



ITdotHealth: SMART Decisions

June 26 - 27, 2017

Computational Health Informatics Program
Boston Children's Hospital

Department of Biomedical Informatics
Harvard Medical School

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This conference is being videotaped and photographed

Agenda

June 26th, 2017		
10:45 AM	Lunch and Networking	Minot Room
12:00 PM	Senator Cassidy and Representative Burgess	Lahey Room
12:45 PM	Opening Remarks, Goals Ken Mandl	Lahey Room
12:55 PM	Keynote Jeffrey Dean	Lahey Room
2:15 PM	SMART Update, SMART FHIR App Gallery Daniel Gottlieb	Lahey Room
2:35 PM	SMART Extensions: SYNC for Science, CDS Hooks Josh Mandel	Lahey Room
3:00 PM	Break	Lahey Room
3:30 PM	<p><i>The last Mile: Delivering apps and services to the point of care</i> Moderator: Ken Mandl, Boston Children's Hospital Panelists</p> <ul style="list-style-type: none"> • Paula Braun, Centers for Disease Control & Prevention • Nate Gross, Doximity • William Harty, Premier • Rachel Petersen, SureScripts • Jeremy Warner, Vanderbilt 	Lahey Room

Agenda

June 26th, 2017

4:15 PM	<p><i>Current State: Native EHR API Capabilities and Business Models</i> Moderator: Daniel Gottlieb, Boston Children's Hospital Panelists:</p> <ul style="list-style-type: none">• Tony Confrey, Athena Health• Sharma Manoj, Allscripts• David McCallie, Cerner• Isaac Vetter, Epic	Lahey Room
5:00 PM	<p><i>Tools and services for marshaling data at scale</i> Moderator: Andy Palmer, Koa Labs, Tamr Panelists:</p> <ul style="list-style-type: none">• William Crawford, Fitbit• Len D'Avolio, Cyft• Shawn Murphy, Partners Healthcare• Jason O'Meara, Quest Diagnostics, LLC• John Shon, Illumina	Lahey Room
6:00 PM	Reception	Courtyard Cafe

Agenda

June 27th, 2017		
8:30 AM	Breakfast	Ballard Room
9:30 AM	<p><i>Open or shut case? Open standards in commercial systems</i></p> <p>Moderator: John Wilbanks, Sage Bionetworks</p> <p>Panelists:</p> <ul style="list-style-type: none"> • Gil Alterovitz, Boston Children's Hospital • Deborah Estrin, Cornell Tech • Adrian Gropper, Patient Privacy Rights • Andy Palmer, Koa Labs Tamr • Jon White, ONC 	Lahey Room
10:15AM	<p><i>The Role of consensus, law and regulation</i></p> <p>Moderator: Ken Mandl, Boston Children's Hospital,</p> <p>Panelists:</p> <ul style="list-style-type: none"> • Aneesh Chopra, Nav Health • Natalie Kates, Digital Health Service • Donald Rucker, ONC • John Wilbanks, Sage Bionetworks 	Lahey Room
11:00 AM	<p><i>Hooks for Decision Support. Can we get there fast?</i></p> <p>Moderator: Josh Mandel, Harvard, Verily</p> <p>Panelists:</p> <ul style="list-style-type: none"> • Blackford Middleton, Apervita, Inc. • Kevin Shekleton, Cerner • Gajen Sunartha, Boston Children's Hospital • Micky Tripathi, MAeHC & Argonaut Project 	Lahey Room

Agenda

June 27th, 2017

11:30 AM	<i>Preparing the Enterprise</i> Moderator: Arnaub Chatterjee, McKinsey & Company Panelists: <ul style="list-style-type: none">• Charles Bach, Kaiser Permanente• James Buntrock, Mayo Clinic• Keith Dreyer, Partners Healthcare• Alistair Erskine, Geisinger Health System• William Gregg, HCA• Adam Landman, Partners Healthcare• Hilten Patel, Advisory Board Company	Lahey Room
12:00 PM	Lunch	Ballard Room
1:15 PM	<i>Closing Keynote</i> Atul Gawande	Lahey Room

Welcome

Welcome!

The 2017 SMART Health IT meeting (ITdotHealth: SMART Decisions) is intended to forge interdisciplinary partnerships, combining 22 years of federally funded research at the Boston Children's Hospital Computational Health Informatics Program (CHIP) and Harvard with the know-how of industry leaders, governments, NGOs, and leading academics. The sessions will be sharply focused on issues around development of HIT platforms, their attendant ecosystems, and how to bring decision support and knowledge into the clinician's workflow.

The meeting brings together key stakeholders from industry, government, academia and the public sector to follow up the work begun eight years ago at the first ITdotHealth meeting. We have two extraordinary keynote speakers—the renowned surgeon and writer Atul Gawande, and Jeffrey Dean, one of Google's most influential engineers since 1999, and co-founder of Google Brain.

We explore AI, genomics, and decisions in medicine, but from a unique, highly operational and implementation-oriented perspective. On the tail end of an historic \$48-billion-dollar federal investment in HIT, participants examine how to support a flexible, nimble health system that delivers insights to the point of care in the clinician's workflow or to the patient at home. Insights derived not only from machine learning algorithms and population-level data sources, but also alerts and guidelines from public health agencies and professional societies.

ITdotHealth brings together a community of leaders in health, policy, & technology that can steer a national conversation. We introduced the idea of a standard healthcare API in a 2009 paper in the *New England Journal of Medicine* suggesting that electronic health record systems should look a lot more like an iPhone than they currently did. The iPhone and Android platforms separate the system from the functionality provided by the applications. And the applications are substitutable: a consumer can download a calendar reminder system, reject it, and download another one instead. The consumer is committed to the platform, but the applications compete on value and cost.

With a \$15M grant from HHS, we developed a model for such a system—SMART Health IT, from which we have learned important lessons about the technical, regulatory, and business implications of this transformative and rapidly evolving trend. Because of SMART Health IT, an app written one time, can now run widely in healthcare, including at leading institutions including Duke Medical Center, Intermountain Healthcare, Partners Healthcare, Geisenger, and Boston Children's Hospital. A critical difference between SMART apps and the tens of thousands of apps in the Google and Apple stores, is that SMART on FHIR apps are built into the workflow of clinicians and patients at home, and have full access to health system data to drive functionality

The 21st Century Cures Act, just passed by Congress, has instantiated this core principle requiring APIs that provide access to all data elements of a patient's electronic health record.

Top EHR vendors are implementing SMART through a project called Argonaut. The CMS meaningful use stage three regulations require a SMART-like API for patients to download their own data. The All of Us initiative is promoting Sync for Science, a SMART extension enabling patients to connect an app to an EHR to download and direct their data to the project. SMART is supporting the ecosystem in developing standardized protocols for launching third party decision support services and associated apps from within HIT workflows (CDS-Hooks). HHS made a grant to our team resulting in the recent launch of an updated SMART App Gallery, also serving FHIR.org.

All sessions are plenary. All invitees are full participants.

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Sincerely,

Ken Mandl, MD, MPH

ITdotHealth: SMART Decisions was made possible through the generous support of **The Gordon and Betty Moore Foundation**. We would also like to thank current and past organizations on the SMART Advisory Committee for their support: The Advisory Board Company, The American Medical Association, Blue Cross Blue Shield Association, The BMJ Group, Centros, The Hospital Corporation of America (HCA), Eli Lilly, Polyglot Systems, Premier, Inc., Quest Diagnostics, and Surescripts.



Kenneth Mandl, MD, MPH

Director, Computational Health Informatics Program
Boston Children's Hospital
Donald A.B. Lindberg Professor of Pediatrics and
Biomedical Informatics
Harvard Medical School

Mandl's work at the intersection of population and individual health has had a unique, sustained influence on the developing field of biomedical informatics. His Presidential Early Career Award for Scientists and Engineers was for pioneering real time biosurveillance, tracking Infections and detecting outbreaks with diverse data. Mandl has long advocated for patient participation in producing and accessing data. He created the first personal health systems, crowdsourced knowledge from online patient networks, and advanced participatory medicine and engagement in clinical trials. He leads the SMART project as well as the Accessible

Research Commons for Health (ARCH Commons) system across Boston hospitals and nationally. He was advisor to two Directors of the CDC and chaired the Board of Scientific Counselors of the NIH's National Library of Medicine. Dr. Mandl has been elected to multiple honor societies including the American Society for Clinical Investigation, Society for Pediatric Research, American College of Medical Informatics and American Pediatric Society.

