

BLAVATNIK INSTITUTE BIOMEDICAL INFORMATICS

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Can Al Accelerate Precision Medicine?

Harvard Medical School June 18, 2019

Welcome

Recent progress in artificial intelligence has been touted as the solution for many of the challenges facing clinicians and patients in diagnosing and treating disease. Concurrently, there is a growing concern about the biases and lapses caused by the use of algorithms that are incompletely understood. Yet precision medicine* requires sifting through millions of individuals measured with thousands of variables: an analysis that defeats human cognitive capabilities.

In this conference, we ask the question whether AI can be used effectively to accelerate precision medicine in ways that are safe, non-discriminatory, affordable and in the patient's best interest. To answer the question, we have three panels and three keynote speakers.

The first panel addresses the question of **Policy and the Patient: Who's in Control?** We will review the intersection of consent, transparency and regulatory oversight in this very dynamic ethical landscape.

The second panel, **Is There Value in Prediction?**, addresses a widely-shared challenge in medicine, which is to predict the patient's future, and most importantly, their response to therapy. Can AI actually make an important contribution here?

The third panel on **Hyperindividualized Treatments** asks the question of how to think about a future that is fast becoming the present, where therapy is "hyper-individualized," so it is the very uniqueness of your genome that determines your therapy.

As always, we have a patient representative for our opening keynote, **Matt Might**, who returns to this annual conference to discuss the development of an algorithm for conducting precision medicine, through the lens of a personal story: discovering that his child was the first case of a new, ultra-rare genetic disorder. Our midday keynote by Professor **Regina Barzilay** will guide us through a personal journey from diagnosis to an exciting agenda to increase precision in discovery of cancer treatments and improved delivery of cancer care. Our closing keynote will be given by **Jim Tananbaum** of Foresite Capital. He is one of the original investors and drivers of Insitro, an Al company that seeks to become a full-service therapeutic engine.

We hope this conference will create a larger consensus around these still controversial and mostly uncharted questions.

Isaac S. Kohane Marion V. Nelson Professor and Chair, Department of Biomedical Informatics

*What do we mean by "precision medicine"? From the perspective of one of the members of the National Academy of Sciences committee that wrote the report, we mean taking an explicit multidimensional view of patients: not just one data modality such as genomics or environmental exposure. We argue that this perspective allows for more precise matching of humans to disease states (diagnosis), future disease states (prognosis) and appropriate therapies.





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Agenda

8:00–9:00am	Continental Breakfast and Check-in
9:00–9:15am	Welcome: Isaac Kohane, Harvard Medical School
9:15–9:30am	Opening Remarks: George Daley, Dean, Harvard Medical School
9:30–10:15am	Opening Keynote: Matt Might, Hugh Kaul Precision Medicine Institute at UAB
10:15–11:30am	PANEL 1: Policy and the Patient: Who's in Control?
	Andy Coravos, Elektra Labs
	Kadija Ferryman, Data & Society Research Institute
	 James Ostell, NCBI, NLM, NIH
	 Jonathan Zittrain, Harvard Law School
11:30am–12:15pm	LUNCH
12:15–1:30pm	PANEL 2: Is There Value in Prediction?
	Gabriel Brat, Beth Israel Deaconess Medical Center
	Arnaub Chatterjee, Acorn Al, Medidata Solutions
	Shez Partovi, Amazon Web Services
	Christine Tsien Silvers, HealthReveal
1:30–2:15pm	Keynote: Regina Barzilay, Massachusetts Institute of Technology
2:15–2:30pm	BREAK
2:30–3:45pm	PANEL 3: Hyperindividualized Treatments (Moderator: David Shaywitz)
	George Church, Harvard Medical School
	Matthew De Silva, Notable Labs
	Ken Ehlert, UnitedHealth Group
	Kimberly LeBlanc, Undiagnosed Diseases Network
	Timothy Yu, Boston Children's Hospital
3:45–4:30pm	Closing Keynote: Jim Tananbaum, Foresite Capital
4:30–4:45pm	Closing Remarks: Isaac Kohane, Harvard Medical School

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Remarks

Isaac Kohane

Isaac (Zak) S. Kohane, MD, PhD, is the inaugural Chair of the Department of Biomedical Informatics and the Marion V. Nelson Professor of Biomedical Informatics at Harvard Medical School. He served as coauthor of the Institute of Medicine Report on Precision Medicine that has been the template for national efforts. He develops and applies computational techniques to address disease at multiple scales: from whole healthcare systems as "living laboratories" to the functional genomics of neurodevelopment with a focus on autism.

Over the last 30 years, Zak's research agenda has been driven by the vision of what biomedical researchers could do to find new cures, provide new diagnoses and deliver the best care available if data could be converted more rapidly to knowledge and knowledge to practice. In so doing, Kohane has designed and led multiple internationally adopted efforts to "instrument" the healthcare enterprise for discovery and to enable innovative decision-making tools to be applied to the point of care. At the same time, the new insights afforded by 'omic-scale molecular analyses have inspired him and his collaborators to work on re-characterizing and reclassifying diseases such as autism, rheumatoid arthritis and cancers. In many of these studies, the developmental trajectories of thousands of genes have been a powerful tool in unraveling complex diseases.

