Assistant Professor, University of Washington, 3900 Northeast Stevens Way, AERB 141B, Seattle, WA, 98195, United States of America, shuai.huang.ie@gmail.com, Ying Lin, Shan Liu

Personalized health surveillance is an enabler for transitioning healthcare practice from reactive care to preventive care. While advances in sensing and information technologies have result in an abundance of data, translating them into diagnosis or prognosis need a seamless combination of data analytics and clinical assessment. To scale up personalized surveillance, we developed a selective sensing method that integrates degradation modeling, prognosis, and optimization, which can cost-effectively monitor a large number of individuals by exploiting the similarities of their trajectories.

3 - Using Bayesian Updating to Inform Mode of Delivery Prediction

Karen Hicklin, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, khickli@ncsu.edu, Julie S. Ivy, Vidyadhar Kulkarni, Evan Myers, Fay Cobb Payton, Meera Viswanathan

In 2012, there were approximately 3.95 million births in the U.S., 32.8% of which were C-sections (CS) which are associated with an increased risk of neonatal respiratory morbidity and can cause major complications in subsequent pregnancies. We model the mode of delivery decision process for when a CS is needed due to a "failure to progress" diagnosis for laboring women. The model uses Bayesian updating to determine when to classify the patient as "failure to progress" using current information and when to seek additional information by prolonging labor before the patient type is decided.

■ TD12

12-Cumberland 4

Planning and Scheduling Methods for Capacity Management in Healthcare

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Mark Van Oyen, Professor, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, vanoyen@umich.edu

1 - Stochastic Operating Room Planning with Recovery Flow

Maya Bam, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, mbam@umich.edu, Brian Denton, Mark Van Oyen

Surgery scheduling is impacted by operating room (OR) availability, surgeons, and downstream resources like the recovery room. We present a new approach, based on collaboration with a mid-sized hospital, that uses well-performing fast approximation methods to create schedules that minimize blocking of the ORs due to overutilization of downstream resources, OR overtime, and surgeon elapsed time. Discrete event simulation is used to evaluate performance metrics of relevance to practice.

2 - A Queuing Network Approach to Capacity Planning in Community Care

Jonathan Patrick, Associate Professor, University of Ottawa, Ottawa, ON, Canada, patrick@telfer.uOttawa.ca, Hadi Bidhandi, Pedram Noghani

We present a queuing network model for a network of community care facilities. We take advantage of recent developments in heuristic models for solving networks with blocking and use the output of those heuristics in an optimization model using simulated annealing. The goal is to minimize a weighted sum of the blocking probabilities at each node based on a budget constraint. The complete model is tested using data from a local health authority and incorporating six community care facilities.

3 - An Outpatient Planning Optimization Model for Integrated Care and Access Management

David Kaufman, University of Michigan, IOE, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, davidlk@umich.edu, Jivan Deglise-Hawkinson, Jonathan Helm, Mark Van Oyen

We present a data-driven planning methodology for outpatient scheduling based upon a practice-based collaboration. Our capacity planning model, a mixed integer program, seeks to limit by patient type the time delay from an appointment request to its occurrence while managing the patient mix and utilization. Validation and insights are emphasized.

■ TD13

13-Cumberland 5

PANEL: Decision Sciences Journal Initiative in Healthcare Analytics: The Nexus of Operations Efficiency and Healthcare Information

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Thomas Stafford, Editor, Decision Sciences Journal, Fogelman College of Business, University of Memphis, Memphis, TN, 38152, United States of America, tstaffor@memphis.edu

1 - Decision Sciences Journal Initiative in Healthcare Analytics

Moderator: Thomas Stafford, Editor, Decision Sciences Journal, Fogelman College of Business, University of Memphis, Memphis, TN, 38152, United States of America, tstaffor@memphis.edu, Panelists: Robert Schmidt, Ramesh Sharda

Decision Sciences Journal has a strong interest in the analysis and understanding of healthcare. We offer a panel describing research publication opportunities, and prospective authors will receive one-on-one mentorship with key editors in preparation for Journal submission. Topics of interest span social media, descriptive, predictive and prescriptive analytics in healthcare.

■ TD14

14-Cumberland 6

Healthcare Operations III

Contributed Session

Chair: Anne Fuller, Associate Professor, Sacramento State University, 6000 J Street, Tahoe Hall room 2017, Sacramento, CA, 95819, United States of America, anne.fuller@csus.edu

1 - An Empirical Analysis of the Effects of Personnel Scheduling on Hospital Performance

Randy Bradley, University of Tennessee, 304 Stokely Management Center, Knoxville, TN, 37996, United States of America, rbradley@utk.edu, Bogdan Bichescu, Joon In, John Bell, Wei Wu

Despite efforts to improve scheduling and resource allocation via the adoption of disparate technologies in hospitals, there is still a lack of empirical evidence that indicates where, and if, the value proposition of such investments exists. We employ difference-in-differences regression modeling to analyze panel data on 268 hospitals. Our findings suggest which applications impact specific measures of performance. This study offers several theoretical and managerial implications offering a better understanding of the potential benefits of the use of applications for personnel scheduling.

2 - Delivering Surgical Care to Underserved Communities: Development of an Integrative Framework

Ujjal Kumar Mukherjee, Ph.D. Candidate, Supply Chain and Operations, University of Minnesota, 321 19th Avenue S, Minneapolis, MN, 55455, United States of America, mukh0067@umn.edu, Emily Kohnke, Kingshuk K Sinha

In this research we undertake a field research to develop an integrative framework (3A's framework) for the effective delivery of healthcare to underserved communities in developing nations. The research was conducted in collaboration with a NGO (Children's HeartLink) in interior China to address the issue of delivery of pediatric cardiac surgeries. Through a multi-method triangulation we have developed an integrative framework which links affordability, awareness and access to the volume and quality of cardiac surgeries.

3 - Where's the Fat? Misguided Lean

Anne Fuller, Associate Professor, Sacramento State University, 6000 J Street, Tahoe Hall room 2017, Sacramento, CA, 95819, United States of America, anne.fuller@csus.edu, Yang Sun, Martha Wilson

A cogent definition of value in health care is essential for identifying areas for improvement. We explore how the definition of value can guide or misguide quality improvement approaches. Of particular interest, is the overarching focus on applying lean methodology in health care, which may be a myopic approach. This exploration is guided by strategic analysis, supported by performance metrics, and tested with simulation modeling. We use dynamic simulation models to compare different methods of healthcare delivery with an emphasis on the role of "lean" improvements.

Friday, 8:00am - 9:30am

■ FA01

01-Broadway A

Panel Discussion: Soft Skills for Leaders in Healthcare Analytics

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Jean Ann Larson, CEO and Founder, Jean Ann Larson & Associates, 1412 Prairie Drive, Carrollton, TX, 75007, United States of America, jeanann.larson@gmail.com

1 - Soft Skills for Leaders of Healthcare Analytics

Moderator: Jean Ann Larson, CEO and Founder, Jean Ann Larson & Associates, 1412 Prairie Drive, Carrollton, TX, 75007, United States of America, jeanann.larson@gmail.com, Panelists: Christopher Farnham, Randy Dill

Leading teams requires more than just technical skills to ensure the team remains productive and effective. In this session, we will provide an overview of strategies and hands on approaches to help lead teams more effectively. Topics will include developing your leadership competencies, improving your emotional intelligence, managing change and building the team.

■ FA02

02-Broadway B

Healthcare Modelling in Europe: Management and Scheduling

Cluster: EURO Working Group on Operational Research Applied to Health Services (ORAHs)

Invited Session

Chair: Martin Pitt, Associate Professor, University of Exeter, Veysey Building, Salmon Pool Lane, Exeter, UK, EX2 4SG, United Kingdom, m.pitt@exeter.ac.uk

1 - Towards a Structure for Healthcare Systems Modeling

Michael Pidd, Professor of Management Science, Lancaster University, Department of Management Science, The Management School, Lancaster, LA1 4YX, United Kingdom, m.pidd@lancaster.ac.uk

The growing expense of healthcare worldwide is the backdrop to the increased use of OR/MS, though whether real implementation is common is less clear. There are many different methodologies in use and many different application areas. It seems helpful to put some structure on these to support conversations and interactions between analysts, clinical staff and managers so as to increase

the probability of fruitful cooperation, and as an aid to education. Here we develop such a structure, based in part around previous ideas about intended model use.

2 - Patient Discharge Management Policies under Bed Occupancy Pressure

Fermin Mallor, Public University of Navarre, Campus Arrosadia, Pamplona, 31006, Spain, mallor@unavarra.es, Julio Barado, Cristina Azcarate

In this work we study effective management rules to guide doctors' discharge decisions under bed occupancy pressure. We consider Phase-type distributions to model the LoS and its states to represent the different health status of the patient. In an effort to approach the real setting, our analysis includes the delay between deciding to discharge a patient and the time in which the bed is available for another patient.

3 - Online Appointment Scheduling with Different Urgencies and Appointment Lengths

Aleida Braaksma, PhD Candidate, University of Twente & Academic Medical Center Amsterdam, Drienerlolaan 5, Enschede, Netherlands, a.braaksma@utwente.nl, Jivan Deglise-Hawkinson, Brian Denton, Mark Van Oyen, Richard J. Boucherie, Martijn R.K. Mes

The challenge in online appointment scheduling is to not only schedule the current appointment optimally, but also enable efficient scheduling of future appointment requests. We study a problem with different access time norms and appointment lengths for different patient types. The objective is to maximize the number of patients served within their access time norm, while utilizing resources efficiently. We develop an Approximate Dynamic Programming approach and illustrate its performance by application to a short stay nursing ward in the Academic Medical Center Amsterdam, the Netherlands.

■ FA03

03-Broadway C

Simulation In Healthcare I

Contributed Session

Chair: Leslie Gardner, Professor of Mathematics, University of Indianapolis, 1400 East Hanna Avenue, Indianapolis, IN, 46227, United States of America, lgardner@uindy.edu

1 - A Simulation-Based Modeling Platform of Colorectal Cancer Patients' Clinical Pathways

Elnaz Karimi, Ecole Polytechnique de Montreal, 2450 Boulevard Edouard-Montpetit, Montreal, QC, H3T 1J4, Canada, karimi.lnz@gmail.com, Karam Mustapha, Quentin Gilli, Jean-Marc Frayret

In this study we examine the development process of a patient-centered object-oriented discrete event simulation to model the colorectal cancer clinical pathway (CP) in Montreal's Jewish general hospital. The simulation platform provides an excellent tool for analyzing the current CP and developing applicable scenarios to improve quality of care.

2 - Using Simulation to Design an Emergency Department: Architecturally, Operationally and Clinically

Robin Clark, QMT Group, 1143 Oak Ridge Tpke, Suite 107A-134, Oak Ridge, TN, 37830, United States of America, Clark@qmtgroup.com, Susan O'Hara, Steve Langston

Healthcare clients capture patient data in every department and with every process. However, hospitals struggle with using this data analytically to improve their systems. In this presentation, we will discuss how one community hospital used simulation to influence architectural, clinical and operational design of its new emergency department. During the project, an unexpected budgetary cut dictated that a further reduction of rooms was necessary. The model was reused for a second study, which included construction phasing, so that it was closely aligned with patient throughput.

3 - A Population Health Simulation to Assess the Cost Effectiveness of Colonoscopies

Leslie Gardner, Professor of Mathematics, University of Indianapolis, 1400 East Hanna Avenue, Indianapolis, IN, 46227, United States of America, lgardner@uindy.edu, Macanda Simpson

Employers need to understand the cost effectiveness of preventive health care as they negotiate rates for health care plans. This paper presents an Excel-based population health simulation to assess the cost effectiveness of colonoscopies. Results of the age stratified simulation confirmed that the appropriate age for a first colonoscopy is 50. Results also include a sensitivity analysis of the trade-off on colonoscopy costs and cancer treatment. The simulation is that it provides a user friendly Excel-based tool to analyze costs and ages for screenings.

■ FA04

04-Broadway D

Predictive Analytics in Health Care

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Xi Chen, University of Texas at Austin, Austin, TX, 78712, United States of America, carol.chen@utexas.edu

1 - A K-nearest Neighbors Survival Probability Prediction Method for Kidney Graft Failure Prediction “

David Lowsky, Santa Monica, CA, United States of America, dlowsky@gmail.com, Stefanos Zenios, Donald Lee, Jeffrey McCullough, Yichuan Ding, L. Ross, J. Thistlethwaite

Accurate survival prediction techniques are important tools for evaluating treatment benefit and for guiding treatment selection. The utility of these methods are perhaps best showcased by Adjuvant! Online, a forecasting tool for cancer survival rates. In this work we introduce a simpler nonparametric alternative to existing prediction methodologies that requires no particular structural assumptions and can be applied to a wide variety of other settings. We apply our algorithm to forecast post-transplant survival probabilities for kidney transplant recipients.

2 - Pattern-Based Survival Analysis of Chronic Kidney Disease

Ersoy Subasi, Assistant Professor, Florida Institute of Technology, 150 W. University Blvd, Melbourne, FL, 32901, United States of America, Ersoy.Subasi@yahoo.com, Munevver Subasi, Michael Lipkowitz, Melissa Moreno, Travaughn Bain

In this study we develop a robust pattern-based survival analysis technique to identify combinatorial patterns of clinical, proteomic and genomic features in African-American Study of Chronic Kidney Disease (AASK) data. We investigate the effects of APOL1 risk variants on progression and its interactive effects with baseline proteinuria, the blood-pressure goal, and antihypertensive-drug interventions. The pattern-based survival models are expected to help better the understanding of the pathophysiology of progression of chronic kidney disease, and hence, to lead new clinical interventions.

3 - Texas Arbovirus Risk Maps

Xi Chen, University of Texas at Austin, 1114 Camino La Costa, Austin, TX, 78752, United States of America, carol.chen@utexas.edu, Nedialko Dimitrov, Lauren Meyers

Dengue virus and chikungunya virus are two key mosquito-borne diseases in Texas. To focus state resources, public health officials need to identify the geographic risk areas for these diseases. We consider thousands of possible risk models, based on maximum entropy methods, combined with data on the transmission vectors, environmental, and socio-economic factors. We select the best model empirically, using historical Texas dengue data. The final model is in use by Texas health officials.

■ FA05

05-Broadway G

Using Health IT to Improve Patient Experience

Cluster: INFORMS Information Systems Society

Invited Session

Chair: David Anderson, CUNY Baruch, 55 Lexington Ave, New York, NY, 10010, United States of America, davidryberganderson@gmail.com

1 - Healthcare Response to Urban Disasters

Andres Jola-Sanchez, Indiana University, 1309 E. 10th St., Kelley School of Business, Bloomington, IN, 47405, United States of America, ajolasan@indiana.edu, Jonathan Helm, Alex Mills, Mohan Tatikonda, Bobby Courtney

Following a disaster in an urban area, on-scene responders decide how to distribute casualties to hospitals. Using data from a major metropolitan area, we show the value of different types of coordination regarding hospitals' capacity information. While good coordination improves the response, it also magnifies the effect of predictable variability.

2 - Critical Complements: Patient and Provider Engagement with Technology

Vickee Wolcott, PhD Student / U.S. Army Officer, University of Maryland - College Park, 3711 Campus Dr, Apt 480, College Park, MD, 20740, United States of America, vickeewolcott@gmail.com, Ritu Agarwal, Guodong (Gordon) Gao, D. Alan Nelson

This study examines the effects of a patient portal on patients' health outcomes and costs. We examine discrete and complementary effects of patient and provider activation from a relationship-centered care perspective, using a rich dataset with administrative, medical and training data on 760k U.S. Army soldiers.