Distinguished Keynote Panel



Bill Cassidy, MD

United States Senator for Louisiana

Dr. Bill Cassidy is the United States Senator for Louisiana.

Bill grew up in Baton Rouge, Louisiana and attended Louisiana State University (LSU) for undergraduate and Medical School.

For nearly three decades, Bill has provided care for uninsured and underinsured patients in Louisiana's charity hospital system.

During this time, he co-founded the Greater Baton Rouge Community Clinic, a clinic providing free dental and health care to the working uninsured. Bill also created a private-public partnership to vaccinate 36,000 greater Baton Rouge area children against Hepatitis B at no cost to the schools or parents. In the wake of Hurricane Katrina, Bill led a group of health care volunteers to convert an abandoned K-Mart building into an emergency health care facility, providing basic health care to hurricane evacuees.

In 1990, Bill joined LSU Medical School teaching medical students and residents at Earl K. Long hospital, a hospital for the uninsured.

In 2006, Bill was elected to the Louisiana State Senate.

In 2008, he was elected to the United States House of Representatives to represent Louisiana's Sixth Congressional District. In the U.S. House, Bill served on the Energy and Commerce Committee.

In 2014, he was elected to the U.S. Senate. He serves on the Health Education Labor & Pensions (HELP), Energy and Natural Resources, Finance, Veterans Affairs and Joint Economic Committees.

Bill is married to Dr. Laura Cassidy and they have three children. Laura is a retired general surgeon specializing in breast cancer. She helped found a public charter school to teach children with dyslexia. Bill, Laura and their family attend church at the Chapel on the Campus.



Michael Burgess, MD

United States Congressman

Dr. Michael Burges has served the constituents of the 26th District since 2003 in the United States House of Representatives following nearly three decades as a practicing physician.

He currently serve on the prestigious House Energy and Commerce Committee where he is the Chairman of the House Energy and Commerce Subcommittee on Health and sits on the Subcommittee on Oversight and Investigations and the Subcommittee on Digital Commerce and Consumer Protection. He is also a member of the Rules Committee and the Helsinki Commission.

As of the 115th Congress, Dr. Burgess is the most senior medical doctor, on both sides of the aisle, serving in the House of Representatives. He has been a strong advocate for health care legislation aimed at reducing health care costs, improving choices, reforming liability laws to put the needs of patients first, and ensuring there are enough doctors in the public and private sector to care for America's patients and veterans. Dr. Burgess worked for many years to repeal Medicare's Standard Growth Rate (SGR) formula a top priority. At the beginning of the 114th Congress, over ninety percent of both chambers of Congress supported the formula's repeal and it was signed into law. As one of the largest entitlement reforms in the past few decades, this landmark policy will ensure greater access and quality for seniors, more stable reimbursements for providers, and a more fiscally solvent Medicare system as a whole.

Dr. Burgess has also focused on medical research and innovation and public health policy, including reforms to the Food and Drug Administration (FDA) and of the nation's laws on healthcare information technology (HIT). He has earned a reputation as a problem-solver and has earned a number of awards and recognition including being named in 2013 as one of *Modern Healthcare's* 50 Most Influential Physician Executives and Leaders.

Dr. Burgess graduated with both an undergraduate and a master's degree from North Texas State University, now the University of North Texas, received his M.D. from the University of Texas Medical School in Houston, and completed his residency programs at Parkland Hospital in Dallas. He also received a master's degree in Medical Management from the University of Texas at Dallas, and in May 2009 was awarded an honorary Doctorate of Public Service from the University of North Texas Health Sciences Center. He and his wife Laura have been married for over 40 years, and they have three children and two grandsons.

Keynote Speaker

Jeffrey Dean, PhD



Jeff joined Google in 1999 and is a Senior Fellow in its Research Group, where he leads the Brain team, Google's deep learning research team, currently working on large-scale distributed systems for machine learning. He has co-designed/implemented five generations of Google's crawling, indexing, and query serving systems; including major pieces of Google's initial advertising, AdSense for Content systems, distributed computing infrastructure, MapReduce, BigTable and Spanner systems, protocol buffers, LevelDB, systems infrastructure for statistical machine translation and a variety of internal and external libraries and developer tools. He received a Ph.D. in Computer Science from the University of Washington in 1996, working with Craig Chambers on compiler techniques for object-oriented languages. He is a Fellow of the ACM and AAAS, a member of the U.S. National Academy of Engineering, a recipient of the Mark Weiser Award and the ACM-Infosys Foundation Award in Computing Sciences.

Keynote Speaker

Atul Gawande, MD, MPH

Surgeon, Author, Professor, Public Health Researcher



Atul Gawande, MD, MPH, is a surgeon, writer, and public health researcher. He practices general and endocrine surgery at Brigham and Women's Hospital. He is Professor in the Department of Health Policy and Management at the Harvard T.H. Chan School of Public Health and the Samuel O. Thier Professor of Surgery at Harvard Medical School. He is also Executive Director of Ariadne Labs, a joint center for health systems innovation, and Chairman of Lifebox, a nonprofit organization making surgery safer globally. Atul has been a staff writer for The New Yorker magazine since 1998 and has written four New York Times bestsellers: *Complications*, *Better*, *The Checklist Manifesto*, and most recently, *Being Mortal: Medicine and What Matters in the End*. He is the winner of two National Magazine Awards, AcademyHealth's Impact Award for highest research impact on healthcare, and a MacArthur Fellowship, and is a member of the National Academy of Medicine.

Moderator Profiles



Daniel Gottlieb

Boston Children's Hospital

Dan Gottlieb is the Technical Lead for the SMART Health IT Project and focuses on creating a technology platform that makes it easy for innovators to build applications that seamlessly and securely plug into electronic health record systems, patient-facing health record portals, and researcher-facing data warehouses throughout the healthcare system. This work includes development of open specifications for security and data access based on the HL7 FHIR standard, as well as open source tools for developers to build, test and distribute apps that support these specifications. Prior to joining SMART Health IT, Dan managed the design and development for the New York City

Health Department of a large scale population health analytics software platform that is being used for research, quality measurement and clinical care. He has a master's degree in health policy from NYU.



Andy Palmer, MBA

Koa Labs

Andy Palmer is a serial entrepreneur who specializes in accelerating the growth of mission-driven startups. Andy has helped found and/or fund more than 60 innovative companies in technology, health care and the life sciences. Andy's unique blend of strategic perspective and disciplined tactical execution is suited to environments where uncertainty is the rule rather than the exception. Andy has a specific passion for projects at the intersection of computer science and the life sciences. Most recently, Andy co-founded Tamr, a next generation data curation company and Koa Labs, a start-up club in the heart of Harvard Square, Cambridge, MA.



John Wilbanks

Sage Bionetworks

John Wilbanks is the Chief Commons Officer at Sage Bionetworks. Previously, Wilbanks worked as a legislative aide to Congressman Fortney “Pete” Stark, served as the first assistant director at Harvard’s Berkman Center for Internet & Society, founded and led to acquisition the bioinformatics company Incellico, Inc., and was executive director of the Science Commons project at Creative Commons. In February 2013, in response to a We the People petition that was spearheaded by Wilbanks and signed by 65,000 people, the U.S. government announced a plan to open up taxpayer-funded research data and make it available for free. Wilbanks holds a B.A. in philosophy from Tulane University and also studied modern letters at the Sorbonne.



Josh Mandel, MD

Harvard Medical School, Verily

Josh is a physician and software developer working to fuel an ecosystem where technology supports better health. He works at Verily as Health IT Ecosystem Lead, with a focus on the Precision Medicine Initiative's "All of Us" research program. After earning a B.S. in computer science and electrical engineering from the Massachusetts Institute of Technology and an M.D. from the Tufts University School of Medicine, he joined the Harvard Medical School Department of Biomedical Informatics, where he served as lead architect for SMART Health IT (<http://smarthealthit.org>) and spearheaded the Clinical Decision Support Hooks project. As a member of the national Health IT Standards Committee, Josh has a special interest in tools and interfaces that support software developers who are new to the health domain.



Arnaub Chatterjee, MHA, MPA **McKinsey**

Arnaub is Senior Expert in the Pharmaceutical and Medical Products group at McKinsey & Company. Additionally, he serves as Lecturer in the Department of Policy Analysis and Management at Cornell University and is Teaching Associate in the Department of Health Care Policy at Harvard Medical School.