Zak's i2b2 project is currently deployed internationally to over 120 major academic health centers to drive discovery research in disease and pharmacovigilance (including providing evidence on drugs which ultimately contributed to a boxed warning by the FDA). Zak also currently leads four NIH-funded projects that cut across the entire agenda: 1) a Center for Excellence in Genomic Science to study neuropsychiatric disease at multiple levels, from molecular characterization of induced neurons obtained from fibroblasts of patients to automated classification of the textual component of their electronic medical record; 2) the Coordinating Center for the Undiagnosed Disease Network, where patients with rare and unknown diseases are provided with combined clinical and molecular diagnoses in a nationally-scaled infrastructure so that they can see the right expert with all their relevant data at hand; 3) a Center for Excellence in Big Data to Knowledge to both create a nationally scaleable research data-sharing infrastructure and demonstrate its use for neurodevelopmental diseases, and 4) the Network of Enigmatic Exceptional Responders (NEER), to study those individuals who have responded seemingly miraculously to cancer treatments across a large number of cancers using the full range of measurement types, from -omics to electronic health records to personal questionnaires.

George Daley

George Q. Daley, MD, PhD, is Dean of Harvard Medical School, Caroline Shields Walker Professor of Medicine, and Professor of biological chemistry and molecular pharmacology at Harvard Medical School.

Daley's research focuses on stem cells, cancer and blood disorders. He received his bachelor's degree, *magna cum laude*, from Harvard (1982), a doctorate in biology from MIT (1989), where he worked with Nobel laureate David Baltimore, and his medical degree from Harvard Medical School (1991), *summa cum laude*.

Daley pursued clinical training in internal medicine at Massachusetts General Hospital, where he served as chief resident (1994–1995), and a clinical fellowship in hematology/oncology at Brigham and Women's Hospital and Boston Children's Hospital.

He was a founding member of the executive committee of the Harvard Stem Cell Institute, and served as president of the International Society for Stem Cell Research from 2007 to 2008 and as its clerk from 2012 to 2015. He anchored the special task forces that produced the society's guidelines for stem cell research (2006) and clinical translation (2008) and their subsequent revisions and updates (2016).

Daley has been elected to the National Academy of Medicine, the American Society for Clinical Investigation, the American Association of Physicians, the American Pediatric Societies, the American Academy of Arts and Sciences and the American Association for the Advancement of Science.

Daley was an inaugural winner of the National Institutes of Health Director's Pioneer Award for highly innovative research and has received the Judson Daland Prize from the American Philosophical Society for achievement in patient-oriented research, the E. Mead Johnson Award from the American Pediatric Society for contributions to stem cell research, and the E. Donnall Thomas Prize of the American Society of Hematology for advances in human induced pluripotent stem cells.





Keynote Speakers

Matt Might

Matt Might has been the Director of the Hugh Kaul Precision Medicine Institute at the University of Alabama at Birmingham (UAB) since 2017. At UAB, Matt is the Hugh Kaul Endowed Chair of Personalized Medicine, a Professor of Internal Medicine and a Professor of Computer Science.

From 2016 to 2018, Matt was a Strategist in the Executive Office of the President in The White House. And, in 2015, Matt joined the faculty of the Department of Biomedical Informatics at Harvard Medical School.

Matt is co-founder and Chief Scientific Officer of NGLY1.org, and he was a co-founder and Scientific Advisor to Pairnomix. Q-State Biosciences acquired Pairnomix in October 2018, and Matt remains a Scientific Advisor.

Regina Barzilay

Regina Barzilay is a professor in the Department of Electrical Engineering and Computer Science and a member of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology. Her research interests are in natural language processing. Currently, she is focused on bringing the power of machine learning to oncology. In collaboration with physicians and her students, she is devising deep learning models that utilize imaging, free text, and structured data to identify trends that affect early diagnosis, treatment, and disease prevention. She is poised to play a leading role in creating new models that advance the capacity of computers to harness the power of human language data.

Professor Barzilay is a recipient of various awards including an NSF Career Award, the MIT Technology Review TR-35 Award, Microsoft Faculty Fellowship and several Best Paper Awards in top NLP conferences. In 2017, she received a MacArthur fellowship, an ACL fellowship and an AAAI fellowship.

Barzilay received her MS and BS from Ben-Gurion University of the Negev, her PhD in Computer Science from Columbia University, and spent a year as a postdoc at Cornell University.

Jim Tananbaum

Jim Tananbaum, founder, chief executive and managing partner of Foresite Capital, left Harvard in 1991 with an MD and MBA, and in the nearly three decades since created billions of dollars in shareholder value in a host of large and small healthcare companies. Foresite Capital is based in San Francisco.

Jim's first success came while he was still at Harvard when he co-founded GelTex Pharmaceuticals. For less than \$80 million in seed funding, GelTex brought two drugs to market. The company was acquired in 1998 for \$1.6 billion when its lead drug, Renagel (later renamed Renvela), had an annual revenue run rate exceeding \$200 million. Decades later, Renvela still has annual sales of about \$1 billion.

Jim was also the founding chief executive of Theravance, Inc., which has since split into two parts, one of which is now part of GSK's respiratory franchise through a joint venture, Innoviva, and the other was spun out into Theravance Biopharma, Inc. Together, they have a combined market capitalization that exceeds \$3 billion.

As an undergraduate, Jim attended Yale College, where he graduated with a BS and BSEE in Applied Math and Electrical Engineering/Computer Science. He then attended the Harvard/MIT HST program and graduated with an MD from Harvard and an MS from MIT. He also earned an MBA from Harvard while playing rugby. He has been fascinated by the intersection between computer science, genetics and biology ever since. His company formation and investing strategy has long married the intersection of clinical and biological science and genetics and computational analytics.

Foresite Capital was founded in 2011. Jim's investment experience also includes being a founding partner of Prospect Venture Partners II and III, and earlier in his career, a partner of Sierra Ventures, where he helped establish its healthcare services investment practice. Jim has led numerous investments, including Amira Pharmaceuticals, Amerigroup, Healtheon, and Jazz Pharmaceuticals.







Panels



Policy and the Patient: Who's in Control?



Andy Coravos Elektra Labs

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