3 - Nurse Staffing in Perianesthesia Care Units using Discrete Event Simulation

Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N Charles St, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu, Scott Levin

We use a discrete event simulation to model patient flow and nurse staffing in a perianesthesia care unit (PACU) at Johns Hopkins Hospital. The simulation generates patients which flow through perioperative care, resulting in detailed output on predicted patient census, boarding times, and length of stay. This output was then used to determine nurse staffing at various levels of patient flow. We show that reducing patient length of stay in the PACU by an hour results in three fewer beds and one fewer nurse needed to provide care.

■ FA06

06-Broadway H

Measuring Impacts of Electronic Medical Records in Hospitals

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Raghu Santanam, Professor, Arizona State University, P.O. Box 874606, Department of Information Systems, Tempe, AZ, 85287, United States of America, raghu.santanam@asu.edu

1 - Antecedents and Consequences of Abandonment of Electronic Medical Record Systems

Kartik Ganju, Temple University, 210 Speakman Hall, Philadelphia, PA, United States of America, kartik.ganju@temple.edu, Pei-Yu Chen, Hilal Atasoy, Paul Pavlou

We examine which hospitals are more likely to abandon using EMR systems and the consequences of this is. We find that the abandonment of EMR systems leads to an increase in operational cost of hospitals and that smaller hospitals are more likely to abandon the use of these systems.

2 - A Model of Process-Based Automation: Evidence from the Healthcare Industry

Trent Spaulding, Assistant Professor, Appalachian State University, 261 Locust St, Boone, NC, 28608, United States of America, spauldingtj@appstate.edu, Michael Furukawa, Raghu Santanam

We test a model of process-based automation. The model describes how continuity of information flow and automation of sequential steps affect cost. We use five years of data from CMS, AHA, HIMSS Analytics and California OSHPD. Automation does not confer uniform benefits across the sequential steps of the business process.

3 - Length of Stay Management through Clustering and Order Switching

Daniel Gartner, Carnegie Mellon University, The H. John Heinz III College, Pittsburgh, PA, United States of America, daniel.gartner@mytum.de, Rema Padman

This study examines clustering of inpatients using clinical and demographic attributes to identify Length of Stay (LOS) outliers. Learning from retrospective data on appendectomy patients, we develop a two-stage procedure that i) identifies a typical cluster with LOS outliers and ii) compares orders pairwise to determine candidates for order switching. Results indicate that switching orders in homogeneous inpatient sub-populations within the limits of clinical guidelines may be a promising decision support strategy for LOS management.

■ FA07

07-Broadway J

Applications in Cancer Screening and Treatment

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Jennifer Lobo, Assistant Professor, P.O. Box 800717, Charlottesville, VA, 22908, United States of America, jem4yb@eservices.virginia.edu

1 - An Analytics Approach to Designing Combination Chemotherapy Regimens for Cancer

John Silberholz, PhD Student, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, 02139, United States of America, josilber@mit.edu, Dimitris Bertsimas, Stephen Relyea, Allison O'Hair

We present a data-driven approach for designing new chemotherapy regimens for advanced gastric and breast cancer. Our approach combines (i) construction of a large-scale database of clinical trial results, (ii) statistical modeling to predict

outcomes of new drug combinations, and (iii) optimization models to select novel treatments that strike a balance between maximizing patient outcomes (exploitation) and learning new things about treatments that may be useful in the future (exploration).

2 - Optimizing Public Health Interventions that Change Preferences via Simulation

Maria Mayorga, Associate Professor, North Carolina State University, Daniels 376, Raleigh, NC, 27695, United States of America, memayorg@ncsu.edu, David Cornejo, Stephen Roberts

For colon cancer, one barrier to improvement in the health of the population is a low participation in screening and monitoring programs. Spending on public health programs that increase participation has the ability to improve health outcomes. We propose an optimization framework to make spending allocation decisions. We evaluate policies via a simulation optimization methodology.

3 - Ductal Carcinoma in Situ Decision Process

Shadi Hassani Goodarzi, Graduate Student, North Carolina State University, 380 Daniels Hall, Raleigh, NC, 27695, United States of America, shassan3@ncsu.edu, Julie S. Ivy

Ductal Carcinoma In Situ (DCIS) is arguably a direct precursor of Invasive Breast Cancer (IBC). Approximately one woman is diagnosed with DCIS for every four women diagnosed with IBC (Allegra 2010). About 14%-53% of DCIS turn into IBC, after long follow-up periods (Bayraktar 2013). So about 47%-86% of the DCIS cases are over diagnosed and as a result, treatment can only cause harm for these patients. Using dynamic programming, we try to improve the DCIS decision process based on patient's tumor characteristics while reducing over diagnosis.

FA08

08-Broadway K

Student Research Projects in Healthcare Operations

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, amycohn@med.umich.edu

1 - Improving Access to an Outpatient Endocrinology Clinic

Moses Y.H. Chan, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, mosesyhc@umich.edu, Amy Cohn

In this research, we have taken the novel approach of collecting, over several months, a daily snapshot of the year-long clinic scheduling horizon and developing a relational database to analyze this data. The aim is to understand how patient appointments are scheduled and how appointments are cancelled, rescheduled, and ultimately used or "wasted."

2 - Coordinated Scheduling of Operating Room and Clinic Time Blocks for Surgical Attendings

Brian Lemay, University of Michigan, IOE Department, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, blemay@umich.edu, Amy Cohn, William Pozehl, Elizabeth Olin, Yicong Zhang

We develop and solve an optimization model for scheduling surgeons into both operating and clinic room blocks over a monthly horizon. We describe our model's objective, constraints, and non-conventional decision variables, and provide examples of the analyses we've conducted using our model on data from a major teaching hospital.

3 - Optimizing which Chemotherapy Drugs to Pre-Mix and When

Donald Richardson, PhD Student, University of Michigan-Ann Arbor, 1433 Natalie Ln Apt#204, Ann Arbor, MI, 48105, United States of America, donalric@umich.edu

In collaboration with the University of Michigan Comprehensive Cancer Center, we are developing a data-driven, optimization-based approach to improving the timeliness of drug preparation for chemotherapy infusion patients while reducing staff workload and improving resource utilization. This is accomplished by determining an optimal schedule indicating which chemotherapy drugs to pre-mix and at what time of day.

4 - Patient Flow in a Pediatric Emergency Department

Brooke Szymanski, Center for Healthcare Engineering and Patient Safety - University of Michigan, 1075 Beal Ave., Ann Arbor, MI, United States of America, bmsizy@umich.edu, Hassan Abbas, Amy Cohn

In this talk, we present an ongoing initiative with Mott Children's Hospital at the University of Michigan. This is an interactive visual tool we developed in conjunction with clinicians at Mott. Intended for patients, relatives, and providers, it depicts the hospital (e.g. number of beds in the emergency department, different inpatient units, etc.) and allows the patients to interactively experience the potential stages of the care being provided, while allowing the providers to understand the full system, not just the section they work in.

FA09

09-Cumberland 1

The Impact of IT on Healthcare

Cluster: Health Information Technology and Management

Invited Session

Chair: Juhee Kwon, City University of HK, Tat Chee Avenue, Hong Kong, Hong Kong - PRC, juhee.kwon@cityu.edu.hk

1 - Can Social Media Improve Patient-Doctor Relationship and Patient Well-Being?

Ben Liu, Assistant Professor, City University of Hong Kong, Hong Kong, China, qianliu@cityu.edu.hk

We examine how the use of social media in the Chinese healthcare industry affects the relationship between patient and doctor, and patients' well-being. We argue that social media can support both the informational aspect (e.g., exchange of information about patients' condition) and affective aspect (e.g., expression of empathy and support) of the interaction. We test our hypothesis on longitudinal data collected from an online medical consultation website. We show that social media can be an important means to achieve better healthcare without a substantial increase in government health expenditure.

2 - Meaningful Healthcare Security: The Effect of Meaningful-Use Attestation on Healthcare Security

Juhee Kwon, City University of HK, Tat Chee Avenue, Hong Kong, Hong Kong - PRC, juhee.kwon@cityu.edu.hk, M. Eric Johnson

This study examines how meaningful-use attestation influences the occurrence of data breaches and how breach performance is associated with penalties from prior breaches. We find that while attesting hospitals observe reduced external breaches only in the short term, they observe short-term increases in accidental internal breaches but eventually see longer-term reductions. Further, we find that the interaction between meaningful-use attestation (carrot) and prior failure resulting in penalties (stick) enhances short-term reductions of accidental internal and external breaches.

3 - A Non-Cooperative Game with Incomplete Information to Improve Patient Hospital Choice

Jie Song, Dr., Peking University, NO. 298 Chengfu Road, Haidian District, College of Engineering, Beijing, 100871, China, songjie@coe.pku.edu.cn

In this paper, we introduce a game theoretic framework that considers both the influence of static and dynamic factors on patients' choices among healthcare facilities. We formulate a non-cooperative game with incomplete information and regard the equilibrium of this game as a best prediction of patients' hospital choice results. We implement the proposed game theoretic framework by a case study. We provide quantitative analysis on the equilibrium to study how those factors affect patients' hospital choices.

4 - Can Online Reviews Predict Medical Board Sanctions?

Evidence from ratemds.com

Shannon Lantzy, PhD Candidate, University of Maryland, College Park, MD, United States of America, slantzy@rhsmith.umd.edu, Shawn Mankad, Siva Viswanathan

Medical licensing is intended to ensure a minimum level of quality in healthcare. However, consumers would undoubtedly like to choose healthcare providers well above the minimum bar. Can online reviews be used to predict which doctors will be sanctioned by their state medical licensing board, and thus help consumers avoid the lowest-quality doctors? We examine review ratings and volume, as well as less-studied measures of dispersion and content cues in the textual reviews. We find that review metrics do differentiate between low-quality doctors and the rest of the physician population.

■ FA10

10-Cumberland 2

Joint Session HealthOp/Public Health: Modeling Emergency Departments and Emergency Response

Cluster: Health Operations & Logistics/

Public Health

Invited Session

Chair: Laura McLay, University of Wisconsin-Madison, 1513 University Ave, ISYE department, Madison, WI, 53706, United States of America, lauramclay@engr.wisc.edu

1 - Incentive-Compatible Prehospital Triage in Emergency Medical Services

Alex Mills, Indiana University, 1309 E. 10th St., Bloomington, IN, United States of America, millsaf@indiana.edu, Eric Webb

Emergency Medical Services (EMS) personnel collect a substantial amount of medical information about the medical acuity of patients who use their services. However, in the US this information is not frequently used to triage patients, resulting in many low-acuity patients being transported to hospitals. Some medical researchers have argued that this is because prehospital triage is simply ineffective or inaccurate. We show that certain types of reimbursement policies could encourage investment in improving triage effectiveness, but these policies are not common in the US insurance system.

2 - Using Machine Learning to Improve Emergency Medicine Operations

Erkin Otles, University of Wisconsin-Madison, 2624 Monroe Street, Madison, WI, 53711, United States of America, otles@wisc.edu

A significant benefit is associated with predicting which Emergency Department patient encounters lead to a readmission. The author investigated the feasibility and effectiveness of using predictive modeling tools, such as logistic regression and decision trees, to screen for recidivism. Findings indicate that machine learning techniques on patient data may prove fruitful in advancing the science of healthcare delivery.

3 - A Multi-Period Dynamic Location Planning Models for Emergency Response

Burcu Keskin, University of Alabama, 361 Stadium Dr., Alston Hall Room 355, Tuscaloosa, AL, 35487-0226, United States of America, bkeskin@cba.ua.edu, Jianing (Jenny) Zhi, Sharif Melouk

We study a multi-period ambulance location problem to minimize the total operational costs while maintaining acceptable response times. Using a new EMS network with of supply centers, hospitals, responder locations and incidents, we propose a deferred service model to decide the number of ambulances and their paths as well as the incidents that are deferred to future periods. Considering network size, fleet size, incident patterns and time-dependent parameters as factors, we compare the results in terms of service quality, response time and cost through experimentation.

4 - Applying Queueing Theory and Simulation to the Modeling of Emergency Departments

Xia Hu, Ph.D. student, University of Maryland, Department of Mathematics, College Park, MD, 20740, United States of America, summer.xia.hu@gmail.com, Sean Barnes, Bruce Golden

Queueing Theory (QT) model is an important tool for Emergency Department (ED) design and management. By reviewing all papers which apply QT to the study of ED performance since 1972, this survey aims to examine the contributions of QT to modeling EDs and identify its limitations when compared to discrete-event simulation (DES). Our results indicate that the combination of queueing and simulation methods can be a powerful approach to better ED modeling.

■ FA11

11-Cumberland 3

Medical Decision Making in Healthcare

Contributed Session

Chair: Brian Rothman, MD, Vanderbilt University Medical Center, 1301 Medical Center Dr, 4648 TVC, Nashville, TN, 37232, United States of America, brian.rothman@vanderbilt.edu

1 - Cost-Effectiveness of Genetic Diagnostic and Treatment Co-Dependent Technologies under Uncertainty

Reza Mahjoub, University of Alberta, Department of Emergency Medicine, 7-36A University Terrace, 8303-112 St., Edmonton, AB, T6G 2T4, Canada, reza.mahjoub@ualberta.ca, Mike Paulden, Philip Akude, Roberta Longo, Peter Hall, Christopher McCabe, Paul Baxter

We propose a framework for optimizing test and treatment decisions; characterizing uncertainty under a scenario consisting of two tests—genetic mutation and clinical expression—and a treatment. The first test identifies existence of health condition, the second the scope for benefit from treatment given clinical expression. Treatment effectiveness is a function of the ability to benefit. By an example we show relationship between test and treatment decisions and cost-effectiveness of therapy.

2 - Overprovision of Expert Service to Waiting Customers

Timothy Chu, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, ttchu@ust.hk, Hongtao Zhang

Motivated by overprovision of expert services in the healthcare sector, this paper aims to complement existing literature in credence goods by considering expert services in a queuing setting where clients choose to obtain service from competing service providers and waiting time is a concern. We investigate the expert's overprovision strategy and its impact on arrivals. We propose a pricing mechanism to mitigate overprovision and identify types of competition that discourage overprovision.

3 - Investigating Steroid Withdrawal Strategies for Patients Post Kidney Transplantation

Yann Ferrand, Assistant Professor, Clemson University, 131-A Sirmine Hall, Clemson, SC, 29634, United States of America, yferran@clemson.edu, Pamela Heaton, Vibha Desai, Christina Kelton, Jaime Caro, Teresa Cavanaugh, Jens Goebel

We evaluate various steroid withdrawal strategies for patients post kidney transplantation. The goal is to minimize three major complications resulting from these complex drug regimens: acute rejection, graft loss and cardiovascular events over the long term. We develop a model calibrated with an econometric study of patient data from a national registry to simulate the long-term course of these patients. We report on the frequency and timing of adverse events and identify trade-offs in the steroid withdrawal strategies.

4 - Perioperative PONV Guidelines Clinical Decision Support Design Analysis

Brian Rothman, MD, Vanderbilt University Medical Center, 1301 Medical Center Dr, 4648 TVC, Nashville, TN, 37232, United States of America, brian.rothman@vanderbilt.edu

Postoperative nausea and vomiting (PONV) is a significant perioperative risk. Near real-time risk analysis and clinical decision support (CDS) based on expert guidelines may decrease PONV, PACU LOS and adverse patient outcomes. CDS implementation must consider issues including data location, entry timing, decisions and decision timing.