Previously, he served as Director of Business

Development and Strategic Partnerships at Merck where he led ventures and partnerships with academic medical centers, payers and technology companies around the novel use of health data and analytics in improving patient care. Prior to Merck, he worked for the Obama Administration serving as an advisor to former Chief Technology Officers Todd Park and Bryan Sivak at the U.S. Department of Health and Human Services (HHS). At HHS, he co-led efforts for the Health Data Initiative, designed the www.healthdata.gov platform, and launched the Innovation Fellows Program. At HHS, he also worked in the Secretary's Office as a lead policy analyst on healthcare fraud and abuse policy initiatives around the Affordable Care Act. Prior to government service, he spent a number of years as a strategy consultant at Deloitte Consulting, advising hospitals, payers and state governments on how to navigate financial and policy challenges. He holds graduate degrees in health administration (MHA) and public administration (MPA) from Cornell University and received his undergraduate degree from the University of Michigan.

Panelist Profiles

“The Last Mile: Delivering apps and services to the point of care”



Paul Braun

Centers for Disease Control and Prevention

Paula Braun is an Entrepreneur-in-Residence (EIR) at CDC’s National Center for Health Statistics. She offers a fresh look on how technology can inform and simplify the way mortality data are collected, analyzed, and reported across the United States. She also collaborates with colleagues across CDC to develop proof-of-concept SMART on FHIR applications to improve population health. Paula began her career as a Presidential Management Fellow at CDC’s National Center on Birth Defects and Developmental Disabilities. After that, she served as an analyst at the Government Accountability Office and later lived and worked at the US Embassies in Iraq and Afghanistan for two years. Immediately prior to her role as an EIR, Paula worked as a data scientist for a predictive analytics firm called Elder Research. Paula routinely puts herself in unfamiliar and unpredictable situations and enjoys performing standup comedy.



Nate Gross

Doximity

Dr. Nate Gross is the co-founder of Doximity, the professional network used by over 70% of US physicians. He is also the co-founder of Rock Health, the full-service venture capital fund for digital health startups. A graduate of the Emory University School of Medicine and Harvard Business School, Dr. Gross serves on the advisory board for the SXSW Accelerator and the Institute for Pediatric Surgical Innovation at Children's National Medical Center, and is affiliated faculty for the Clinical Informatics Fellowship at Stanford



William Harty

Premier

William has over twenty years experience leading the architecture, development, implementation and integration of enterprise class medical software, focusing primarily on clinical surveillance, decision support and interoperability. William is currently the Principal Software Architect over the Clinical Surveillance division at Premier Inc.



Rachel Petersen

Surescripts

Rachel is a product manager on the Critical Performance Improvements Team at Surescripts. She oversees the Surescripts Sentinel, a data analysis and quality monitoring tool. Sentinel brings actionable intelligence to prescribers, pharmacies and PBMs empowering companies to research e-prescribing errors and drive transactional quality improvements. She has over 15 years of experience in software development and product management, supporting many industries including healthcare, agriculture, retail and hospitality. Rachel earned her BS in Engineering from the University of Minnesota, Twin Cities and holds an MBA from the University of Chicago, Booth School of Business. She currently resides in Minneapolis with her family and

a very mischievous goldendoodle.



Jeremy Warner, MD, MS

Vanderbilt University

Jeremy Warner MD, MS is an Assistant Professor of Medicine and Biomedical Informatics at Vanderbilt University, where he also directs the Vanderbilt Cancer Registry and SCT Data Analysis Team. He is a practicing clinician who is board certified in Internal Medicine, Medical Oncology, Hematology, and Clinical Informatics; his clinical focus is lymphoid neoplasms. His research interests are in the area of clinical and translational cancer informatics, including: high-dimensional data analysis and visualization, natural language processing of cancer-specific narratives, and development/implementation of oncology-specific health IT standards. He is immediate past chair of the American Society of Clinical Oncology (ASCO)'s Health IT Workgroup, and helped ASCO to create the Clinical Oncology Treatment Plan and Summary HL7 CDA Implementation Guide. He is the chief

software architect of SMART Precision Cancer Medicine. Both of these efforts were highlighted in the 2016 President's Cancer Panel report, "Improving Cancer-Related Outcomes with Connected Health," and SMART Precision Cancer Medicine was recently noted to be one of the "7 best SMART on FHIR apps." He is a member of the All of Us Research Program's Data and Research Support Center, and is actively involved in efforts to share EHR data through HL7 FHIR and other means.

“Current State: Native EHR API Capabilities and Business Models”



Tony Confrey

Athena Health

Tony Confrey is a Senior Architect and the Executive Director of Integration Services at athenahealth. His teams are responsible for all movement of data into and out-of athenaNet via standard and non-standard interfaces. During his tenure at athena he has also led the Clinicals EHR development team and the Collector Revenue Cycle Management development team. Tony has an MSCS degree from Stanford University and a BA from Trinity College Dublin.



Sharma Manoj

Allscripts

As an Innovations Architect, Manoj Sharma works closely with Allscripts electronic medical records (EMR), population health management and care coordination products to deliver a more connected and Open-platform solutions to access core-clinical information to meet regulatory and industry demands. Manoj championed clinical decision support (CDS) and other analytical solutions within Allscripts to ensure evidence-based real-time solutions, including InfoButton, were utilized to achieve quality outcomes within the clinical and care coordination settings during

the various Meaningful Use stages. His current initiatives, SMART on FHIR and CDS-Hooks, main goals will be to provide an Open and interoperable architecture within Allscripts and the FHIR community that integrates ambulatory, acute and post-acute architecture that spans every care setting.



David McCallie

Cerner

Dr. David McCallie is Senior Vice President for Medical Informatics at Cerner Corporation, and Cerner Engineering Fellow. He is responsible for a research team focused on innovations in clinical informatics. His current research includes applications of semantic content extracted from the EHR using natural language parsing and machine learning techniques. In addition to his work at Cerner, he works with industry collaborators

to create vendor-neutral standards that foster EHR interoperability. He was a co-founder of CommonWell Health Alliance, a multi-vendor trade association devoted to national-scale interoperability. Prior to that, he helped create Direct, a widely-used standard for secure clinical messaging. Dr. McCallie served for 6 years on the ONC HIT Standards Committee, and remains active with ONC FACA workgroups. He is a member of the HL7 Advisory Council, and is one of the founders of the Argonaut Project, a multi-vendor collaborative promoting the development of API-based interoperability standards that leverage HL7's FHIR standard. Dr. McCallie earned a BSEE from Duke, and his MD from Harvard.



Isaac Vetter

Epic

Isaac Vetter is a software developer and a leader on of interoperability efforts at Epic. He consults with health system, academic and commercial developers building apps on top of Epic using standards based technology, including FHIR, SMART on FHIR and other integration methods. Isaac's day job includes managing development Epic's App Orchard and working on CDS Hooks with Argonauts.

“Tools and services for marshaling data at scale”



Leonard D'Avolio, PhD

Cyft

Dr. Leonard D'Avolio, Ph.D. is an Assistant Professor at Brigham and Women's Hospital and Harvard Medical School, the CEO and co-founder of Cyft a healthcare prediction company, an advisor to the Helmsley Charitable Trust Foundation, board member for Youth Development Organization, a researcher and writer. He previously led informatics for the Department of Veterans Affairs' precision medicine initiative (the Million Veteran Program) and the first clinical trial embedded within an electronic medical record system. Dr. D'Avolio founded Ariadne Labs' informatics team and led their partnership strategy as well as the creation of a mobile phone-based system that uses real time data feedback to improve neonatal care in Uttar

Pradesh, India. His work has been funded by several agencies and organizations including the Department of Defense, the Department of Veterans Affairs, the Agency for Healthcare Research & Quality, the National Cancer Institute, Helmsley Charitable Trust Foundation, and the Bill and Melinda Gates Foundation.



William Crawford

Fitbit

William Crawford is a Senior Advisor to the Enterprise and Digital Health group at Fitbit, Inc, where his previous roles included VP of Engineering and Interim CIO. As the head of Fitbit's Boston office, he led the growth of Fitbit's New England product and engineering teams from zero to over 140 people. Prior to Fitbit Will was co-founder and CEO of Linked Medical, an MGH clinical informatics spinoff acquired by DBC Pri-Med in 2013. Earlier roles included Director, Informatics Solutions Group at Children's Hospital Boston, and CTO of Invantage, Inc, which was the

first SAAS toolset for clinical trial management and was acquired by PAREXEL in 2002. From 2006-2007 he was the Health IT Policy Lead in the CMS Office of Policy at the US Department of Health and Human Services. He is also an active angel investor and advisor to young companies in the healthcare and technology verticals. He is the author or co-author of several books on software engineering, and holds a Bachelor's Degree from Yale University, an MBA from the MIT Sloan School of Management, and an MS from the Harvard-MIT Division of Health Science and Technology.



Shawn Murphy, MD, PhD

Partners Healthcare

Dr. Murphy is the Corporate Director of Research Computing and Informatics at Partners HealthCare, is an Associate Professor of Neurology at Harvard Medical School, and serves as Associate Director for the Laboratory of Computer Science at the Massachusetts General Hospital. Dr. Murphy developed and currently directs the Research Patient Data Registry (RPDR) for Partners HealthCare. The RPDR is a large data warehouse with 6.5 million patients and 2.2 billion rows of clinical data, serving as a central clinical data registry for inpatient and outpatient encounters in order to support clinical research. Dr. Murphy is also chief of software development for the NIH-sponsored Informatics for Integrating Biology and the Bedside (i2b2), an open source project that integrates data from the hospital medical record and the bioinformatics community into a common software platform, with over 140 operating installations worldwide. The work of i2b2 is focused on strengthening the understanding of the metabolic and genetic underpinnings of complex diseases by developing an informatics framework to bridge data for clinical research using electronic health records.



Jason O'Meara

Quest Diagnostics

Mr. O'Meara is responsible for overseeing the architecture and design of Quest Diagnostics enterprise analytics, business intelligence and data solutions. He drives the realization of the company's information harmonization and analytics strategy through architectural blueprints, product roadmaps, technology evangelism and data governance.



John Shon, AB, MD

llumina

John Shon is VP of Bioinformatics and Data Sciences at Illumina. In this role he leads a global team of bioinformatics scientists in developing algorithms and methods for Illumina NGS instruments and assays. As part of the Enterprise Informatics business unit, he also leads bioinformatics for clinical interpretation and translational informatics software. Prior to Illumina, Dr. Shon has over a decade of experience in large pharmaceutical companies, most recently as VP of Informatics, Research IT and External Innovation at Janssen Pharmaceuticals (a division of J&J) where he supported R&D, clinical development and Janssen Diagnostics teams. At Roche, Dr. Shon led informatics groups in translational research for target discovery, biomarker selection, drug safety and personalized healthcare. John earned his AB in Biochemistry from Harvard, an MD from Stanford, and completed his internship and residency in Internal Medicine at the University of Chicago, and an MS and postdoc in Medical Information Sciences at Stanford.

“Open or shut case? Open standards in commercial systems. ”



Gil Alterovitz, PhD

Boston Children’s Hospital

Gil Alterovitz is Director of the Biomedical Cybernetics Laboratory and a Harvard professor with the Computational Health Informatics Program at Boston Children’s Hospital and the Harvard/MIT Division of Health Sciences and Technology. A large component of Dr. Alterovitz’s work involves international collaborations that bring together researchers and work on heterogeneous clinico-genomic data. His work also involves leading clinical genomics standards and development. He serves as co-chair of the HL7 Clinical Genomics workgroup (where he is group leader of the FHIR Genomics effort), is on the executive team of the Clinical Workgroup of the Global Alliance for Genomics and Health (GA4GH), and serves as a member of the Institute of Medicine DIGITizE project. Within the SMART consortium, he leads the SMART/FHIR Genomics effort. He was recently also appointed to the national Precision Medicine Task Force and to lead the Sync for Genes effort for enabling a national standard for sharing of clinical genomic information.



Deborah Estrin

Cornell University

Deborah Estrin is a Professor of Computer Science at Cornell Tech in New York City. She is founder of the Health Tech Hub in the Jacobs Institute and directs the Small Data Lab at Cornell Tech. Her current research focus is on mobile health and small data, leveraging the pervasiveness of mobile devices and digital interactions for health and life management (TEDMED). Estrin co-founded the non-profit startup, Open mHealth and sits on several scientific advisory boards for early stage mobile health startups. Previously, Estrin was on the UCLA faculty where she was the Founding Director of the NSF Center for Embedded Networked Sensing (CENS), pioneering the development of mobile and wireless systems to collect and analyze real time data about the physical world. Her honors include: ACM Athena Lecture (2006), Anita Borg Institute's Women of Vision Award for Innovation (2007), The American Academy of Arts and Sciences (2007), The National Academy of Engineering (2009), The IEEE Internet Award (2017).



Jon White, MD

ONC

Dr. Jon White is a family physician who has dedicated his career to improving health and health care quality through the use and sharing of electronic health information. At ONC, Dr. White provides high level executive direction and leadership for all ONC programs and policies, and advances key priorities. He has led mission-critical activities, including the publication of high priority, nationally impactful regulations, implementation of the 21st Century Cures Act, a widely publicized Congressional Report on Information Blocking, and ONC's efforts in the Precision Medicine Initiative. Before his service at ONC, Dr. White was Director of the Division of Health IT at the Agency for Healthcare Research and Quality (AHRQ). Dr. White has deep

experience working with federal government partners (including the Centers for Medicare and Medicaid Services and the Department of Veterans Affairs), as well as key health care professional, patient, policy, and health IT stakeholder groups to implement major health care initiatives. Dr. White trained in family medicine at the University of Virginia and Lancaster General Hospital in Pennsylvania. He is a recipient of the national AAFP Award for Excellence in Graduate Education. He is a charter member of the Zak and Ken Fan Club.

Andy Palmer, See Moderator Profile

“The role of consensus, law and regulation”



Aneesh Chopra

Nav Health

Aneesh Chopra is the President of NavHealth, a member-driven company that harnesses open health data to provide insights and workflow for population health organizations. He served as the first U.S. Chief Technology Officer and authored, "Innovative State: How New Technologies can Transform Government."



Natalie Kates

Digital Health Service

Natalie Kates is a product manager hell-bent on making the healthcare system serve and support Americans everywhere. Natalie was first exposed to the absurd labyrinth that is healthcare data 8 years ago when she led the design and development of a tool to help hospitals automate their financial assistance processes. Since then, she's focused on building accessible products that address systemic data and infrastructure challenges while solving critical user problems. Now at the United States Digital Service she's coming up with ways government can use technology to better solve the tremendous challenges facing our nation's healthcare system.



Donald Rucker, MD

ONC

Dr. Don Rucker is the National Coordinator for Health Information Technology at the U.S. Department of Health and Human Services, where he leads is the formulation of the federal health IT strategy and coordinates federal health IT policies, standards, programs, and investments. Dr. Rucker has three decades of clinical and informatics experience. He started his informatics career at Datamedic Corporation, where he co-developed the world's first Microsoft Windows-based electronic medical record. He then spent over a decade serving as Chief Medical Officer at Siemens Healthcare USA. Dr. Rucker has also practiced emergency medicine for a variety of organizations including at Kaiser in California; at Beth Israel Deaconess Medical Center; at the University of Pennsylvania's Penn Presbyterian and Pennsylvania Hospitals; and, most recently, at Ohio State University's Wexner Medical Center. Dr. Rucker is a graduate of Harvard College and

the University of Pennsylvania School of Medicine, with board certifications in Emergency Medicine, Internal Medicine and Clinical Informatics. He holds an MS in Medical Computer Science and an MBA, both from Stanford.

John Wilbanks, See Moderator Profile

“Hooks for Decision Support. Can we get there fast?”



Blackford Middleton, MD, MPH, MS

Apervita

Blackford Middleton is Chief Informatics and Innovation Officer at Apervita, Inc., a vendor of cloud-based analytics services and a Marketplace for the exchange of knowledge artifacts. He is also an Instructor in the TH Chan Harvard School of Public Health. Dr. Middleton’s work focuses on clinical informatics – the applied science surrounding strategy, design, implementation, and evaluation of information systems in complex environments. He serves as Co-Chair of the Steering Committee for the AHRQ-funded PCOR Clinical Decision Support Learning Network, and as an CDS subject matter expert to MITRE’s Project Connect. During his time as CIO at Vanderbilt he implemented a comprehensive organizational and process redesign to better achieve world-class software development at scale. Previously, he was Corporate

Director of Clinical Informatics Research & Development (CIRD), and Chairman of the Center for Information Technology Leadership (CITL) at Partners Healthcare System, Boston, and Assistant Professor of Medicine at Brigham and Women’s Hospital, Harvard Medical School. His work at Partners focused on building an advanced informatics infrastructure to support translational research, and the development and implementation of knowledge-based tools for cloud-based clinical decision support (provider and patient), knowledge engineering, population management, and support for technology assessment and comparative effectiveness research. Throughout his career he has been actively engaged in mentoring junior faculty, Fellows, and students.