■ FA12

12-Cumberland 4

Operations' Role in Managing Infectious Diseases

Sponsor: INFORMS MSOM HOM SIG

Sponsored Session

Chair: Parastu Kasaie, Postdoctoral Fellow, Johns Hopkins University, 615 N. Wolfe st, E6039, Baltimore, MD, 21202, United States of America, pkasaie@jhu.edu

1 - A Novel Approach for Estimating the Contribution of Recent Transmission to Tuberculosis Incidence

Parastu Kasaie, Postdoctoral Fellow, Johns Hopkins University, 615 N. Wolfe st, E6039, Baltimore, MD, 21202, United States of America, pkasaie@jhu.edu

Using an individual-based simulation model of a tuberculosis (TB) epidemic, we developed a novel tool for estimation of the TB recent transmission proportion that reduces the estimation bias from traditional methods by 60-70%; the absolute magnitude of improvements is greatest in settings with incomplete data coverage.

2 - Likelihood Maximization for Real-time Calibration of Stochastic Compartmental Epidemic Models

Christoph Zimmer, Brigham and Women's Hospital, 641 Huntington Ave., Boston, MA, 02115, United States of America, christoph_zimmer@aol.com, Reza Yaesoubi, Ted Cohen

Early estimation of key epidemic parameters is challenging because data available during early stages of an epidemic (e.g. pathogen-associated hospitalizations) imperfectly reflect the true state of the epidemic. We describe a likelihood-maximization method to calibrate a general class of stochastic compartmental epidemic models using real-time observations. This method is computationally efficient and returns increasingly accurate predictions of key parameters and partially observed outcomes.

3 - How Much is Screening Worth? Estimating the Value of Active Case Finding for Tuberculosis

Andrew Azman, Johns Hopkins University, 615 N. Wolfe St., Baltimore, MD, 21205, United States of America, azman@jhu.edu, David Dowdy, Jonathan Goloub

We use transmission and economic models to estimate the impact of active case finding for tuberculosis in China, India and South Africa.

■ FA13

13-Cumberland 5

Scheduling and Capacity Management

Cluster: College of Healthcare Operations Management, Production and Operations Management Society
Invited Session

Chair: Douglas Morrice, Professor, University of Texas-Austin, Information, Risk, & Operations Management, Austin, TX, United States of America, Douglas.Morrice@mcombs.utexas.edu

1 - Capacity Planning Models to Manage Access Profiles in Large, Heterogeneous Queueing Networks

Jonathan Helm, Indiana University, 1309 E. Tenth St, Bloomington, IN, 47405, United States of America, helmj@indiana.edu, Jivan Deglise-Hawkinson, David Kaufman, Mark Van Oyen, Todd Huschka

With the increasing popularity of Accountable Care Organizations (ACOs), Destination Medical Programs, and other integrated care options, new challenges have arisen. In particular, the capacity planning problem for medical services now becomes a coordinated network problem rather than a service by service optimization. We focus on managing the mix of patients to provide differentiated access based on level of urgency. We solve this by transforming the stochastic network metrics (e.g. network appointment delays) into a deterministic MIP with chance constraints using new linearization methods.

2 - Coordinated Scheduling for a Multi-Station Healthcare Network

Ester Wang, The University of Texas, Austin, McCombs School of Business, Austin, TX, United States of America, wdy@utexas.edu, Douglas Morrice, Kumar Muthuraman

The annual national health expenditure (NHE) in the U.S. is projected to hit \$3 trillion dollars in 2014, which is about 20% of the GDP. As most patients access care through outpatient appointments, optimized scheduling for outpatient appointment is central to the success of health care reform. Our research develops a mechanism that coordinates outpatient appointment scheduling amongst multiple stations in a healthcare network. Our approach has the potential to yield a global optimal solution rather than clinic-specific local optimal solutions, as in most of the existing literature.

3 - Dynamic Patient Scheduling for Multi-Appointment Health Care Programs

Adam Diamant, Assistant Professor, Schulich School of Business, York University, 111 Ian Macdonald Blvd., York University, Toronto, ON, M3J1P3, Canada, adiamant@schulich.yorku.ca, Fayezer Quereshey, Joseph Milner

We investigate the scheduling practices of a multidisciplinary, multistage, outpatient health care program with no-shows. Patients undergo a series of assessments before being eligible for elective surgery. We formulate the problem as a Markov Decision Process and use approximate dynamic programming to find policies to schedule patients to appointments. We propose several heuristic policies and examine the quality of our solutions via structural results and by comparing them to a simulation of the clinic.

■ FA14

14-Cumberland 6

Analytical Applications in Healthcare

Contributed Session

Chair: Supunmali Ahangama, National University of Singapore, Department of IS, School of Computing, Computing 1 13 Computing Drive, Singapore, 117417, Singapore, supunmali@comp.nus.edu.sg

1 - Patient Experience Enhancement via Junior Doctor Manpower Reallocation Optimization

Hong Choon Oh, Senior Manager, Eastern Health Alliance, 5 Tampines Central 1 Tampines Plaza #08-, Singapore, Singapore, hong.choon.oh@easternhealth.sg, Mohan Tiru, Wai Leng Chow, Peter Looi, Ling Tiah, Pak Liang Goh, Hoon Chin Lim

The Accident and Emergency (A&E) Department of a public hospital with over 1,000 beds in Singapore has a distinct patient arrival pattern that is dependent on

the time of the day and day of the week. It is crucial that adequate manpower resources are made available at different times of the day and days of week so that they meet the patient needs in a timely manner. This study offered a case study where significant improvement in waiting time of A&E patients was achieved via application of an integer linear programming model which aimed to match available junior doctor manpower with patient arrival pattern.

2 - Assessing Federal Insurance Exchange Competition through Network Structure Properties

Babak Heydari, Stevens Institute of Technology, One Castle Point on Hudson, Hoboken, NJ, United States of America, babak.heydari@stevens.edu, David Gianetto

Has the federal insurance exchange, established by the US ACA, become more competitive since its launch? Competition in this exchange has been studied by relating insurer count to cost but this approach has been problematic. We propose an alternative approach where a competition network is formed between insurers based on national plan offerings. For competition study, we propose a structural competition metric which shows federal exchange competition has doubled since launch.

3 - An Analytic Model for Health Analytics Process

Supunmali Ahangama, National University of Singapore, Department of IS, School of Computing, Computing 1 13 Computing Drive, Singapore, 117417, Singapore, supunmali@comp.nus.edu.sg, Danny Chiang Choon Poo

HA has enabled a rapid advancement of the healthcare sector from a volume-based to a value-based system. Required dependence of the current HA projects on the skills and domain knowledge of the analysts, unique position of the medical field and ad-hoc approaches practiced have hindered the progress in HA applications. Success of HA depends on the availability of a sound process model and effective project, knowledge and communication management. An effective process model is proposed upon examining the major phases of a HA process using the survey and case study approach.

Friday, 9:45am - 11:15am

■ FB01

01-Broadway A

Systems Engineering and Analytics

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Tarun Mohan Lal, Mayo Clinic, Rochester, Minnesota, mohanlal.tarun@mayo.edu

1 - Use of Engineering Tools to Reduce Costs of Cataract Surgery

Mike Fabel, Senior Health Systems Engineer, Mayo Clinic, 200 1st St SW, Rochester, MN, 55905, United States of America, Fabel.Michael@mayo.edu

With the increasing number of baby boomers requiring Cataract surgery, reducing waste in this procedure is beneficial for both the patient and the practice. Mayo Clinic Ophthalmology utilized process engineering tools to successfully do this. The key tools utilized were value stream mapping, swim lane diagrams, and PDSA. These tools helped generate a wheels in to wheels in time savings of 19.5%.

2 - Analytics to Support Innovation in Outpatient Care Delivery Processes

Tarun Mohan Lal, Mayo Clinic, Rochester, MN, mohanlal.tarun@mayo.edu

With the growing trend and concern surrounding health care workforce shortages, there is an increasing call for the redesign of office practices to reduce inefficiency and improve capacity through better use of existing office staff. In this presentation, we will discuss some innovative models of care delivery such as increase pre-visit work, non-face face visits being implemented at Mayo Clinic that has potential for improved operational performance and staff satisfaction.

3 - Effective Use of Clinical Decision Support to Optimize Utilization of Lab Tests in the Hospital Setting

Muna Khan, Senior Principal Health Systems Engineer, Mayo Clinic, Systems and Procedures, 200 1st Street SW, Rochester, MN, 55905, United States of America, Khan.Munawwar@mayo.edu

In the United States, lab tests account for approximately 4% of all healthcare costs which amount to nearly \$70 billion annually. While such costs are increasing annually by 20% to 25%, part of it is attributed to standing orders in the hospital setting that are only accentuated by the implementation of the electronic health records. This presentation will describe how the Mayo Clinic has employed laboratory test utilization management strategies using clinical decision support in the hospital setting with the goal of providing high-quality, cost-effective patient care. Initial pilot results indicate utilization may be reduced as much as 60% for certain labs effectively minimizing waste and optimizing care

for patients.

■ FB02

O2-Broadway B

Estimation Applications in Healthcare

Contributed Session

Chair: Susan Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu

1 - Six Months of Data: Risk of Death, Quantification of Intervention

Oleg Roderick, Geisinger Health System, 100 Academy Drive, Danville, PA, 17821, United States of America, oeroderick@geisinger.edu

We develop an evidence-driven approach to prognosis of death for medical patients based on a short-term summary of medical history. This fills the gap between the actuarial approaches, and the models developed for a specific diagnosis. We use 200 features from anonymized medical data, merged from clinical and health insurance sources. The predictive model is a hybrid of clustering techniques and adaptive regression. The parametric dependencies in the model are explicit, allowing us to make data-validated statements about the effectiveness of medical intervention.

2 - Do Central Users Matter? Exploring the Role of Social Media in Health Information Dissemination

Daniel Asamoah, Assistant Professor, Wright State University, ISSCM Department, 3640 Colonel Glenn Hwy, Dayton, OH, 45435, United States of America, daniel.asamoah@wright.edu, Ramesh Sharda

Healthcare research has shown that patients rely on the medical opinion of other users online before making a decision on a healthcare product. However, the reliability of this information remains unclear. In this study, we ask "Does social media support the dissemination of quality and objective health information?"

3 - Stronger Instrumental Variables for Estimation of Causal Effects in Healthcare Research

Jose Zubizarreta, Assistant Professor, Columbia Business School, 3022 Broadway, 417 Uris Hall, New York, NY, 10027, United States of America, zubizarreta@columbia.edu

Weak instrumental variables constitute an important problem for estimation of causal effects because confidence intervals do not have adequate coverage and because estimates are highly sensitive to biases from unmeasured confounders. In standard econometric analyses, the strength of an instrument is typically thought as given, but we present a new method that augments the strength of an instrument by solving an integer program. This method builds upon the work of Baiocchi et al. (2010) and constitutes a nonparametric alternative to standard two-stage least squares procedures, although it can be used in conjunction to such procedures as a method that preprocesses the data before analysis. We use this new method to estimate the effect of hospital length stay on readmissions of late-preterm babies in California.

4 - Is Technology Eating Nurses? Evidences from Nursing Homes Staffing and Process Quality

Susan Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu, Abraham Seidmann, Huaxia Rui

We study the effect of advanced information technology on the staffing and process quality of healthcare providers using a unique dataset covering 2,119 nursing homes in the U.S. over a seven-year period.

■ FB03

O3-Broadway C

Simulation in Healthcare II

Contributed Session

Chair: David Morgareidge, Predictive Analytics Director, Page, 1800 Main Street, Suite 123, Dallas, TX, 75201, United States of America, dmorgareidge@pagethink.com

1 - Using DES to Improve ED Throughput by Scheduling Providers by Individual Productivity Metrics

Kelly N Z Rickard, The George Washington University / Department of Engineering Management and Systems Engineering, 800 22nd St. NW, Washington, DC, 20052, United States of America, knz@gwmail.gwu.edu, Jesse M. Pines, Johan René van Dorp

Emergency Department congestion and crowding are international problems that affect health outcomes. The authors, in this work in progress, will show how

provider variation, as in resource utilization or admitting ratio, may inadvertently cause backups on busier days, leading to congestion and crowding that may be sustained through the cyclical weekly period, only resolving in time for the next patient influx. This study, using simulation, aims to demonstrate improved throughput by scheduling providers according to individual productivity variation without requiring change in behavior.

2 - The US Department of Defense's Military Health System Adopts Simulation – How it Will Work

David Morgareidge, Predictive Analytics Director, Page, 1800 Main Street, Suite 123, Dallas, TX, 75201, United States of America, dmorgareidge@pagethink.com

The Department of Defense's Military Healthcare System will shift from static, prescriptive facility design methodologies to one that is performance-based, founded upon simulation, using the author's 2015 policy guidelines, which incorporate process improvement, post occupancy evaluations, and the facility life cycle management process. Simulation enables a single, digital model to incorporate physical space, medical equipment, communication technology, staffing models, patient arrival patterns, and staff processes, to facilitate the design and optimization of space and operational processes.

■ FB04

O4-Broadway D

Joint Session Disease Modeling/Public Health: Session Disease Modeling

Cluster: Disease Modeling and Economic Evaluation/ Public Health

Invited Session

Chair: Ketra Schmitt, Associate Professor, Concordia University, 1455 de Maisonneuve Boulevard West, EV-2, Montreal, QC, H3G1M8, Canada, ketra.schmitt@concordia.ca

1 - Optimal Vascular Access Choice for Patients on Hemodialysis

Steven Shechter, Associate Professor, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, Canada, steven.shechter@sauder.ubc.ca, Reza Skandari, Nadia Zalunardo

Which vascular access to use is one of the most important questions for patients needing hemodialysis. An arteriovenous fistula (AVF) is considered the gold standard. However, it takes approximately three months to know if an AVF surgery is successful. A central venous catheter, on the other hand, can be inserted via a simple procedure and used immediately. We address if/when to perform AVF surgery on HD patients, so as to maximize a patient's survival probability and remaining quality adjusted life expectancy. We also extend our model to consider the possibility of kidney transplantation.

2 - Modeling and Dynamic Optimization of Resources for Multiple Anti-Malaria Interventions

David Hutton, Assistant Professor, University of Michigan, 1420 Washington Heights, SPH II, M3525, Ann Arbor, MI, 48109-211, United States of America, dwutton@umich.edu, Beatrix Balogh, Luojiao Shen, Mark Wilson, Ravi Anupindi, Prashant Yadav, Maryam Sadeghimehr

Many population-level interventions are available to combat malaria, yet policymakers face limited resources. We are developing a decision framework for optimization of a portfolio of malaria interventions over time. This is the first to use both modeling and optimization of a portfolio of malaria interventions over time. We compare and contrast the use of two different model types: a simple and more complex model. The more complex model can more accurately represent the epidemic, but the simpler model may be an acceptable substitute to be used in the optimization.

3 - Modeling Mumps in a University Setting: An Agent-Based Model

Ketra Schmitt, Associate Professor, Concordia University, 1455 de Maisonneuve Boulevard West, EV-2, Montreal, QC, H3G1M8, Canada, ketra.schmitt@concordia.ca, Ali Akgunduz, Seyed Hossein Moosavi

Outbreaks of vaccine-preventable childhood illness are of concern for adult populations in close proximity. In order to describe the dynamics of a mumps outbreak in a university setting, we explore a variety of vaccination levels and assess the potential consequences including economic costs, days of illness and potential for complications.