Kevin Shekleton

Cerner

Kevin Shekleton, a Vice President & Distinguished Engineer at Cerner, is a polyglot technologist, having worked in a wide variety of systems throughout his 15-year career in the healthcare IT industry. He is passionate about technology, interoperability, and open source. Kevin is the lead on the CDS Hooks project and has helped build a vibrant community of support around

the project. At Cerner, he is currently responsible for multiple aspects of Cerner’s platforms and solutions: support for SMART on FHIR, support for CDS Hooks, mobile architectures, and software cybersecurity strategy and implementation.

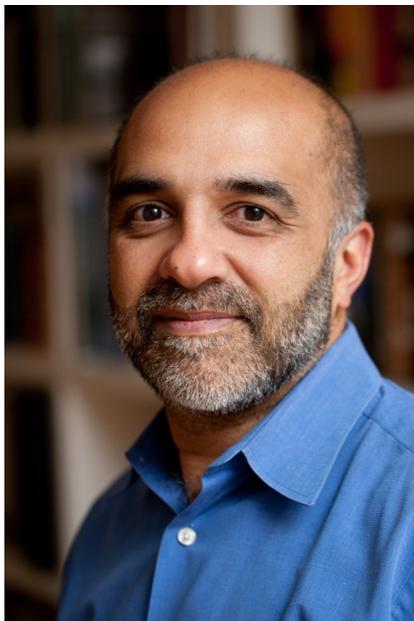


Gajen Sunthara, MS

Boston Children's Hospital

Gajen Sunthara is the Director of Innovation R&D at Boston Children's Hospital. Prior to this role, he helped tech-architect President Obama's Precision Medicine Initiative at the White House, worked at The United States Digital Service (USDS), and served as a Presidential Innovation Fellow (PIF) at the U.S. Department of Health and Human Services/Office of the National Coordinator for Health IT. While in both public service roles, he worked with multiple government agencies including the U.S. Department of Defense (DoD), Veteran Affairs (VA), and the

Centers for Medicare & Medicaid Services (CMS) on the national healthcare information exchange. He also holds a Senior Advisor role for both InciteHealth at the Center for Primary Care at Harvard Medical School and the Silicon Valley based startup Sherbit. In addition, he is the founder of 1upHealth and cofounder of Nightingale Apps. Gajen has a B.Sc. in Computer Science from Wentworth Institute of Technology and a M.S. in Information Technology from Harvard University.



Micky Tripathi, PhD, AB

MAeHC & Argonaut Project

Micky Tripathi is the President & Chief Executive Officer of the Massachusetts eHealth Collaborative (MAeHC), a non-profit corporation providing professional services and technology solutions to improve health care delivery. He is also Project Manager of the Argonaut Project, an initiative to modernize interoperability standards, a Director of the Sequoia Project, a Director of the New England Health Exchange Network (NEHEN), and a member of the HL7 Advisory Council. Prior to joining MAeHC, Mr. Tripathi was the founding CEO of the Indiana Health Information Exchange (IHIE), a health information exchange partnered with the Regenstrief Institute. Mr. Tripathi was also a Manager at the Boston Consulting Group, a strategy and management consulting firm, serving a variety of US and international clients in the bioinformatics, biotechnology, financial services, and pharmaceutical industries. He holds a Ph.D. in

political science from the Massachusetts Institute of Technology, a Master of Public Policy from Harvard University, and an AB in political science from Vassar College. Prior to his career in health care, he was a senior operations research analyst in the Office of the Secretary of Defense in Washington, DC, for which he received the Secretary of Defense Distinguished Civilian Service Award.

“Preparing the Enterprise”



Charles Bach

Kaiser Permanente

Charles Bach is a Data Architect for Kaiser Permanente serving the Southern California region. As an integrated provider, Kaiser Permanente has 21,000 dedicated physicians that cares for over 11 million patients. Kaiser Permanente has the unique advantage of caring for patients through a wide variety of engagement points. However, with this advantage, enormous amounts of data are generated at every touch point along the patient life cycle. In order to derive meaningful information from Kaiser’s complex data environment, Charles designs and provides architecture for data management and analytics solutions. Charles also conducts rapid proof of concepts on new and emerging technologies that can rise to the challenge of a changing healthcare landscape. The goal is to constantly test and create modern industrial strength architectures that can not only analyze vast amounts of data

but also incorporate new technology touch points from social, mobile and wearables.



James Buntrock

Mayo

Mr. James D. Buntrock is the Vice Chair of Information Technology (IT) at Mayo Clinic supporting Enterprise Platforms for Data, Analytics, API, Identity, and Knowledge. He is also serving as the IT director for Mayo Clinic's three collaborative centers — the Center for Individualized Medicine, the Center for Regenerative Medicine and the Center for the Science of Health Care Delivery — supporting discovery, translation and application of new models of care along with new diagnostics and therapies. With his interest in informatics and application of analytics his roles have been shaping science and discovery. He has lead and created IT teams for application

development, enterprise data warehousing, Big Data adoption, genomics data processing, analytic services/methods, and HPC/storage infrastructure. He is currently an Instructor in Medical Informatics at the Mayo Clinic College of Medicine.



Keith Dreyer, DO, PhD, FACR, FSIIM Massachusetts General Hospital

Keith J. Dreyer, DO, PhD, FACR, FSIIM, is Vice Chairman of Radiology and Director of the Center for Clinical Data Science at Massachusetts General Hospital and Associate Professor of Radiology at the Harvard Medical School. He is ABR board certified in diagnostic radiology with a BS in Mathematics, MS in Image Processing, PhD in Computer Science and medical fellowships in Imaging Informatics and Magnetic Resonance Imaging from Harvard University at MGH. Dr. Dreyer has held

numerous board, chair, advisory and committee positions with the American College of Radiology, Radiological Society of North America, Society of Imaging Informatics in Medicine and numerous global healthcare corporations. He has authored hundreds of scientific papers, presentations, chapters, articles and books; lecturing worldwide on clinical data science, cognitive computing, clinical decision support, clinical language understanding, digital imaging standards, and implications of technology on the quality of healthcare and payment reform initiatives.



Alistair Erskine, MD Geisinger Health System

ALISTAIR ERSKINE, MD is Chief Informatics Officer at the Geisinger Health System. He is responsible for sequencing innovative technologies, harmonizing data across the enterprise, and aligning healthcare systems to optimize patient experience. Dr. Erskine heads the Division of Informatics which engages staff in the design and configuration of Geisinger's clinical information

systems and evolves Geisinger's facilities to take advantage of ultramodern technologies. Dr. Erskine oversees Geisinger's Unified Data Architecture, a hedged data management environment powered by Big Data and traditional relational database systems to ensure that data collected as a by-product of clinical, and research investigation are accessible for new discovery and appropriate secondary use. Dr Erskine participates on several clinical informatics research grants (e.g. PCORI, NIH). Prior to Geisinger, Dr. Erskine was appointed Associate Dean of Medical Informatics at Virginia Commonwealth University and was member of the Board for the 650-physician Medical College of Physician practice plan. Dr. Erskine trained at Brown University and Virginia Commonwealth University Health System and is triple Board-Certified in Internal Medicine, Clinical Informatics and Pediatrics. He is currently engaged in a two-year executive MBA program with MIT Sloan School of Management.



William Gregg, MD, MS, MPH

HCA Corp

William M. Gregg, MD, MS, MPH, joined CSG on May 1 as Vice President, Clinical Informatics. In addition to his medical degree, Dr. Gregg holds an undergraduate degree in Electrical Engineering from Georgia Institute of Technology, graduating with highest honors. He earned a master's degree in Clinical Informatics and was a Quality Scholar in the Veterans Administration program. For the past 9 years, Dr. Gregg served as an Assistant Professor of Medicine at Vanderbilt University's Department of Biomedical Informatics, and was the Director of Population Health Informatics. He helped develop successful programs and informatics systems for effective clinical decision support in the electronic health record. Dr. Gregg also helped lead the development of Vanderbilt's Advanced Care Management Informatics infrastructure, leading to a \$19 million CMS Medical Home Award to facilitate its adoption throughout Middle Tennessee.

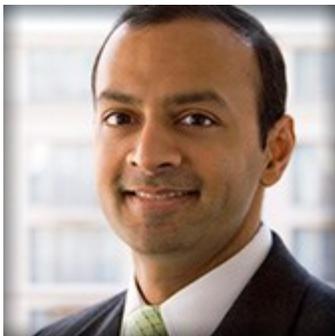


Adam Landman, MD, MS, MHS

Brigham and Women's Hospital

Adam Landman, MD, MS, MIS, MHS is Chief Information Officer at Brigham Health, Assistant Professor of Emergency Medicine at Harvard Medical School, and an attending emergency physician at Brigham and Women's Hospital (BWH). He is an expert in information systems development and implementation. He led a three-year, \$7 million custom software development project to move BWH Emergency Department clinicians from paper-based to electronic documentation. Recently he helped oversee the implementation of Epic and several critical laboratory information systems.

Dr. Landman also created the BWH Digital Health Innovation Group to spur hospital use of digital technology as well as facilitate appropriate use of digital tools by clinicians, innovators, and researchers. As CIO, he is currently responsible for the stabilization and optimization of the EHR, all other hospital information systems, and digital health innovation.



Hiten Patel

The Advisory Board Company

Hiten is the head of Product Management for Enterprise Analytics at The Advisory Board Company. In this role, Hiten leverages his consulting experiences and scientific training in the development and construction of analytic tools and platforms to support the Advisory Board's various membership programs reduce time to value across a variety of problem spaces. Hiten earned his Ph.D. from Harvard University. Prior to joining the firm, he was an Associate with Dean and Company, a strategy consulting firm in Northern Virginia, where he served clients in a variety of industries. Hiten also assisted institutional investors and consulting clients in the pharmaceutical and medical device industries while managing market research studies for MEDACorp, a boutique healthcare consulting firm in Boston.

Participant Profiles



David Ahern, MD

Brigham & Women's Hospital

David is the Director of the Program in Behavioral Informatics and eHealth within the Department of Psychiatry at the Brigham & Women's Hospital and Assistant Professor of Psychology (Psychiatry) at Harvard Medical School. Over his 30-year career David has focused on the intersection of informatics and behavioral science to improve health and healthcare. David was National Program Director for the Health e-Technologies Initiative of the Robert Wood Johnson Foundation from 2002-2009 where he managed a technology research portfolio of 26 grants promoting the use of technology for health behavior change and chronic disease management. He has published over 100 articles, book chapters, and technical reports. In 2013, David began a detail to the National Cancer Institute whereby he serves as a special advisor on health information technology to the Healthcare Delivery Research Program. During his tenure at NCI David has co-edited a book entitled Oncology Informatics recently published by Elsevier with Drs. Brad Hesse and Ellen Beckjord and co-facilitated the President's Cancer Panel workshop series on Connected Health, with release of the final report to President Obama in November 2016.



Michelle Allen

Premier, Inc

Michelle Allen is the Vice President of Safety Solutions for Premier Inc., where she is responsible for leading the Clinical Surveillance business and Integrated Pharmacy technology solutions. Premier's Clinical Surveillance technology, powered by TheraDoc®, is currently used in over 1000 hospitals. TheraDoc has a twelve year, proven track record positively impacting Hospital-Acquired Condition (HAC) and Antimicrobial Stewardship (AMS) goals with real-time technology which clinical teams customize to alert, report and take immediate clinical action around their unique patient population. Michelle has 20 years of experience in healthcare information technology leading high performing teams in strategy, product development, engineering, & operations for Premier, Hospira, GE Healthcare, and Abbott Laboratories. Throughout her career, Michelle has championed interoperability and is currently driving the SMART App and FHIR API development strategies at Premier. Michelle earned her Master's degree in Engineering Management from Northwestern University.



Suresh Balu

Duke Institute for Health Innovation

Mr. Balu is director of the Duke Institute for Health Innovation (DIHI) and provides strategy consulting to several groups at Duke. He joined Duke after working with Deloitte for several years. He received his MBA from the Kenan-Flagler School of Business at the University of North Carolina Chapel Hill.



Aliaa Barakat, PhD

Pulmonary Care and Research Collaborative

Aliaa Barakat is a mathematician and mathematical physicist turned healthcare scientist. She received her Ph.D. in mathematics from the University of Chicago, and held postdoctoral and faculty appointments at Berkeley and MIT. In 2009, Aliaa started a personal journey with a pulmonary illness that inspired me to devote my mathematical research to applications in medicine. She founded and direct a nonprofit organization, the Pulmonary Care and Research Collaborative, dedicated to improving healthcare quality and outcomes for pulmonary patients.

Working with multidisciplinary teams of clinicians, patients and researchers, we are establishing a nationwide data infrastructure to facilitate and efficiently conduct cross-institutional clinical research driven by the needs of patients and their clinicians. Our novel machine intelligence platform builds on the mathematical theory of topological data analysis and enables deep phenotype extraction from clinical, molecular and genomic data. As a staff scientist at the Molecular Biomarkers Nano-Imaging Laboratory at BWH, her research is focused on the mechanistic molecular underpinnings of age-related diseases, and on biomarker modeling of disease progression through the utilization of new imaging technologies and clinical data science approaches. Aliaa cofounded Juventa Sciences, a biotech startup developing therapeutics that target immune dysregulation in metabolic and fibrotic diseases.



Glenorchy Campbell

BMJ

Glen has been in STM publishing for more than 34 years, starting with Alan R. Liss in 1980. In 1990, Glen joined Elsevier as a Biomedical Journals Editor. Over more than 23 years at Elsevier, he held a number of positions with responsibility for setting strategies for the growth and development of biomedical journals in print and online. In his roles as EVP, Global Medical Research, he oversaw more than 435 journals in the health sciences, including The Lancet, and many premier society journals. In his role as EVP, STM Society Publishing, Glen worked with many of the most prestigious

societies in the health, life, physical, and social sciences. Glen joined BMJ late in 2013 as Managing Director the US, and was thrilled to be given responsibility for the development and growth of The BMJ, BMJ Journals, and BMJ Clinical Improvement Products in all the Americas in January of 2017. Glen is a past Chair of the Executive Council of the Professional and Scholarly Publishing Division (PSP) of the Association of American Publishers (AAP). In addition, he serves on the American Medical Publishers Committee (AMPC) of the PSP and the AMPANational Library of Medicine Subcommittee of that group. Glen is currently Chair of Board of Directors of the Friends of the National Library of Medicine



Noah Craft

Science 37

Dr. Noah Craft MD, PhD is the co-founder and CEO of Science 37 and a physician-scientist-entrepreneur. Science 37 transforms the clinical research process, accelerating biomedical discovery and reducing clinical trial costs by shifting the center for research from traditional institutional investigative sites to the patient's home and local healthcare system. We use our patient-centered technology platform (NORA®) to create meta-sites™, simplify the process of participating in trials, and connect patients safely and securely to the world's best scientists, no matter where they live. For 10+ years Dr. Craft has worked on the skin microbiome, parasite immunology, and cancer vaccine development. He also serves as a senior strategic advisor to both VisualDx and Direct Derm. He has published more than 45 peer-reviewed research manuscripts and holds multiple patents. Dr. Craft received a B.S. from Brown University, completed medical school, residency, and post-doctoral research at UCLA.



Finale Doshi-Velez

Harvard University

Finale Doshi-Velez is an assistant professor at Harvard University, working at the intersection of machine learning and healthcare. Her interests include sequential decision-making, with applications to personalizing treatment, and representation learning, with applications to data-driven phenotyping.



Tom Doyle

HCA

Mr. Doyle has been the Chief Architect at HCA for fourteen years. His areas of contribution in that role have encompassed a number of areas including technical governance, solution assurance, problem management and technical design. Other areas of involvement included integration, networking, high availability and disaster recovery. He was the lead behind establishment of HCA's Clinical Data Management solution which integrates data from many hundreds of data sources into Health Information Exchange and Clinical Data Warehouse platforms. Prior to joining HCA he was employed by IBM and Unisys/Sperry in a number of roles that involved platforms ranging from the desktop to mainframes.