■ FB05

05-Broadway G

Public Health

Contributed Session

Chair: Monica Cojocar, Assoc. Professor Mathematics, University of Guelph, 50 Stone Road East, Guelph, ON, N1G 2W1, Canada, mcojocar@uoguelph.ca

1 - Storytelling and Data Visualization to Influence Healthy Behaviors of Citizens

Dawei Wang, Doctoral Student, University of Oklahoma, 307 W. Brooks, Room 303, Norman, OK, 73019, United States of America, dawei@ou.edu, Radhika Santhanam

In this study, we explore the opportunity to leverage visual storytelling to help common citizens understand the implications of improper health behaviors, identify factors, and perhaps make effort to improve their behavior. We use the story telling features of Tableau software to present the results of statistical analysis on factors affecting mortality rates, in a narrative form.

2 - The Moderating Effect of National Culture on Electronic Health Records Adoption

Donald Wynn, Associate Professor, University of Dayton, 300 College Park, Dayton, OH, 45469-2130, United States of America, wynn@udayton.edu, Renee Pratt

Organizations face varied results from the implementation and use of information systems across multiple geographic locations. This is especially true in healthcare where electronic health record (EHR) systems developed in one country are deployed elsewhere with inconsistent results. We use Hofstede's dimensions to investigate the influence of national culture differences on the success of EHR implementation through a review of published research plus empirical data collected in four countries.

3 - Evaluating the Effects of Standardized Patient Care Pathways on Clinical Outcomes

Anna Romanova, University of Tennessee, 916 Volunteer Blvd, Knoxville, TN, United States of America, aromanov@vols.utk.edu, Russell Zaretski

The main focus of this study is evaluation of the patient care pathways' effects on clinical outcomes in a hospital setting when randomized clinical trials are not feasible. Since pathway assignment is not random, it is necessary to achieve data balancing before assessing average treatment effects through employing a variety of bias correction methods. We investigate the efficiency of these methods under conditions of imbalanced samples through the Monte Carlo simulation and utilize the simulation results to estimate the average treatment effects of pathways on the LOS and readmission rates.

4 - Absenteeism Impact on Local Economy during an Epidemic via Constrained Hybrid SI Dynamics

Monica Cojocar, Assoc. Professor Mathematics, University of Guelph, 50 Stone Road East, Guelph, ON, N1G 2W1, Canada, mcojocar@uoguelph.ca, Edward Thommes

We employ a hybrid dynamical system, specifically a non-standard continuous time infection model (SIS) and a discrete transition state matrix encapsulating individuals' daily decision making regarding going to or missing work during an epidemic/pandemic. Simulations for 20 weeks of an 8 hr work day period are run to study the effects of the system parameters on the number of missed work days in the region. Incorporating prophylactic practices (such as existing vaccination) highlights the effects of these practices on the economic impact on the region.

■ FB06

06-Broadway H

Operations Analysis of Health Care

Cluster: Healthcare Analytics and Visualization

Invited Session

Chair: Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu

Co-Chair: Changmi Jung, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, cjung9@jhu.edu

1 - Decision Ambiguity and Conflicts of Interests in Interventional Cardiological Decision-Making

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Xiaofang Wang, Chao-wei Hwang

With the rapidly rising cost of health care, there is a renewed urgency for reducing inappropriate use of percutaneous coronary interventions (PCI). In this work, we provide a quantitative analytical model of clinical and non-clinical factors influencing PCI decision-making processes. The model takes into account both clinical decision ambiguity and conflicts of interests arising from fee-for-service payment systems and revenue-driven motives. Our model provides a useful mathematical framework to inform policy-makers designing guidelines to optimize the use of PCI.

2 - Utilizing Electronic Health Records Data to Predict Risk for Periodontal Disease

Rhucha Paranjape, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, rparanja@andrew.cmu.edu, Thankam Thyvalikakath, Karnali Vyawahare, Rema Padman

In this study, we extract relevant risk factors from structured and unstructured data present in the dental electronic health records of 2,370 patients who underwent comprehensive oral examination and analyze and visualize their risk for periodontal disease in the context of their systemic disease, social habits and oral health.

3 - Alternating Direction Methods for Large-Scale Doubly Regularized Support Vector Machine

Anh Ninh, Rutgers University, ninhtuananh@gmail.com

We introduce a new algorithm for the solution of the doubly regularized support vector machine. Numerical examples will be presented for various gene expression data sets.

■ FB07

07-Broadway J

Decision Making in Health Care

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Margaret Brandeau, Stanford University, MS&E Department, Stanford, CA, 94305, United States of America, brandeau@stanford.edu

1 - Individual Decision-Making in Breast Cancer

Elisa Long, Assistant Professor, University of California, Anderson School of Management, Los Angeles, CA, United States of America, elisa.long@anderson.ucla.edu

Women newly diagnosed with breast cancer face a multitude of decisions regarding their own treatment, often with incomplete information about key uncertainties. This presentation will give an overview of specific situations, including genetic testing, chemotherapy timing, surgery type, and fertility considerations, and discuss how decision analysis and mathematical modeling can play a role in helping women make informed, individualized decisions in breast cancer treatment.

2 - Stochastic Next-Day OR Scheduling Heuristics

Enis Kayis, Assistant Professor, Ozyegin University, Industrial Engineering Department, Istanbul, Turkey, enis.kayis@ozyegin.edu.tr, Taghi Khaniyev, Refik Gullu

We consider the daily scheduling problem of a single OR with uncertain surgery durations. Our aim is to find the optimum sequence and scheduled starting times of the surgeries to minimize weighted sum of expected patient waiting times and OR idle times. In addition to analytical results providing useful insights on the characteristics of the optimum solutions, we develop heuristics for sequencing and duration assignments and compare their performance.

3 - Optimal Timing of Drug Sensitivity Testing for Patients on First-Line TB Treatment in India

Sze-chuan Suen, Stanford University, 117 Encina Commons, Stanford, CA, 94305, United States of America, ssuen@stanford.edu, Margaret Brandeau, Jeremy Goldhaber-Fiebert

Drug sensitivity testing (DST) tuberculosis (TB) patients in first-line treatment can be used to triage those with drug-resistant disease into more effective care, but the optimal time to administer the costly DST has not been established. Cheaper, but imperfect, sputum smear (SS) tests that cannot detect drug resistance can be used to determine if a patient remains uncured. We use a partially observed Markov decision process framework to determine when and how often SS test information should be collected and use this information to find the optimal time DST should be administered in India.

4 - Evaluating Health Outcomes of Interventions that Affect Fertility and Childbearing

Margaret Brandeau, Stanford University, MS&E Department, Stanford, CA, 94305, United States of America, brandeau@stanford.edu, Jeremy Goldhaber-Fiebert

How should health impacts of interventions that affect current and future fertility and childbearing be measured? We reviewed literature on economic evaluations of such interventions. We find that the economic evaluations inconsistently consider health outcomes in ways that often appear biased towards the interventions considered. As the Panel on Cost-Effectiveness in Health and Medicine updates its guidelines, standardizing the practice of cost-effectiveness analysis is a priority. Our study contributes to harmonizing methods in this respect.

■ FB08

08-Broadway K

Decision Models in Healthcare

Cluster: INFORMS Health Applications Society

Invited Session

Chair: Vishal Ahuja, Assistant Professor, Southern Methodist University, P.O Box 750333, Dallas, TX, 75275, United States of America, vahuja@smu.edu

1 - Predicting Colorectal Cancer Mortality

Margret Bjarnadottir, University of Maryland, College Park, MD, United States of America, margret@rhsmith.umd.edu, Kim Rhoads, Leila Zia

Colorectal cancer (CRC) is the third most common cancer. Over 135,000 patients are diagnosed with CRC each year in the US. Any CRC treatment decision should be guided by carefully weighted analysis of the potential harm and benefits of the treatment, together with the mortality risk of the patient. Estimating patients' mortality risk is not trivial, and in this research we build comprehensive, time dependent mortality prediction models. We analyze the performance of the models and contrast variable importance for short term vs. long term survival.

2 - When is an Ounce of Prevention Worth a Pound of Cure? Finding High-Risk Patients for Case Management

David Anderson, CUNY Baruch, 55 Lexington Ave, New York, NY, 10010, United States of America, davidryberganderson@gmail.com, Margret Bjarnadottir

Studies on the cost-effectiveness of case management programs find that their performance is mixed, at best. In this paper we posit an opportunity to improve outcomes and lower costs by targeting certain patients for case management and early intervention. Utilizing modern data mining methods, we develop a methodology to identify these patients, whose costs are currently low but will increase significantly in the near future. We also show that unless case management can prevent over 7.5% of health care cost increases, it may benefit enrolled members but will not reduce overall costs.

3 - Approximation Methods for Determining Optimal Allocations in Response Adaptive Clinical Trials

Vishal Ahuja, Assistant Professor, Southern Methodist University, P.O Box 750333, Dallas, TX, 75275, United States of America, vahuja@smu.edu, John Birge

Response-adaptive clinical trials, where patient assignment to treatments evolves dynamically, offer potential for efficiency gains over traditional designs, and typically modeled as Bayesian adaptive MDP. A consequence of this setup is the increase in problem size, often exponentially, with trial size and complexity. We propose grid-based approximation as a way to reduce the problem dimensionality and the associated computationally burden, thus widening the scope of implementing adaptive designs.

4 - Dynamic Learning of Patient Response Types: An Application to Treating Chronic Diseases

Diana Negoescu, University of Minnesota, 111 Church St. SE, Minneapolis, MN, United States of America, negoescu@umn.edu, Kostas Bimpikis, Margaret Brandeau, Dan Iancu

Accurate biomarkers to routinely assess the effectiveness of treatments for chronic illnesses are not always available. Medical decision makers must learn about treatment effectiveness using noisy, subjective feedback from patients. We develop a model for choosing between treatments with unknown stochastic effectiveness, where the belief about effectiveness evolves dynamically and treatments may have side effects that decrease quality of life. We find analytical expressions, study structural properties for switching policies and illustrate our model in a case study on multiple sclerosis.

■ FB09

09-Cumberland 1

Data Driven Decision Models in Healthcare

Contributed Session

Chair: Joe Klobusicky, Applied Mathematician, Geisinger Health System, 100 N Academy Ave., Danville, PA, 17821, United States of America, jkklobusicky@geisinger.edu

1 - Patient-Centered Medical Decision Making Regarding Colorectal Cancer Screening

Magda Gabriela Sava, PhD Candidate, Joseph M. Katz Graduate School of Business, 241 Mervis Hall, Pittsburgh, PA, 15260, United States of America, mgsava@katz.pitt.edu, Luis G. Vargas, James G. Dolan, Jerrold H. May

Colorectal cancer is one of the leading causes of mortality, but it can be preventable using the available screening options. We use real patient data to assess the degree of improvement from the transition to a team-based model, as opposed to a patient-only structure. We also investigate how to use the AHP sensitivity and stability analysis into a higher dimensional space.

2 - Identifying Readmissions to a Cardiac Intensive Care Unit

Yazan F. Roumani, Assistant Professor, Oakland University, 342 Elliot Hall, Rochester, MI, 48309, United States of America, roumani@oakland.edu, Yaman Roumani, Joseph Nwankpa

We analyze ICU readmissions using Support Vector Machines (SVM), C5 and logistic regression (LR) with a variety of misclassification cost ratios (MCR). Using recall, specificity and confusion entropy, we show that C5 and SVM outperform LR in identifying patients who are more likely to be readmitted. Our findings could be utilized by ICU clinicians and administrators as a decision support tool for the early identification of patients who are more likely to be readmitted.

3 - Managing Admission, Discharge and Transfers (ADTs): Resilient Behavior under High Unit Workload

Anne Miller, Associate Professor, Vanderbilt University Medical Center, 1211 21st Avenue South, Nashville, TN, United States of America, Anne.miller@vanderbilt.edu, Anil Aswani, Jason Slagle, Mo Zhou, Dan France

High workload shifts are related to increased mortality. Effective management involves negotiating unit resources. This study explores relationships between unit telephone calls, ADTs and nurse to patient ratios (NPRs). Hourly ADT, NPR and phone call rates were collected for 2 years for 5 related units. Using linear regression, t-tests showed that telephone call patterns are related (Adj. R²=0.21) to NPRs and ADTs (e.g., high admissions, transfers and NPRs associated with more holds). Further research is needed to understand how these results are related to management practices and patient outcomes.

4 - Reducing Patient Overtesting via a Weighted Nearest Neighbor Algorithm

Joe Klobusicky, Applied Mathematician, Geisinger Health System, 100 N Academy Ave., Danville, PA, 17821, United States of America, jkklobusicky@geisinger.edu

Defensive medicine through excessive testing is commonly believed to be a significant contributor to accelerating healthcare costs. Current methods to mitigate this practice are typically based on clinical guidelines developed from aggregate data that are secondarily generalized, in a uniform fashion, to an entire patient cohort. The objective of this study is to provide a patient-specific, probabilistic analytic tool capable of informing real-time decision making for ordering additional lab studies for a specific patient.

■ FB10

10-Cumberland 2

Modeling Patient Flows in Hospitals

Cluster: Health Operations & Logistics

Invited Session

Chair: Michael Rossi, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, United States of America, mrossi09@gmail.com

1 - Predicting Number of Patient Admission Days using Disease Network

Pankush Kalgotra, Oklahoma State University, 102 GU OSU, Stillwater, Stillwater, OK, 74074, United States of America, pankush@okstate.edu, Ramesh Sharda, Bryan Hammer

Hospital observation care can be costly to hospitals due to limited beds, staff and equipment. The main goal of this study is to predict the length of stay of a patient in a US hospital on the basis of the primary disease diagnosis. We follow

a network approach to solve the problem. We build predictive models using network measures such as centrality and structural holes to predict the hospital stays. The novelty of this study is the use of network properties to make predictions.

2 - Improving Patient Flow with Data-Driven Patient Prioritization Method in the Emergency Department

Kar Way Tan, Assistant Professor of Information Systems (Practice), Singapore Management University, 80 Stamford Road, Singapore, 178902, Singapore, kwtan@smu.edu.sg, Sean Shao Wei Lam

We aim to improve the length-of-stay (LOS) of patients in the Emergency Department (ED) ambulatory care area. We propose the use of real-time computerized physician order entry data and ED patient flow management system to estimate the consultation time of patients re-entering the queue to consult a doctor again after receiving treatment or results of tests. The estimation allows decision-makers to apply dynamic prioritization strategies that help the ED to identify patients who can complete their ED treatment process quickly, freeing up resources in the ED and lowering overall LOS.

■ FB11

11-Cumberland 3

Session SIG Health

Cluster: Association for Information Systems SIG-Health

Invited Session

Chair: Benjamin Schooley, Assistant Professor, University of South Carolina, 1301 Gervais St., Columbia, SC, 29072, United States of America, bschooley@hrsm.sc.edu

1 - Health Behavior Change Support System Impact in China

Doug Vogel, eHealth Research Institute Director, Harbin Institute of Technology, School of Management, Harbin, China, isdoug@hit.edu.cn

Healthcare is at a time of crisis. Increasingly, though, there is a plethora of data available to assist in chronic disease prevention and early detection as well as home-based monitoring to maximize treatment effectiveness and minimize ongoing hospital visits. Group Support Systems (GSS) provide a convenient and efficient mechanism to engage multiple stakeholders to seek solutions to data management issues in implementing the kinds of Health Behavior Change Support Systems (HBCSS) that have the potential to be effective. Research in progress at the Harbin eHealth Research Institute is seeking to address this situation in a series of studies using an action design research approach.