Marie Dunn, MS

Health Catalyst

Marie Dunn is Vice President for Population Health Strategy and Operations at Health Catalyst, a data warehousing, analytics, and outcomes improvement company. Marie has spent the majority of her career at the intersection of technological innovation and health care. In her work at Health Catalyst, she has played leadership roles in the launch of several new products and services, including the firm's Accountable Care Product Line, Professional Services Division, "living lab" partnership with Allina Health, and Population Health work. Previously, Marie served as a Senior Consultant at The Advisory Board Company to health information technology executives. In this capacity, she led the firm's meaningful user research and consulting engagements. Marie has also worked with Partners HealthCare, InterSystems, and SMART Platforms in health IT strategy roles focused on population health management, analytics, and interoperability. Marie holds a MS in Health Policy and Management from Harvard School of Public Health, where she served as a teaching fellow to Drs. Lucian Leape and Ashish Jha. She holds and a BA in Economics from The University of Virginia.



Andrew Eland

DeepMind

Andrew leads our team of software engineers bringing cutting-edge technology to our NHS partners. He's one of the world's most experienced mobile engineers, having led the teams behind Google Maps for Android and iPhone, one of the most downloaded apps of all time. Andrew went on to lead the engineering for philanthropic efforts at Google.org, working on ambitious projects to help emergency response in major crises, track the spread of flu, and increase participation in elections. He has a long track record of working with major institutions, having started out building the very first interactive TV services within the BBC, and later partnering with universities and researchers across Europe on projects to improve urban planning.



Peter Embi, MD, MS, FACP, FACMI

Regenstrief Institute, Inc

Dr. Embi is an internationally recognized researcher, educator, and leader in the field of clinical and translational research informatics, with numerous peer-reviewed publications and presentations describing his innovations in the field. Dr. Embi currently serves as President and CEO of the Regenstrief Institute, and he holds related leadership roles at Indiana University and the IU Health System. He previously served in various leadership positions at The Ohio State University, including Interim Chair of Biomedical Informatics, Informatics Director of the OSU Center for Clinical and Translational

Science, and Chief Research Information Officer at the OSU Wexner Medical Center. Prior to that, he was on the faculty of the University of Cincinnati College of Medicine, where he was the founding director of the UC Center for Health Informatics. Among his numerous awards recognitions, Dr. Embi is a Fellow of the American College of Physicians, a Fellow of the American College of Medical Informatics, and he is Chair-Elect of the Board of Directors of the American Medical Informatics Association.



Brad Engels

First Bank Data, Inc (FDB)

Brad Engels joined First Databank, Inc. (FDB)—part of the Hearst Health Network—in 2003. He's the Product Manager of FDB's Cloud Connector (a Web API) and MedKnowledge Framework (an SDK). He also manages some aspects of FDB's Canadian products. His professional background has focused on the utilization of FDB's medication knowledge base within vendor applications, and his exposure has led to a solid foundation of CDS deployments within various traditional markets (inpatient, ambulatory, and retail

pharmacy). He's interested in exploring emerging technologies related to CDS, interoperability, and open APIs, as well as exploring the opportunities they bring (both new product opportunities for FDB, and new ways for FDB to promote positive change in the industry). Interests for fun include blockchain, beer, and boardgames of all kinds!

Keith Figlioli, MBA

Long River Ventures



Keith J. Figlioli is currently a Venture Partner with Long River Ventures. He was most recently Premier, Inc.'s Senior Vice President of healthcare informatics. In this role, he led the company's enterprise healthcare technology business unit and helped the company raise \$820M in its IPO. Prior to Premier, Keith was with Eclipsys (acquired by Allscripts) as its Senior Vice President of Enterprise Solutions, where he was responsible for all go-to-market activities, market planning and solution strategic direction across clinical, financial and operational product offerings. Earlier in his career, Keith was the senior business development executive at a management consulting and systems integration company focusing on Fortune 1000 companies and

previously served in a variety of business development and marketing roles for the health information technology industry including work for Per-Se Technologies, Medaphis and NEC. Keith has a M.B.A. from Boston University and a B.A. from Wheaton College. He is a member of the Board of Trustees at Wheaton College and strategic advisor to Cyft, Inc. He has previously served on the Health IT Standards Committee for the Office of the National Coordinator and the board of directors for Global Healthcare Exchange (GHX), Activate Networks, Good Sports, and MassBike.

Allen Flynn, PharmD

University of Michigan Medical School



Following his graduation as a Doctor of Pharmacy from the University of Michigan, Allen Flynn studied Computer Science. After working as a network analyst during the dot-com bubble he returned to pharmacy practice as a hospital staff pharmacist. Allen was promoted to Coordinator and became involved with several major health IT projects. For the next 8 years he held roles of increasing responsibility while developing his expertise in electronic health records and medication system safety. This real-world experience inspired Allen to dedicate his professional life to generally improving the capabilities of health IT. He went back to school and is presently a doctoral candidate in the School of Information at the

University of Michigan, where he studies community-based digital knowledge management for health. Allen also serves as tech lead for the Knowledge Grid team of the Department of Learning Health Sciences at Michigan. The Knowledge Grid is a Learning Health System infrastructure component being developed for retaining, sharing, and deploying machine-interpretable biomedical knowledge.



Kathe Fox, PhD

Aetna

Kathe P. Fox, Ph.D., is a member of our Analytics and Behavior change organization and leads the Informatics activities which support the design and assessment of provider and network services; supports the assessment and monitoring of Aetna's Joint Venture partners; and oversees reporting and analysis for Plan Sponsors. Kathe also helps manage data governance for external release of Aetna data for research. Recently Kathe won the 2014 Aetna Innovator of the Year Award for her Health/Wealth product idea. Prior to joining Aetna, Kathe was Vice President and Practice Leader for Health Plan customers at Medstat (now Truven Health Analytics) where she was responsible for analytic and consulting solutions for the managed care market. She also led a number of federal contracts including the CMS Medicaid Encounter Data Quality and Performance Measurement project for the Centers for Medicare and a AHRQ Medical Errors Reporting Implementation Plan. Kathe holds a Ph.D. from Yale University (Department of Epidemiology and Public Health) and a B.A. in History from Skidmore College.



Rick Freeman

iSalus Solutions

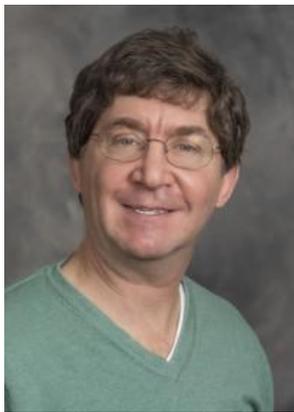
Mr. Freeman is the President and CEO of iSalus Solutions and founded the company in 2012. As one of the original founders of the Healthcare Services Platform Consortium (HSPC), he has been involved with the SMART on FHIR initiative since late 2013 when he and his company teamed up with HSPC, Cerner, SMART, and Intermountain Healthcare to feature it at HIMSS 2014. Since then, under his leadership, his company has been at the center of the emergence of the healthcare application ecosystem by building the SMART on FHIR sandboxes run by SMART and HSPC, integration libraries, tutorials, implementation guides, and numerous SMART apps (many of which are in production today). He continues to be actively involved in driving its adoption and as a result has developed strong relationships with the country's largest EHR vendors and is regularly asked to speak at national HIT conferences.



Nils Gehlenborg, PhD

Harvard Medical School

Nils Gehlenborg, PhD, is an Assistant Professor in the Department of Biomedical Informatics at Harvard Medical School. Nils received his PhD from the University of Cambridge and was a predoctoral fellow at the European Bioinformatics Institute (EMBL-EBI) in the Functional Genomics Group of Alvis Brazma. Dr Gehlenborg completed his postdoctoral training as a Research Associate in the lab of Peter J Park at the Center for Biomedical Informatics at Harvard Medical School. The goal of Nils' research is to improve human health by developing visual interfaces and computational techniques that enable scientists and clinicians to efficiently interact with biomedical data. Tight integration of algorithmic approaches from biomedical informatics with advanced data visualization techniques is central to his efforts, as is close collaboration with clinicians and experimentalists. Currently, Nils is researching and developing novel tools to visualize 3D genome conformation data as well as heterogeneous data from large-scale cancer genomics studies. These efforts integrate visual and computational approaches to support sense-making in biology and to support reproducible, collaborative research. Nils is also a Co-Investigator for the 4D Nucleome Network Data Coordination and Integration Center hosted at Harvard Medical School.