2 - Predicting Physicians' Intention to use Information Technologies: The Role of Prior Behavior

Neset Hikmet, Associate Professor, University of South Carolina, 1301 Gervais St., Columbia, SC, 29072, United States of America, nhikmet@hrsm.sc.edu, Ben Schooley

This study examines factors to predict physicians' intention to use health information technology (HIT). The specific HIT examined is a tablet computer used by physicians to access the hospital systems EHR in outpatient physician practices. Using the theory of planned behavior, we found that physicians' performance expectancy, social influence, perceived behavioral control, and prior usage behavior were significant predictors of their future HIT usage intention. We describe how this theory can be extended using other salient constructs.

3 - Improving Provider-patient Communications with Mobile Multi-media Computing

Tonia San Nicolas-rocca, Assistant Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States of America, tonia.sannicolas-rocca@sjsu.edu, Ben Schooley

This study investigated the design of a mobile assisted video and 3D image instruction system to aid healthcare workers to communicate instructions to patients. The system was used in an outpatient clinic setting and evaluated based on two provider-patient communication outcomes: 1) patient understanding about their condition and medical instructions; and 2) patient perceptions toward their health care providers. Results showed strong evidence that the system was perceived as helpful for improving patient understanding, and that it improved communication between physicians and patients.

■ FB12

12-Cumberland 4

Outpatient Appointment Scheduling

Cluster: College of Healthcare Operations Management, Production and Operations Management Society

Invited Session

Chair: Kenneth Klassen, Professor, Brock University, Dept of FOIS, Goodman School of Business, St Catharines, ON, L2S 3A1, Canada, kklassen@brocku.ca

1 - A Decision Support System for Appointment System Templates with Operational Performance Targets

William Millhiser, Associate Professor, Baruch College, Zicklin School Of Business, One Bernard Baruch Way, Box B9-240, New York, NY, 10010, United States of America, william.milhiser@baruch.cuny.edu, Emre Veral

We present a web-based appointment scheduling system for outpatient services where appointment templates meet user-defined operational targets based on probabilities of achieving conflicting goals: managed/fair waiting times, dependable session end times, and minimal unintended idle time for providers. Using historical service times and an underlying model based on prior research, we demonstrate that appointments that meet these operational targets can be scheduled in a real-time environment, while the software provides dynamic assistance in selecting appointment slots.

2 - Appointment Scheduling with Multiple Providers and Stochastic Service Times

Mohamad Soltani, PhD Student, University of Alberta, 2-24 Business Building, Edmonton, AB, T6G 2R6, Canada, soltani@ualberta.ca, Michele Samorani, Bora Kolfal

We consider a multi-server appointment scheduling problem in which patients may not show up, and those who show up require stochastic service times. We model this problem to evaluate each candidate solution. We statistically find some properties for the optimal or near optimal solutions, and design a simulation optimization approach using these properties. We also propose a heuristic algorithm, and validate its performance by comparing its result with our simulation optimization approach.

3 - Multi-Stage Outpatient Clinics: Appointment Schedules that Improve Performance

Kenneth Klassen, Professor, Brock University, Dept of FOIS, Goodman School of Business, St Catharines, ON, L2S 3A1, Canada, kklassen@brocku.ca, Reena Yoogalingam

This study considers the design of appointment schedules in a multi-stage environment. In this scheduling framework, a mid-level service provider (MLSP) may see a patient before the physician. The purpose of this paper is to determine the circumstances under which a MLSP becomes the best strategy for a clinic for improving clinic operations and to consider the best schedule and optimal sequencing of patients in such cases.

■ FB13

13-Cumberland 5

Hospital Operations: Scheduling

Cluster: College of Healthcare Operations Management, Production and Operations Management Society

Invited Session

Chair: Cecilia Zenteno, Massachusetts General Hospital, 55 Fruit Street, White 400, Boston, MA, 02114, United States of America, azenteno@mg.harvard.edu

1 - Operating Room Scheduling under Waiting Time Constraints: The Chilean AUGE Program

Javiera Barrera, Assistant Professor, Universidad Adolfo Ibañez, Diagonal Las Torres 2640, Edificio C, Santiago, RM, 7941169, Chile, javiera.barrera@uai.cl, Susana Mondschein, Rodrigo A. Carrasco

Although scheduling surgeries in operating rooms is a well-known problem, the introduction of the AUGE plan in Chile adds a new complexity. This plan provides a set of guarantees for patients which includes that surgeries that are not performed within a maximum time frame in the public system are deferred incurring in additional costs. We propose a two-level stochastic formulation: at the higher level, we solve an aggregated problem, and use this solution as an input for the lower level problem.

2 - Adaptive Robust Optimization of Surgery and Downstream Capacity Planning

Saba Neyshabouri, George Mason University, 4400 University Drive, MS 4A6, SEOR Dept., Fairfax, VA, 22030, United States of America, sneyshab@gmu.edu, Bjorn Berg

Delivering high quality care requires coordinated planning when care is provided in sequential stages. We present a stochastic optimization model to schedule surgeries with limited downstream capacity. The model includes uncertainty in surgery duration as well as the subsequent length-of-stay. We use adaptive robust optimization to model the dynamic nature of process. Decomposition-based solution methods are used to solve problem instances. Managerial insights based on the model are presented.

3 - Smoothing Resource Utilization in a Large Cancer Center Infusion Unit

Cecilia Zenteno, Massachusetts General Hospital, 55 Fruit Street, White 400, Boston, MA, 02114, United States of America, azentenolangle@mgh.harvard.edu, Wendi Rieb, Retsef Levi, Inga Lennes, Mara Bloom, Peter Dunn, Bethany Daily

We describe a data-driven online scheduling algorithm that aims at smoothing the intra-day resource utilization in a large Infusion Unit. Part of the Massachusetts General Hospital Cancer Center, the unit currently experiences midday congestion even if its daily average utilization is 55%. Based on integer optimization and simulation techniques, the algorithm incorporates all relevant clinical and operational constraints. The projected impact is a 30% reduction in the peak's average utilization.

■ FB14

14-Cumberland 6

Healthcare Policy

Contributed Session

Chair: Joris Klundert, Department Chair, Erasmus University Rotterdam, Burg Oudlaan 50, iBMG, Rotterdam, 3000 DR, Netherlands, vandeklundert@bmg.eur.nl

1 - Health Policy Mapping

David Sulek, Principal Director, Booz Allen Hamilton, 901 I Street, NW, Washington, DC, 20005, United States of America, sulek_david@bah.com, Michael Mayer, Athena Tang

Policy mapping is an analytic service that enables strategic decision-making in complex, interagency policy environments. Generating a visual mapping of a policy landscape provides clients with a unique, holistic perspective on policies that affect them and their stakeholders. This enables an organization to increase awareness of existing policy while providing a framework for anticipating and adjusting to new legislation or policy that may be developed. Policy mapping can also enable clients to foresee and react to potential points of friction (i.e., conflicts, overlaps) and can position them to make strategic, data-driven decisions. For this presentation, the team will highlight practical applications of this technique in the healthcare space, including a mapping of ACA implementation (payer/provider) and food security legislation (life sciences).

2 - Equity and Efficiency in the Allocation of Health Care Resources

John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, jh38@andrew.cmu.edu, H. Paul Williams

We address the distribution of health care resources so as to take into account both equity and efficiency. Rather than model the problem as multi-criteria optimization, we use a single-objective model with an equity-sensitive Rawlsian lexmax criterion that becomes progressively utilitarian as marginal costs rise. We derive a nonobvious MILP formulation whose LP relaxation describes the convex hull of the feasible set (before side constraints are added). We apply it to a health care planning problem based on realistic cost and demand data and interpret the results.

3 - Health Value Analysis of Allocation Policies in Kidney Exchange

Joris Klundert, Department Chair, Erasmus University Rotterdam, Burg Oudlaan 50, iBMG, Rotterdam, 3000 DR, Netherlands, vandeklundert@bmg.eur.nl

The allocation policy used in kidney exchanges substantially affects the outcomes of the exchanges as it determines which patient-donor pairs are involved in an exchange and with whom they exchange. In this paper we analyze the health outcomes of various previously proposed allocation policies and propose a new policy intended to maximize health value. We present a new Markov model for the dynamic health status of patients and conduct long term simulations with kidney exchange data from the Netherlands. In order to maximize health outcomes we combine the Markov chain model with a branch-and-price algorithm for optimal matching. Our results indicate that the sum of quality adjusted life years can be improved by 6% over current practice without reducing equity or the number of transplants.

Friday, 11:30am - 1:00pm

■ FC01

01-Broadway A

Big Data Analytics in Medicine

Sponsor: INFORMS Analytics Section

Sponsored Session

Chair: Daniel Conway, Director, Mba In Analytics, Loras College, 1450 Alta Vista Drive, Dubuque, IA, 52001, United States of America, Daniel.Conway@loras.edu

1 - Personalized Medicine: Managing Expectations so that Big Data does not Lead to Big Mistakes?

Dale Lehman, Professor Of Business Administration, Loras College, 1450 Alta Vista, Dubuque, IA, 52001, United States of America, dale.lehman@loras.edu, Daniel Conway

"Personalized Medicine" is a rapidly growing industry that relies on predictive modeling techniques, often using "big data." However, the (in)accuracy of predictions is not fully appreciated by practitioners, patients, or even analysts. We explore these issues, focusing on both predictive accuracy and the inherent uncertainty in probabilistic estimates that result from modern predictive modeling. We also discuss the importance of communicating probabilistic predictions of diagnoses and treatments to potential patients.

2 - Predicting Surgical Site Infections in Real-Time

Nick Street, University of Iowa, United States of America, nick-street@uiowa.edu, John Cromwell, Akpene Gbegnon, Jose Monestina

Surgical site infections (SSIs) are a major cause of morbidity, mortality, and hospital readmissions in general surgery patients. Real-time prediction of risk is needed prior to and during the time of an operation so that preventative strategies can be applied. We develop classifiers that can be used in real-time by combining operative data entered through a web interface and patient variables extracted from the EHR, to predict patients at risk for SSIs within 30 days of their operation, even before the patient leaves the operating room. In this talk we discuss data pre-processing, analyze the effectiveness of hte classifiers, and identify the most important predictors.

3 - Applying Parametric and Non-parametric Modeling to Crowd-source Red Blood Cell Transfusion Decisions

Rhiannon Harms, Executive Director, Strategic Improvement and Planning, UnityPoint Health, 350 N. Grandview Avenue, Dubuque, IA, 52001, United States of America, rhiannon.harms@unitypoint.org, Benjamin Cleveland

We decompose blood transfusion decisions into the probability that a patient requires an RBC transfusion and, given that a transfusion is required, the expected number of units transfused, to develop expected RBC utilization. We develop statistical models to assess transfusion practice. UnityPoint Health utilizes this methodology to inform ongoing professional practice evaluation of physicians as required by the Joint Commission. Since its adoption, hundreds of patients in UnityPoint Health didn't receive a blood transfusion who, based on previous evidence and insight, would likely have received a transfusion.

■ FC02

02-Broadway B

Optimization Applications in Healthcare

Contributed Session

Chair: Neelima Ramaraju, Director, Global Health Applications, LLamasoft, 201 S Main st, Suite 400, Ann Arbor, MI, 48104, United States of America, neelima@llamasoft.com

1 - Generating Well-Dispersed Representations for Multiobjective Radiation Treatment Planning

Gokhan Kirlik, Postdoctoral Researcher, University of Maryland School of Medicine, 22 South Greene Street, Baltimore, MD, 21201, United States of America, gokhankirlik@umm.edu, Hao Zhang

The challenge in radiation treatment planning is to ensure delivery of the prescription dose to the tumor while limiting normal tissue toxicity. One way of dealing with these trade-offs is to use multiobjective optimization. In this study, we present a method that generates well-dispersed representations of the nondominated set for multiobjective optimization problems. We demonstrate this approach on generating treatment plans for locally advanced head neck cancer cases.

2 - Pharmaceutical Launch Optimization under International Reference Pricing

Ivan Oliveira, Director, Advanced Analytics, SAS, 100 SAS Campus Dr, Cary, NC, 27513, United States of America, Ivan.Oliveira@sas.com, Patrick Homer

Countries often impose International Reference Pricing for pharmaceutical products that launch in global portfolios. We present a formal mathematical methodology that has been implemented in global pharmaceutical companies in practice to determine optimal launch sequences. We evaluate the effectiveness of simple rule-of-thumb practices commonly used in the industry and demonstrate ways to visualize results and implement the capability.

3 - Inventory Routing Problem on Blood Collection and Management: A Case Study for a Regional Blood Bank

Rizvan Erol, Cukurova University, Cukurova University Industrial, Engineering Department Balcali Campus, Adana, 01330, Turkey, rerol@cu.edu.tr, Yusuf Kuvvetli, Elifcan Gocmen

People are in need of blood products because of accidents, illnesses etc. Therefore, blood should be stored on blood banks to serve people at any time. Blood is perishable: therefore, inventory levels should be well managed to meet both regular and emergency demands. In this study, an inventory routing problem is presented for finding the delivery routes and inventory levels from distribution centers to hospitals to minimize transportation, operating and inventory costs.

4 - Route Design and Fleet Optimization for Last-Mile Delivery of Essential Medical Products

Neelima Ramaraju, Director, Global Health Applications, LLamasoft, 201 S Main St, Suite 400, Ann Arbor, MI, 48104, United States of America, neelima@llamasoft.com

This paper documents the use of Transportation Guru™, a user-friendly vehicle routing and network optimization tool from LLamasoft™, in planning last-mile delivery networks (routing, fleet-sizing, costing, etc.) for essential medical products in Sub-Saharan Africa. Methods to address unique challenges related to fleet types, capacities, road conditions, product characteristics and seasonal constraints are discussed. Challenges to performing such analyses and to scaling such studies are also discussed. Examples of field studies performed in several African countries are discussed.

■ FC03

03-Broadway C

Surgery Sheduling

Contributed Session

Chair: Sandeep Rath, PhD Candidate, UCLA Anderson, B501 Gold Hall, Los Angeles, CA, 90024, United States of America, sandeep.rath.1@anderson.ucla.edu

1 - Day Surgery Scheduling as a Three-Station Flow Shop Scheduling Problem

Xue Bai, Assistant Clinical Dept. Manager, West China Hospital of Sichuan University, NO.37 Guo Xue Xiang Chengdu P.R. China, ChengDu, 610064, China, baixueer19861017@163.com, Li Luo

We develop models for scheduling the three stages of day-surgery as the three stage flow shop scheduling problem (FSSP). We formulate a mixed integer linear programming (MILP) problem with priorities using data from a Chinese Hospital. Computational experiments with the MATLAB 7.0 base on the genetic algorithm design are reported. We find that optimal scheduling strategy can not only minimize the make-span of the whole day surgery process but also adjust the scheduling result in time when another priority surgery comes in.

2 - Optimization for Elective Surgery Scheduling: From Tactical to Strategic

Olivia Smith, IBM Research - Australia, 204 Lygon St, Carlton, VI, 3053, Australia, livsmith@au1.ibm.com, Hamideh Anjomshoa, Irina Dumitrescu

We consider the problem of optimizing the surgery schedules for an Australian hospital with many competing constraints and objectives. The purpose of this talk is to discuss scheduling methods based on mathematical optimization. In particular, we consider how a model designed for relatively short term decision making can be extended to the longer term. We compare different possible extensions regarding computational effort, quality of solutions, and usefulness of the model for decision making.

3 - A Mixed Integer Programming Approach to Next Day Surgery Scheduling with Simultaneous Decision

Halil Ibrahim Guenduez, Post Doc, RWTH Aachen University, Kackertr. 7, Aachen, 52072, Germany, guenduez@dpor.rwth-aachen.de, Martin Westhofen, Martin Nikolas Baumung, Hans-Juergen Sebastian

The presentation will mainly focus on the next day scheduling for the Clinic for Otorhinolaryngology and Plastic Surgery of the Head and Throat at University Hospital Aachen where, rather than scheduling surgeries for a whole week, a subset from all upcoming elective surgeries needs to be selected and scheduled for the next day. This task comprises allocating an operating room and a surgeon to each surgery and determining the start and ending times of each surgery. Surgeries are selected with regard to different priorities reflecting the urgency, the number of times a surgery has been postponed, etc. and the scheduling is performed in such a way that the utilization of the operating rooms is maximized. Surgeons are allocated to surgeries according to their professional qualifications and perform surgery in blocks if possible. In this work, we refer to blocks as an uninterrupted sequence of consecutive surgeries in the same operating room. For solving this problem, we propose a mixed integer linear programming model that addresses the above mentioned decisions simultaneously.

4 - Integrated Staff and Room Scheduling for Surgeries: Methodology and Application

Sandeep Rath, PhD Candidate, UCLA Anderson, B501 Gold Hall, Los Angeles, CA, 90024, United States of America, sandeep.rath.1@anderson.ucla.edu, Kumar Rajaram

We consider the problem of minimizing expected resource usage and overtime costs across multiple parallel resources such as anesthesiologists and operating rooms which are used to conduct a variety of surgical procedures at large multi-specialty hospitals. We develop a data driven robust optimization method that solves large-scale real-sized versions of this model close to optimality. The model is currently in the process of being implemented at UCLA Ronald Reagan Medical Center.

■ FC04

04-Broadway D

Disease Modeling ñ II

Cluster: Disease Modeling and Economic Evaluation

Invited Session

Chair: Yasin Ceran, Santa Clara University, Santa Clara, CA, United States of America, yaceran@gmail.com

1 - Exercise Capacity and Mortality in Veterans With and Without Type-2 Diabetes: An Analysis using Propensity Matching

Yasin Ceran, Santa Clara University, Santa Clara, CA, United States of America, yaceran@gmail.com, Mehmet A. Baktir, Jonathan Myers, Yasin Ceran

In this study, we used a cohort of veterans with and without Type-2 diabetes to assess the association between exercise capacity and mortality using a propensity score matching method. Although the trend in the association between exercise capacity and all-cause-mortality was similar for matched and unmatched data, the mortality risks were relatively inflated when using unmatched data.

2 - Preference-Sensitive Risk Cutoff Values for Prenatal Integrated Screening Test for Down Syndrome

Jia Yan, Georgia Institute of Technology, Atlanta, GA, United States of America, jyan40@gatech.edu, Pinar Keskinocak, Turgay Ayer, Aaron B. Caughey

Down syndrome (DS) is the most common chromosomal abnormality. Currently a one-size-fit-all risk cutoff value is used in DS screening to identify women with a high risk of having a DS baby and recommend an invasive diagnostic test as a follow-up. However, this one-size-fits-all type of risk cutoff value cannot capture various preferences of pregnant women about pregnancy outcomes. In this study, we assess the impact of women's preferences on the optimal DS risk cutoff values of integrated screening.

3 - Data-driven Personalized Treatment Design for Managing Multiple Health Conditions

Xin Wei, Georgia Tech, Atlanta, Georgia, xwei36@gatech.edu, Eva Lee

This is joint work with Grady Hospital and Emory University. Managing multiple conditions is challenging and complex. This talk will present a personalized treatment paradigm where treatment evidence will be uncovered and then incorporated within a single modeling framework. The objective is to optimize the outcome while minimizing polypharmacy. Results for real-patient cases will be presented.

■ FC05

05-Broadway G

Quality in Healthcare

Contributed Session

Chair: Seamus McKinsey, Booz Allen Hamilton, 901 15th Street NW, Suite 300, Washington, DC, 20005, United States of America, mckinsey_seamus@bah.com

1 - Implementation of Online Dashboard to Support Specialty Access Improvement

Rachel Weber, Management Engineer, Rady Children's Hospital-San Diego, 510 Nautilus St, Apt 2, La Jolla, CA, 92037, United States of America, rachel.weber@healthcareie.com, Abbey Tadlock

Pediatric specialty care faces potential challenges in achieving timeliness and equity of care due to high demand for finite resources. Rady Children's Hospital and Health Center set out to manage patient access to their specialty divisions to ensure a reasonable delay of 10 days from request for appointment until date of appointment. Additionally, they wanted to ensure that the same reasonable delay was experienced by all patients. Through mapping, measurement, and the implementation of an online dashboard, the number of specialties with a delay under 10 days has grown from 8 to 13.

2 - Patient-Minded Use of Healthcare Information Systems and Specified Organizational Routines

John Gardner, Brigham Young University, 663 TNRB, Provo, UT, 84663, United States of America, johnwgardner@byu.edu, Kenneth Boyer, Peter Ward

The enactment of affordances from IT requires joint consideration of the actual IT as well as organizational attributes or processes. We use split-group structural equation modeling (SEM) to empirically examine the use of IT through the lens of organizational mindfulness, simultaneously with adherence to organizational routines. The hospital serves as the unit of analysis. We use time-sequenced data from multiple independent sources to test clinical performance across 262 U.S. hospitals and find contrasting results in hospitals with low versus high IT adoption.

3 - Role of IT Architecture on HIT-Induced Error: A Conceptual Study

Rishikesh Jena, University of Arkansas, 204 Business building, Fayetteville, AR, 72701, United States of America, rjena@uark.edu, Sankara Subrama Srinivasan

This project examines the effect of healthcare IT (HIT) on technology induced errors, known as HIT-induced error. While empirical evidence suggests that HIT reduces medical error, extensive use of HIT can potentially introduce new types of error. This project proposes that flexible HIT architecture will have a positive effect in reducing HIT-induced errors. Given that very few IS studies have looked into the effect of HIT artifact and its influence on healthcare outcomes, this research contributes to literature on the role of HIT artifact and the effect on outcomes of "meaningful use," specifically the impact on technology induced medical error. By articulating the role of HIT artifact on technology induced medical errors, the research highlights the need to focus on the growing concerns of the unintended consequences of HIT.

4 - Quality Measurement Model

Seamus McKinsey, Booz Allen Hamilton, 901 15th Street NW, Suite 300, Washington, DC, 20005, United States of America, mckinsey_seamus@bah.com, David Sulek, Tanya Alteras, Tori Adams

The shift towards patient-centered care delivery and value-based payment models requires robust measures of health care quality, yet little is known about the relative costs and benefits of quality measures. Booz Allen is modeling the relationship between measures, collection and reporting burden, and outcomes of cost and quality. A systems dynamics model will project costs and benefits of interacting risks and interventions, and stochastic optimization techniques will approximate optimal measure sets under uncertainty and with a large number of variables.

■ FC06

06-Broadway H

Patient Flow Decision Models

Contributed Session

Chair: Thiago Amaral, Dr., Universidade Federal do Vale do S, o Francisco, Colegiado de Engenharia de Produçã,o - UN, Juazeiro, Brazil, prof.thiago.magalhaes@gmail.com

1 - Dynamic Scheduling of a Post-Discharge Follow-Up Organization to Reduce Readmissions

Xiaoyang Yu, Indiana University Bloomington, 2001 E. Lingelbach Ln Apt 325, Bloomington, IN, 47408, United States of America, xy9@indiana.edu, Jonathan Helm, Shanshan Hu

Hospital readmissions are a growing problem. Many readmissions are preventable by properly monitoring patients post-discharge. We consider an organization that dynamically will schedule and staff post-discharge monitoring schedules for a cohort of patients being randomly discharged from client hospitals. We formulate this problem as an infinite horizon dynamic program that can be solved using approximate dynamic programming that leverages analytical results from a stylized version of the problem. Results are demonstrated using data from multiple hospitals over a 6 year period.

2 - Flow Mapping and Simulation in the Public Healthcare System in an Emergency Unit in Juazeiro-BA

Thiago Amaral, Dr., Universidade Federal do Vale do São Francisco, Colegiado de Engenharia de Produção - UN, Juazeiro, Brazil, prof.thiago.magalhaes@gmail.com, Carlos Arcanjo, Ana Souza

We develop process maps and use discrete event simulation of an Emergency Unit to identify system bottlenecks in order to improve patient flow. Several problems were identified - one of the most aggravating is that more than 50% of patients, who should stay for a maximum of 24 hours, exceed this time, compromising the quality of service. Actions were proposed through quality tool of Ishikawa Diagram, analyzing the root causes of problems faced by the Emergency and Urgency departments. In conclusion, this study highlights the possibility to mathematically identify the processes bottlenecks. This shows problems were not previously noticed by the direction, which provides a scientifically supported decision-making.

■ FC09

09-Cumberland 1

Creating Value, Staff and Patient Satisfaction

Contributed Session

Chair: John Huppertz, Associate Professor, Union Graduate College, 80 Nott Terrace, Schenectady, NY, 12308, United States of America, huppertj@uniongraduatecollege.edu>

1 - An Innovative Model to Deliver Value-Based Care

Min Chen, Assistant Professor, Florida International University, 10200 SW 8th St, Miami, FL, United States of America, minchenchen@gmail.com

This paper presents an innovative operational model that takes patient severity, scheduling flexibility and coordination into account. Data obtained from a group practice based in Florida show that such patient-centered approach is associated with a decrease in hospitalization and an increase in patient satisfaction.

2 - Evaluation of Universal Health Coverage in Indonesia: System Dynamics Approach with Value Co-Creation

Irsanti Hasyim, Student, Tokyo University of Science, 2641 Yamazaki Noda Community House S4011, Noda, 2780022, Japan, irsanti.hasyim@gmail.com, Ryuta Takashima, Takamori Ukai, Santi Novani

Indonesian government implemented new social security system in 2014, which targeted to cover all population with health insurance by 2019. With the scope of Bandung City, the aim of this research is to gain a better understanding of system behavior by means of system dynamic with value co-creation concept in order not only to better manage the system but also to give suggestion in form of new policy and various scenarios.

3 - Predicting Patient Satisfaction from Comments on Hospitals' Social Media Pages: A Sentiment Analysis

John Huppertz, Associate Professor, Union Graduate College, 80 Nott Terrace, Schenectady, NY, 12308, United States of America, huppertj@uniongraduatecollege.edu>, Peter Otto

Social media platforms, such as Facebook, are an important medium that can help hospitals to obtain unbiased sentiments from patients on quality care. However, in spite of their potential value there has been little empirical research into how the quality perceptions of what patients say on Facebook correlated with what they actually experienced. Our research addresses these deficiencies by using a linguistic analysis, derived from statistical natural language processing (NLP), to compare sentiments from hospitals Facebook sites with the HCAHPS survey of discharged patients. Findings suggest that what patients say on Facebook about their experience with a hospital correlates with the discharge survey results. The results of the research also suggest that Facebook comments can serve as an early warning system to hospital administrators, alerting them to problems in the organization before they receive formal documentation in the form of HCAHPS survey results.

■ FC10

10-Cumberland 2

Data-Driven Decisions in Healthcare

Cluster: Health Operations & Logistics

Invited Session

Chair: Mohsen Bayati, Stanford University, 655 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu

1 - Evidence of Strategic Behavior in Medicare Claims Reporting

Hamsa Bastani, Stanford University, 10 Comstock Circle, Apt 304, Stanford, CA, 94305, United States of America, hsrldhar@stanford.edu, Mohsen Bayati, Joel Goh

Upcoding is the practice where medical providers alter claims data to receive increased reimbursement. We present a novel approach using instrumental variables and a double regression to determine the extent of upcoding of hospital-acquired conditions in the United States. We also make several policy recommendations based on our results.

2 - Forecasting Emergency Department Wait Times

Sara Kwasnick, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94114, United States of America, kwasnick@stanford.edu, Erjie Ang, Erica Plambeck, Mohsen Bayati, Michael Aratow

We propose and implement a method for accurately forecasting wait times for low-acuity patients in an emergency department. We validate the method's performance using historical and post-implementation data from four hospitals. We also describe post-implementation impacts of wait time information on patient behavior.

3 - Low-cost Multiple Disease Prediction

Mohsen Bayati, Stanford University, 655 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu, Andrea Montanari, Sonia Bhaskar

Recently, in response to the rising costs of healthcare, most companies offer wellness programs to help high risk employees for developing chronic disease, identified via a low-cost screening procedure. This talk is about derivation and validation of a low-cost and accurate disease screening method via high-dimensional multi-task learning.

■ FC14

14-Cumberland 6

Analytical Applications with Diseases

Contributed Session

Chair: Abdulaziz Alkabaa, University of Tennessee, 1001 Cain Oak Place, 1001, Knoxville, TN, 37909, United States of America, aalkabaa@vols.utk.edu

1 - An Application of Model-Based Analytics in Risk-Based Monitoring in Clinical Trials

Rajneesh Patil, Quintiles, 5827 South Miami Blvd, Morrisville, NC, 27560, United States of America, Rajneesh.Patil@Quintiles.com, Xiaoqiang Xue, Chao Deng

This project addresses: how can we identify clinical trial quality issues upfront, and how can we improve investigative site performance? We developed an interactive integrated analytics tool that transforms sophisticated statistical analysis into insightful information and actionable decisions. For a given risk level, the analysis identifies those investigative sites and their associated data points that exhibit higher risk potentials compared to their peers. This practice can enable the study team to target and prioritize resources around identifiable risks relating to subject safety and investigative site performance.

2 - Probabilistic Principle Component using CICOMP with Logistic Regression on Cancer Tissues

Abdulaziz Alkabaa, University of Tennessee, 1001 Cain Oak Place, 1001, Knoxville, TN, 37909, United States of America, aalkabaa@vols.utk.edu, Hamparsum Bozdogan

This research presents the Probabilistic Principle Component Analysis (PPCA) in the estimated kernel density using the Asymptotic Mean Integrated Squared Error (AMISE) with optimality criterion used to select bandwidth, for smoothing purposes. In 2000 genes data sets for colon cancer tissues were collected for 62 patients classified as 22 normal and 40 tumor. Using the Constant Information Complexity (CICOMP) to select the best number of principle components and compare those with the traditional way of PPC. Finally, we are going to fit a logistic regression framework with the inverse of the Sigmoidal logistic function Logit as link function on the first 200 genes after applying PCA, and chose the best PCs through stepwise subset selection method as our new predictors to build the logistic regression model and eventually addressing which genes are responsible to the tissue types.

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 Ganju, Kartik FA06
 Gao, Guodong (Gordon) WA13, FA05
 Gao, Yu TD07
 Gardner, Christopher Poster
 Gardner, John FC05
 Gardner, Leslie FA03
 Garifullin, Maxim Poster
 Garimella, Kiran TD01
 Garrido, Terhilda TA01
 Gartner, Daniel Poster, TD06, FA06
 Gbegnon, Akpene FC01
 Gentilcore, Anastasia Poster
 Gentili, Monica WE12
 Gentry, Sommer TB10
 Ghahestani Bojd, Behnaz TC09
 Ghate, Archis TD03
 Ghosh, Kaushik TA09
 Gianetto, David FA14
 Gillens, Benjamin (Eric) TB03
 Gilli, Quentin FA03
 Gloor, Peter TD09
 Gocmen, Elifcan WA14, FC02
 Goeble, Jens FA11
 Goh, Joel TA07, FC10
 Goh, Pak Liang FA14
 Gohagan, John Poster
 Golden, Bruce FA10
 Goldhaber-Fiebert, Jeremy WA07, FB07
 Goldlust, Eric Poster
 Goldstein, Susan WE03
 Golmohammadi, Davood WE13
 Goloub, Jonathan FA12
 Gopalappa, Chaitra TD08
 Green, Brian TC11
 Green, Linda TC12
 Griffin, Jacqueline TD03

Griffin, Jennifer WA08
 Grimm, Jodi TA01
 Grippa, Francesca TD09
 Grum, Mark WC07
 Guardiola, Ivan G. WE12
 Guenduez, Halil Ibrahim FC03
 Guffey, Patrick TA02
 Gullu, Refik FB07
 Gupta, Ashish WA14
 Gupta, Diwakar TC01
 Gupta, Diwaker TA12, TC07
 Gupta, Mayank WA06
 Gupta, Rajnish TA02
 Gurvich, Itai WA12

H

Hagedorn, Brittany TA14
 Hall, Peter FA11
 Hammer, Bryan FB10
 Han, Sang-Pil TD09
 Hansen, John H. L. TC02
 Hao, Haijing TD05
 Harati, Pravara WE12
 Hardisky, Joseph TC14
 Harms, Rhiannon FC01
 Harper, Paul TC03
 Harris, Anthony TD07
 Harris, Shannon TB13
 Hassan Zadeh, Amir Poster
 Hassani Goodarzi, Shadi FA07
 Hasyim, Irsanti FC09
 Hazen, Gordon WE07
 He, Qie TD03
 Heatherly, Raymond WE03
 Heaton, Pamela FA11
 Heching, Aliza WE10
 Heien, Christopher WA08
 Heim, Joseph A. WA11, WE11
 Helm, Jonathan WC03, WC12, TA12, TC07, TC08, TD12, FA05, FA13, FC06
 Henderson, Shane WC04
 Heydari, Babak FA14
 Hickey, Ed WC01
 Hicklin, Karen TD11
 Higle, Julia TA11
 Hikmet, Neset FB11
 Hockenberry, Jason TB09
 Hodor, Paul Poster
 Homer, Patrick FC02
 Hong, Young-Chae WA06
 Hooker, John FB14
 Hopp, Wallace WA13
 Hostetler, Seth WA06
 Hravnak, Marilyn WC06
 Hribar, Michelle Poster
 Hu, Michael TC07
 Hu, Shanshan FC06
 Hu, Xia FA10
 Huang, Hao WA11
 Huang, Kai TB11
 Huang, Shuai WE05, TD11
 Huda, Ahsan Poster
 Hughes, Elliott Poster
 Huh, Tim TC12
 Huppertz, John FC09
 Huschka, Todd FA13
 Hutton, David FB04
 Hwang, Chao-wei FB06

I

Iancu, Dan FB08
 Ilies, Iulian TC11
 In, Joon TD14
 Ingolfsson, Armann WE02, TA07, TB14
 Irvin, Nate TB07
 Ivy, Julie S. WE08, TD11, FA07

J

Jackson, Edmund WC01
 Janos, Kayla Poster
 Jarvenpaa, Sirkka TD09
 Jena, Rishikesh FC05
 Johnson, M. Eric TD05, FA09
 Jola-Sanchez, Andres FA05
 Jones, Ian WC14
 Jones, Spencer TB01
 Jordan, Victoria WA05, TA01, TC01
 Joshi, Kris WB01
 Jung, Changmi TB09

K

Kahana, Eva TA03
 Kahng, Minsuk WA06
 Kalgotra, Pankush FB10
 Kamali, Michael WC07
 Kamath, Janine TA01
 Kaminsky, Philip TC08
 Kan, Chen WC03, WE04
 Kan, Ethel Poster
 Kang, Hyojung WA06
 Kantarcioglu, Murat WE03
 Kapadia, Sagar WA14
 Kapoor, Bhushan TB06
 Karaca, Zeynal WA09
 Karambelkar, A. TD06
 Karanfil, Ozge WE04, TA11
 Karimi, Elnaz FA03
 Kasaie, Parastu FA12
 Katsipis, Iakovos TA14
 Kaufman, David TD12, FA13
 Kaufman, Laura TC02
 Kayis, Enis FB07
 Kazemian, Pooyan TC08
 KC, Diwas WE02
 Keil, Mark TC06
 Keller, Robin TD04
 Kelton, Christina FA11
 Keskin, Burcu FA10
 Keskinocak, Pinar TC04, TD08, FC04
 Ketterer, Ashley TB03
 Khan, Muna FB01
 Khaniyev, Taghi FB07
 Kheong, Ooi Chee Poster
 Khojandi, Anahita WC08
 Khuntia, Jiban TA09, WE09
 Kilambi, Vikram TB10
 Kim, Sang-Pil TB12
 Kim, Song-Hee WE02
 Kim, Yeongin WA09
 Kin, Ong Poon Poster
 Kirksey, Kirk TC06
 Kirlik, Gokhan FC02
 Klassen, Kenneth FB12

Klobusicky, Joe FB09
 Klundert, Joris TA07, TB08, FB14
 Kohnke, Emily TD14
 Kokangul, Ali WA14
 Kolfal, Bora FB12, TA07
 Kong, Chung Yin WA07
 Kong, Nan WC05
 Kortbeek, Nikky TD02
 Kotapuri, Eliezer TC14
 Kotas, Jakob TD03
 Kramer, Barnett Poster
 Krikorian, Mariam WE14
 Kucukyazici, Beste WC07, TA04
 Kulkarni, Vidyadhar TD11
 Kumar, Vikas WA06
 Kumara, Soundar WC08, WE04
 Kuntz, Karen WA07
 Kuvvetli, Yusuf FC02
 Kwasnick, Sara FC10
 Kwon, Hyeokoo Eric TD09
 Kwon, Juhee TD05, FA09

L

Laber, Eric WA04
 Lal, Geeta TB14
 Lam, Sean Shao Wei Poster, FB10
 Langston, Steve FA03
 Lantzy, Shannon FA09
 Larson, Jean Ann FA01
 Lau, Boon Yong TC14
 Lavieri, Mariel TC04, TC07, TC08
 Lawrence, Christie WA01
 Leder, Kevin TD03, WA04
 Lederle, Mike WE14
 Lee, Donald FA04
 Lee, Elliot TC08
 Lee, Eva WA05, WC04, WC06, TC10, FC04
 Lee, Kun Chang Poster
 Lee, Seung Yup WE14
 Lehman, Dale FC01
 Lemay, Brian FA08
 Lennes, Inga FB13
 Lesnick, Burt WA06
 Leung, Zachary TD06
 Levi, Retsef TC04, FB13
 Levin, Scott FA05
 Lewis, Carmen TB11
 Lewis, Megan TB10
 Leykum, Luci WA11
 Li, Jingshan TB05
 Li, Jinyun TC06
 Li, Jun WA13
 Li, Na WC05
 Li, Quanlin WC05
 Li, Shu-Hsing TC09
 Li, Wei TC03
 Li, Zihao TC04
 Liang, Teow Kiok Poster
 Lim, Hoon Chin FA14
 Lin, Carrie Ka Yuk TC14
 Lin, Yi-Chin TB02, TB06
 Lin, Ying TD11, WE05
 Lin, Yu-Kai TC09
 Ling, Teresa WaiChing TC14
 Linz, David WA11
 Lipkowitz, Michael FA04
 Liu, Ben FA09
 Liu, Boying WA03

Liu, Nan TC07
Liu, Shan WE05, TD11
Liu, Xiang TC07
Liu, Xiaojin WE03
Liu, Zekun WA10
Lobo, Jennifer TA11
Locke, Robert WC08
Lombardi, Lorinna Poster
Long, Elisa FB07
Longo, Roberta FA11
Looi, Peter FA14
Lotery, Andrew WA02
Lowsky, David FA04
Lu, Susan Feng TA04, FB02
Luciano, Joanne S. TA03
Luo, Li FC03, WA03

M

Ma, Claire TD10
Ma, Linlin WE08
Maass, Kayse Lee WA03
Macal, Charles TD04
Maclehose, Richard WA07
Macy, Michelle Poster
Madala, Divya TB14
Maei, Hamid WA04
Magazine, Michael TA12
Mah, Rick WC07
Mahjoub, Reza FA11
Maitre, Nathalie TC02
Malik, Sana WE05
Malin, Bradley WE03
Mallor, Fermin FA02
Mamani, Hamed TA12
Mankad, Shawn FA09
Marathe, Achla TD08
Marciniak, Beth TB03
Margolis, Peter TD09
Markmann, James TD06
Marks, Lawrence WE08
Marques, Infs TD02
Marshall, James Poster
Martinez Villarreal, Pamela WC12
Martins, Luis TD09
Marx, Ed WC01, WE06
Maslow, Benjamin TC11
Mathis, Andrew Poster
Matteson, David WC04
Matuszak, Martha TD03
May, Jerrold H. TB03, TB13, FB09
Mayer, Michael FB14
Mayorga, Maria FA07
Mazur, Lukasz WE08
McCabe, Christopher FA11
McCullough, Jeffrey WC09, FA04
McDaniel, Reuben TD09
McEvoy, Matthew TA02
McKay, Kenneth WC05
McKethan, Aaron TB01
McKinney, Gregory WA03
McKinsey, Seamus FC05
Mehrizi, Hossein WE10
Mehrotra, Mili TA12
Mehrotra, Sanjay Poster, WC05, WC10
Melouk, Sharif FA10
Mendoza Gómez, Rodolfo TC03
Menon, Nirup TD09

Menser, Carrie TC02
Merdan, Selin TA11
Mes, Martijn R.K. FA02
Meyer, Nicholas WA04
Meyers, Lauren WC04, FA04
Milford, Creagh TA06
Miller, Anne FB09
Miller, Christopher WC12
Miller, David TA11
Miller, Dianne Poster
Miller, George TA05
Millhiser, William FB12
Mills, Alex WC12, FA05, FA10
Milner, Joseph FA13
Minasian, Lori Poster
Mingle, Damian WC01
Mintz, Yonatan TC08
Mishra, Abhay TC06
Mitchell, Victoria L. TC03
Mitra, Sinjini TB06
Mohan Lal, Tarun TC01, FB01
Molik, David TA03
Mondschein, Susana FB13
Monestina, Jose FC01
Montanari, Andrea FC10
Montie, James WE07, TA11
Moosavi, Seyed Hossein FB04
Morel, Josh WC05
Moreno, Melissa FA04
Morgan, Daniel TD07

P

Pacifici, Krishna WA04
Padman, Rema WC06, Poster, TB02, TB06, TB09, TD06, FA06, FB06
Padmanabhan, Paddy WA01
Panda, Swetasudha TB08
Paranjape, Rhucha TD06, FB06
Parikh, Mansi Poster
Park, Hyunwoo WA06
Patel, N. TD06
Patil, Rajneesh FC14
Patrick, Jonathan WE10, TD12
Patterson, Brian WE02
Paulden, Mike FA11
Pavlou, Paul FA06
Paynabar, Kamran WC03
Perakis, Georgia TC04
Perry, Thad Poster
Phillips, Raymond WE12
Pidd, Michael FA02
Pienta, Robert WA06
Pineles, Lisa TD07
Pines, Jesse M. FB03
Pinker, Edieal WE02
Pinsky, Michael WC06
Pitt, Martin WA02
Plaisant, Catherine WE05
Plambeck, Erica FC10
Poellabauer, Christian TC02
Pooya, Pegah WE08
Poulouse, Benjamin WE01
Powers, Jamie WA01
Pozehl, William WA06, FA08
Pratt, Renee FB05
Provost, Shannon TD09
Puckey, Jason WA14
Puterman, Martin TD10

Q

Qiu, Yunzhe WA10
Quammen, Rebecca WE03
Queenan, Carrie TC13
Quereshy, Faye FA13

R

R.K., Palvannan Poster, TC14
Rafman, Heidi TC14
Raghavan, Nandini Poster
Raghunathan, Srinivasan WA09
Rajan, Balaraman TB02
Rajaram, Kumar FC03
Ramanan, Devi Poster
Ramaraju, Neelima FC02
Randolph, Adriane WE03
Ranjan, Chitta WC03
Rask, Kimberly TB09
Rastpour, Amir TA07
Rath, Sandeep FC03
Read-Brown, Sarah Poster
Reich, Brian WA04
Reid, Mary Poster
Relyea, Stephen FA07
Renfro, David TB03
Resnick, Matthew WE01
Reznick, Leah Poster
Rhoads, Kim FB08
Richards, David Poster
Richardson, Donald FA08
Rickard, Kelly N Z FB03
Rieb, Wendi FB13
Rifkin, D. TD06
Rimar, Joan WE02
Ring, Steves TC06
Rios Mercado, Roger Z. TC03
Roberts, Stephen FA07
Robinson, Lawrence W. TC07
Roderick, Oleg FB02
Roehrig, Charles TA05
Romanova, Anna FB05
Romeijn, Edwin TD03
Romero, Gonzalo TC04
Rosales, Claudia WE13
Ross, L. FA04
Rossi, Michael WC13
Rossiter, Stuart WA02
Roth, Aleda WC13
Rothman, Brian FA11
Rothman, Richard TB07
Rouhana, Matthew WC12
Roumani, Yaman FB09
Roumani, Yazan F. FB09
Roy, Arkajyoti WC10
Ruan, Tong TA03
Rui, Huaxia FB02
Ruiz Vargas, Estefania TB04
Russ, Stephan WC14
Ryan, Jim TB11
Ryan, Rosemary TB11

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Sabouri, Alireza TC12
Sadeghimehr, Maryam FB04
Sager, Thomas TD09
Saigal, Romesh WA08
Samorani, Michele FB12
San Nicolas-Rocca, Tonia FB11
Sandberg, Warren S. WA05
Sander, Aaron Poster
Sanderson, Kendall TC11
Sandholm, Tuomas TB10
Sandikci, Burhaneddin TC12
Sandoval, Samuel TC14
Santanam, Raghu FA06
Santhanam, Radhika FB05
Santos Almeida, Álvaro FC09
Sarhangian, Vahid WE10
Sauré, Antoine WE10
Sava, Magda Gabriela FB09
Schapiro, Hannah WA03
Schell, Gregory TC04
Scheller-Wolf, Alan WE10
Schmidt, Robert TD13
Schmidt, Todd Poster
Schmitt, Ketra FB04
Schneider, Sandra TC02
Schooley, Ben FB11, FB11
Schrage, Michael WA05
Sebastian, Hans-Juergen FC03
Sefcovic, Natasha Poster
Segev, Dorry TB10
Seidmann, Abraham TA08, TB02, FB02
Senot, Claire TC13
Serban, Nicoleta WA06, WE12
Sgro, Gaetan TB03
Shams, Issac WA08
Shapoval, Andriy TC10, WC04
Sharda, Ramesh Poster, TD13, FB02, FB10
Sharifi Sedeh, Reza Poster
Sharman, Raj TA09
Shashank, Abhinav TA13
Shechter, Guy TA08
Shechter, Steven FB04, TC12
Shen, Luoqiao FB04
Shepardson, Dylan WC04
Shi, Kevin Poster
Shi, Lu TD07
Showalter, Timothy TA11
Shukla, Aishwarya Deep WA13
Shumsky, Robert TB14
Shylo, Oleg WC08
Siddiqui, Sauleh FA05
Silberholz, John FA07
Sim, Joe TC14
Simpson, Macanda FA03
Singh, Bismark WC04
Singh, Harpreet TC06
Sinha, Kingshuk K WE03, TA13, TB14, TD14
Sinha, Saumya TD03
Sinha, Shoubhik TA13, TB14
Skandari, Reza FB04
Skolarus, Ted TC07
Slagle, Jason FB09
Smalley, Hannah TD08
Smilowitz, Karen WC10, Poster
Smith, Olivia FC03

Smith, Peter TA05
Smith, Raymond FB03
Smith-Daniels, Vicki WC13
So, Hyunji TD09
Soderberg, Karen WE03
Sohn, Ernest Poster
Soltani, Mohamad FB12
Song, Hummy WA12, TA07
Song, Jie WA10, FA09
Song, Xiaolong TC09
Song, Yongjia WA10
Sonuc, Sibel TC11
Souza, Ana FC06
Spaulding, Trent FA06
Sridhar, Sriram Poster
Srinivasan, Sankara Subrama
WE09, FC05
Staats, Bradley WE02
Stafford, Thomas TD13
Stallings, Emily TB03
Stauffer, Jon TA12
Stein, Joshua TC08
Stephens, Eric WC01
Storer, Joey WE04
Stramer, Susan WC11
Street, Nick FC01
Strömblad, Christopher WA14,
TC01
Subasi, Ersoy FA04
Subasi, Munevver FA04
Subasi, Sean Berkan Poster
Subbaswamy, Adarsh WE03
Subramanian, Ravi TB14
Suen, Sze-chuan FB07
Sulek, David FB14, FC05
Sun, Yang TD14
Sutton, Richard WA04
Swann, Julie TC04, TD08
Szymanski, Brooke Poster, FA08

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Tabaie, Azade WE14
Tadlock, Abbey FC05
Takashima, Ryuta FC09
Tamil, Lakshman TC02
Tan, Joseph TB11
Tan, Kar Way FB10
Tan, Yong TC09
Tang, Athena FB14
Tang, Xiaoxu TC07
Tanniru, Mohan TA09
Tao, Youyou TC06
Tatikonda, Mohan TA13, FA05
Tayur, Sridhar TD06
Temple, Michael TC05
Ten Haken, Randall TD03
Teo, Edmund TC14
Teredesai, P. TD06

Tezcan, Tolga WC07, TB02
Thistlethwaite, J. FA04
Thomas, Ranjeeta TA05
Thommès, Edward FB05
Thyvalikakath, Thankam FB06
Tiah, Ling FA14
Tidor, Bruce Poster
Tighe, Patrick WC02, TA06
Tilson, David TD04
Tilson, Vera TA08, TD04
Tiru, Mohan FA14
Tomlins, Scott WE07
Torabi, Elham WC12
Totten, Franklin Poster
Tracton, Gregg WE08
Truong, Van-Anh TD10
Tsai, Mitchell WC02
Tucker, Anita WA12,
WC13, TA07
Turgean, Lior TB03
Turhan, Aykut TB12

U

Ukai, Takamori FC09
Underwood, Daniel WE07
Unertl, Kim TC05

V

Valenzuela Ocaña, Karla B. TC03
Van de Ven, Peter TC07
Van Dorp, Johan RenÉ FB03
Van Houdenhoven, Mark TD02
Van Jaarsveld, Willem TB08
Van Mieghem, Jan WA12
Van Oyen, Mark TC08, TD12,
FA02, FA13
Vande Berg, Jeffery TB14
Vargas, Luis G. TB13, FB09
Venkataraman, Sriram WC13
Veral, Emre FB12
Verma, Rohit WA12
Viana, Joe WA02
Vinson, David WA12
Viswanathan, Meera TD11
Viswanathan, Siva FA09
Vlachy, Jan WA09
Vogel, Doug FB11
Volk, Michael TC08
Vorobeychik, Yevgeniy WE03,
TB08
Vyawahare, Karnali FB06

W

Wagelmans, Albert TA07, TB08
Wallinga, Jacco TB08
Wan, Zhiyu WE03
Wanderer, Jonathan WE06
Wang, Biao WC05
Wang, Dawei FB05
Wang, Ester WA11, FA13
Wang, Guihua WA13
Wang, Haofen TA03
Wang, Hesheng TD03
Wang, Jingxing WA08
Wang, Lu WA12
Wang, Xiaofang FB06
Wang, Xinshang TD10
Wang, Yu WC12
Wang, Zhehui WA03
Ward, Peter TC13, FC05
Warner, Debra WE12
Webb, Eric FA10
Weber, Leah TD10
Weber, Rachel FC05
Wei, John WE07
Wei, Wei-qi WE06
Wei, Xin FC04
Westgate, Bradford WC04
Westhofen, Martin FC03
White III, Chelsea C. WC11
White, Emily TA14
Wilkerson, Gary WA14
Wilkes, Mitch TC02
Williams, H. Paul FB14
Wilson, Mark FB04
Wilson, Martha TD14
Witkiewitz, Katie WA04
Wolcott, Vickee FA05
Wong, Herbert WA09
Wong, Jing Ping Poster
Woodard, Dawn WC04
Wu, Jiang TA03, TB05
Wu, Sophia WE05
Wu, Victor TD03
Wu, Wei TD14
Wynn, Donald FB05

X

Xia, Weiyi WE03
Xie, Q. TD06
Xie, Xiaolei WA10
Xue, Min Poster
Xue, Xiaoqiang FC14

Y

Yackel, Thomas Poster
Yadav, Nikhil TC02
Yadav, Prashant FB04
Yaesoubi, Reza FA12
Yan, Jia FC04
Yan, Lucy TC09
Yan, Xiangbin TC09
Yang, Hui WC03, WE04
Yang, Hung-Jen TC09
Yang, Kai WA08
Yang, Qingyu WE14
Yang, Yang Poster
Yao, David D. WA03
Yaraghi, Niam WA09
Yeh, Heidi TD06
Yi, Zinan TD07
Yih, Yuehwern TB12
Yildiz, Ozlem WC07
Yim, Dobin WE09
Yoogalingam, Reena FB12
Young, Chris WA14
Young, Gary WE13
Yu, Xiaoyang FC06

Z

Zabinsky, Zelda WA11, WE11
Zalunardo, Nadia FB04
Zaretzki, Russell FB05
Zaric, Greg TB04
Zayas-Caban, Gabriel WC07
Zeng, Li TD11
Zenios, Stefanos TB10, FA04
Zenteno, Cecilia FB13
Zepeda, David WE13
Zhang, Bo TC07
Zhang, Can WC11
Zhang, Hao WC03, FC02
Zhang, Hongtao FA11
Zhang, Qingpeng TB05
Zhang, Yicong FA08
Zhang, Yiye WC06, Poster
Zheng, Zhiqiang (Eric) TC06
Zhi, Jianing (Jenny) FA10
Zhong, Xiang TB05
Zhou, Mo FB09
Zhu, Cheng TA04
Zhu, Junfeng TD03
Zhuang, Weifen WA03
Zia, Leila FB08
Zimmer, Christoph FA12
Zokaeinikoo, Maryam WC08
Zolbanin, Hamed Poster
Zonderland, Maartje WA03
Zubizarreta, Jose FB02
Zuhr, Erica Poster
Zur, Richard TB04

Wednesday, 8:30am - 10:00am

WA01	Integration of Analytics for Point of Care Decision Support
WA02	Healthcare Modelling in Europe
WA03	Stochastic Models in Healthcare
WA04	Decision Making for Optimal Treatment Strategies
WA05	Panel: Healthcare Systems — Big Data and IT Challenges
WA06	Analytics and Visualization in Emergency Departments
WA07	Calibration Methods for Mathematical Models of Health Applications
WA08	Analytics in Healthcare Operations
WA09	Economics of Health Information Sharing
WA10	Hospital Operational Process Modeling and Optimization
WA11	Advanced Healthcare Resource Allocation
WA12	Behavioral Operations in Health Care Organizations
WA13	Choice Modelling Applications in Healthcare
WA14	Predictive Modelling in Healthcare Operations I

Wednesday, 10:30am - 11:30am

WB01	Wednesday Plenary – Kris Joshi
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Wednesday, 12:30pm - 2:00pm

WC01	PANEL: Utilizing Analytics to Drive Operational and Financial Decision-making in Healthcare
WC02	Driving Quality Improvement I
WC03	Big Data Analytics and Health Informatics
WC04	Public Health Modeling
WC05	Economic and Disease Modeling
WC06	Applications of Healthcare Information Systems
WC07	Emergency Care
WC08	Health Interventions
WC09	Economics of Healthcare IT
WC10	Data-Driven Healthcare Systems Optimization
WC11	Blood Supply Chain Management
WC12	Clinical Care Delivery Operations
WC13	Cost and Payment Models for Effective Healthcare
WC14	From Model to Reality: Barriers to Implementation in Healthcare

Wednesday, 2:00pm - 3:30pm

WD01	Posters
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Wednesday, 3:30pm - 5:00pm

WE01	Surgeons' Perspective: Surgical Quality and Outcomes Research
WE02	Empirical studies of workload effects in acute care
WE03	Healthcare Informatics
WE04	Disease Modeling
WE05	Understanding Patterns in Healthcare Data
WE06	Big Data and Analytics in the Modern Healthcare Enterprise
WE07	Healthcare Policy
WE08	Modeling to Enhance Healthcare Delivery
WE09	Health Information Technology and Patient Engagement I
WE10	Optimal Decision Making using Stochastic Models in Healthcare
WE11	The Challenges of using Industrial and Systems Engineering to Transform American Health Care
WE12	Predictive Modelling in Healthcare Operations II
WE13	Hospital Operations
WE14	Healthcare Operations

Thursday, 8:30am - 10:00am

TA01	Award Winning Healthcare Analytics Organizations
TA02	Driving Quality Improvement II
TA03	Data Analytics for Healthcare
TA04	Economic Evaluation and Financial Incentives in Healthcare
TA05	Strategic Investment Appraisal
TA06	Implementation of Predictive Models for Surgical Patients
TA07	INFORMS Health Application Society: Best Student Paper Competition Finalists
TA08	Case Studies in Healthcare
TA09	Health Information Technology and Patient Engagement II
TA11	Modeling Cancer Progression Screening & Treatment
TA12	Modeling Contract & Payment Policies in Healthcare
TA13	New Frontiers in Operations Management Research
TA14	Policy in Healthcare

Thursday, 10:30am - 12:00pm

TB01	Panel: Roundtable on Healthcare Policy and Analytics
TB02	Influencing Provider and Patient Behavior
TB03	Hospital Readmissions: Modeling Strategies and Future Challenges
TB04	Joint Session Disease Modeling/Public Health: Economic Evaluation in Medicine and Public Health
TB05	Online Analytics Applications in Healthcare
TB06	Case Studies in Healthcare via Analytics
TB07	Linking Hospital Emergency Department Information and Workflow to Public Health
TB08	Joint Session HealthOp/Public Health: Optimization of Screening and Vaccination for Infection Prevention
TB09	Healthcare Information Technology and Healthcare Outcomes
TB10	Joint Session Health Operations/Public Health: Organ Allocation/Exchange Models
TB11	IS&T for improving the healthcare process and system
TB12	Scheduling and Optimization in Healthcare
TB13	Patient Flow
TB14	Healthcare Operations I

Thursday, 12:00pm - 1:30pm

Special Lunch Speaker – Jonathan Perlin

Thursday, 1:30pm - 3:00pm

TC01	Panel Discussion with Leading Healthcare Organizations
TC02	Biometric Signal Process for Clinical Decision Making
TC03	Optimization in Healthcare I
TC04	Incentives in Healthcare Supply Chains
TC05	Workflow Methods and Analytics
TC06	Health Care Operations and Analytics
TC07	Operational Models in Outpatient Setting
TC08	Operations Research Approaches to Medical Decision Making
TC08	Operations Research Approaches to Medical Decision Making
TC09	Healthcare and Data Analytics
TC10	Health Optimization
TC11	Models for Post-Operative Care Resource Analysis and Management
TC12	Modeling Healthcare Operations
TC13	Process View of Quality in Healthcare
TC14	Healthcare Operations II

Thursday, 3:30pm - 5:00pm

TD01	Predictive Modeling
TD02	Healthcare Modelling in Europe Assignment and Optimization
TD03	Optimization in Healthcare II
TD04	Markov Models in Treatment Choices and Agent-Based Model of Ebola Spread
TD05	The Dark and Light Side of Healthcare IT
TD06	Healthcare Analytics and Operations Management
TD07	Models of Disease Prevention through Improved Behaviors
TD08	Joint Session Disease Modeling/Public Health: Disease Modeling
TD09	Networks and Platforms in the Healthcare Sector
TD10	Appointment Scheduling
TD11	Smart Monitoring and Delivery
TD12	Planning and Scheduling Methods for Capacity Management in Healthcare
TD13	PANEL: Decision Sciences Journal Initiative in Healthcare Analytics: The Nexus of Operations Efficiency and Healthcare Information
TD14	Healthcare Operations III

Friday, 8:00am - 9:30am

FA01	Panel Discussion: Soft Skills for Leaders in Healthcare Analytics
FA02	Healthcare Modelling in Europe: Management and Scheduling
FA03	Simulation In Healthcare I
FA04	Predictive Analytics in Health Care
FA05	Using Health IT to Improve Patient Experience
FA06	Measuring Impacts of Electronic Medical Records in Hospitals
FA07	Applications in Cancer Screening and Treatment
FA08	Student Research Projects in Healthcare Operations
FA09	The Impact of IT on Healthcare
FA10	Joint Session HealthOp/Public Health: Modeling Emergency Departments and Emergency Response
FA11	Medical Decision Making in Healthcare
FA12	Operations' Role in Managing Infectious Diseases
FA13	Scheduling and Capacity Management
FA14	Analytical Applications in Healthcare

Friday, 9:45am - 11:15am

FB01	Systems Engineering and Analytics
FB02	Estimation Applications in Healthcare
FB03	Simulation In Healthcare II
FB04	Joint Session Disease Modeling/Public Health: Session Disease Modeling
FB05	Public Health
FB06	Operations Analysis of Health Care
FB07	Decision Making in Health Care
FB08	Decision Models in Healthcare
FB09	Data Driven Decision Models in Healthcare
FB10	Modeling Patient Flows in Hospitals
FB11	Session SIG Health
FB12	Outpatient Appointment Scheduling
FB13	Hospital Operations: Scheduling
FB14	Healthcare Policy

Friday, 11:30am - 1:00pm

FC01	Big Data Analytics in Medicine
FC02	Optimization Applications in Healthcare
FC03	Surgery Sheduling
FC04	Disease Modeling ñ II
FC05	Quality in Healthcare
FC06	Patient Flow Decision Models
FC09	Creating Value Staff and Patient Satisfaction
FC10	Data-Driven Decisions in Healthcare
FC14	Analytical Applications with Diseases