Howard Goldberg, MD

Baystate Health

Dr. Howard Goldberg is Chief Medical Information Officer and VP Clinical Informatics at Baystate Health in Springfield, MA. In his role, Dr. Goldberg also serves on the steering committee and as an executive sponsor to Baystate's incubator program TechSpring. Prior to coming to Baystate, Dr. Goldberg held positions at the Harvard teaching hospitals, including Associate Director for Informatics at the Deaconess Hospital, faculty at the Center for Clinical Computing at Beth Israel Deaconess Medical Center, and Sr. Corp Manager for Informatics Infrastructure at Partners HealthCare System. Dr. Goldberg also served as Vice President for R&D and Product Development for Clinician Support Technology, where he worked with pioneer Dr. Charles Safran on innovations in patient portals. Dr. Goldberg has over 25 years of informatics experience, having worked with teams at the Johns Hopkins Hospital in developing the first clinical systems incorporating networks, relational databases, and multi-windowing clinical workstations. He is well-known for work with clinical terminologies, terminology services, and remote, interoperable decision support. Dr. Goldberg is board-certified in general internal medicine and clinical informatics, having completed an NLM-sponsored fellowship in Informatics and Clinical Decision-Making at Tufts Medical Center.



William Gordon

Partners Healthcare

Will is an internist and hospitalist at Massachusetts General Hospital and Clinical Informatics Fellow at Partners HealthCare / Brigham & Women's Hospital. He graduated from Weill Cornell Medical College and completed his Internal Medicine residency at Massachusetts General Hospital where he also worked at the MGH Laboratory of Computer Science. Prior to his role at Partners, he was the Director of Clinical Product at Kyruus, a patient access and provider-side population health information technology company based in Boston. He is interested in information security and data interoperability and leads the Boston SMART on FHIR interest group.



Adrian Gropper, MD

Patient Privacy Rights

Adrian Gropper, MD is the leading advocate and developer of patient-centered health records technology. His paper on linking the licensed physician to the patient without institutional intermediaries won a prize at ONC's 2016 Blockchain Health competition. He founded the HIE of One open source reference implementation project and a co-founder of OpenID HEALTH Relationship Trust (HEART). A career medical device entrepreneur, he founded AMICAS (NAS:AMCS) as the first Web-based radiology PACS and the first to provide imaging links in electronic health records. Dr.

Gropper also founded MedCommons to develop software for image-enabled, patient-centered health records supporting all of a patient's caregivers. He contributed to many standardization efforts including IHE, HITSP, Liberty Alliance and the Continuity of Care Record. Dr. Gropper helped create Blue Button, Direct Project, and Blue Button Plus and speaks frequently on privacy engineering in health care. He served on the Board and Management Council of the Identity Ecosystem Steering Group. Dr. Gropper holds degrees as an engineer from MIT and physician from Harvard Medical School.



Pete Groves

McKinsey & Company

Pete is the Partner and General Manager for PMP Analytics, McKinsey's center of excellence for building and operating advanced analytics assets to serve the Pharma and Medical Products (PMP) industry. In that role, Pete manages a team of 50 and oversees the Firm's investments and external partnerships in relevant technologies. Pete joined McKinsey in 2007; prior to taking this role, he was previously a Partner in McKinsey's hospitals and health insurance practice, serving clients in data- and analytics-enabled transformations. Outside of McKinsey, Pete was Head of Research at the hedge fund Bridgewater Associates; was a General Manager at the education Firm Kaplan, Inc.; and was the founding Executive Director of LIFT, a national non-profit to serve and empower families

to break the cycle of poverty. Pete graduated with degrees from Columbia Business School and Yale University; he lives outside of New York City with his wife, a clinical psychologist, and their two children.



Lovisa Gustafsson, MBA

The Commonwealth Fund

Lovisa Gustafsson runs The Commonwealth Fund's Breakthrough Health Care Opportunities. In this role, Ms. Gustafsson is responsible for developing and managing all aspects of the program, identifying new breakthrough opportunities, and developing a strategy to build on the current initiatives already underway. Prior to joining the Fund, Ms. Gustafsson served as senior vice president for the Marwood Group, a health care advisory organization, where she managed various outsourced private equity due diligence and strategy consulting engagements. In this role her work focused on federal and state reimbursement and regulatory trends and outlook, market research, and

corporate strategy advisory services for investor, corporate, and non-profit clients. Before her role at the Marwood Group, she worked as a manager in corporate strategy and business development at McKesson, a senior consulting associate in quality and operations support for Kaiser Permanente, a senior policy analyst at the Commonwealth of Massachusetts Office of Medicaid, and a manager at Avalere Health. Ms. Gustafsson earned an M.B.A. in healthcare management from the Wharton School at the University of Pennsylvania and a B.A. in Sociology from Harvard.



Tonya Hongsermeier, MD, MBA

Lahey Health

Tonya Hongsermeier, MD MBA currently serves as Vice President and CMIO at Lahey Health, an integrated healthcare system serving New England. Formerly, she was a Principal Informatician in Clinical Informatics R&D at Partners Healthcare System and has served as a Team Lead on both the AHRQ-funded Clinical Decision Support Consortium project and the ONC-funded Advancing Clinical Decision Support project. Prior to this, she served for 5 years as Senior Corporate Manager for Clinical Knowledge Management and Decision Support. In this capacity she built a knowledge management team and lead implementation of a collaboration, CDS authoring and content management platform for enterprise Clinical Decision Support. She also served as a co-chair for the Semantic Web Healthcare-Life sciences Special Interest Group for the World Wide Web Consortium. She received her MD from Boston University and completed her Residency in Medicine and Fellowship in Clinical Nutrition at the Deaconess Hospital. She received an MBA in Healthcare Management from BU School of Management in 1995, and has held several positions in industry leading a variety of informatics efforts. Prior to joining Partners Healthcare System, she was VP for Knowledge Management Solutions and Patient Safety at Cerner

Corporation.

Stan Huff, MD

Intermountain Healthcare



Dr. Huff is the Chief Medical Informatics Officer at Intermountain Healthcare, and a Professor (Clinical) of Biomedical Informatics at the University of Utah. He is board certified in Clinical Pathology. He has worked in the area of medical vocabularies and medical database architecture for the past 25 years. He is currently a fellow of the American College of Medical Informatics, a co-chair of the LOINC Committee, and a co-chair of the HL7 Clinical Information Modeling Initiative (CIMI). He is also the Chair of the Healthcare Services Platform Consortium (HSPC) and the Chair of the FHIR

Foundation. He is a former member of the ONC HIT Standards Committee. He teaches a course in medical vocabulary and data exchange standards in the Department of Biomedical Informatics at the University of Utah.



Jason Johnson, AB, PhD

Dana-Farber Cancer Institute

Jason M. Johnson, PhD joined the Dana-Farber Cancer Institute in April 2016 and serves as Chief Health Information Officer, overseeing a set of central informatics and analytics capabilities. Prior to joining the institute, Dr. Johnson was Executive Vice President and Head of R&D at PatientsLikeMe, a patient-focused research company in Cambridge, MA. He came to that position after serving in various leadership roles in scientific informatics, data science, knowledge management and bioinformatics/genomics at Merck for many years. Dr. Johnson holds AB and BS degrees from Stanford University, a Master's degree from the University of Cambridge (UK) and a PhD in Biophysics from Harvard University.



Nina Kandilian

Pulse@MassChallenge

Nina Kandilian manages operations for PULSE@MassChallenge, the State of Massachusetts' digital health startup accelerator. At PULSE, Nina is responsible for driving the core program, strategy and application process through to execution while building meaningful partnerships between corporations and startups. Having spent a majority of her career implementing new technology in academic medical centers, Nina has a deep understanding of the daily challenges providers and patients face while providing and navigating care. Most recently, she worked at Massachusetts General Hospital alongside the clinical leadership team on the largest EHR implementation in Partners Healthcare history. Nina is extremely passionate about making healthcare better through technology and believes that entrepreneurs and startups are the key catalyst of innovation in digital health. She serves as a board member for the Boston chapter of the American College of Healthcare Executives (ACHE), Early Careerist Network. At ACHE, she focuses on future leader development and works to introduce healthcare technology careers to students in high school and college. Nina graduated with summa cum laude honors from Suffolk University with a dual B.S. in Sociology and Legal Studies. She spent the beginning of her career working in corporate contract negotiation before transitioning to healthcare technology.



Ramin Khorasani, MD, MPH

Center for Evidence Based Imaging, Brigham and Women's Hospital

Dr. Khorasani is Professor of Radiology at Harvard Medical School and Distinguished Chair for Medical Informatics at Brigham and Women's Hospital (BWH) in Boston. He has served as Vice Chairman of the Department of Radiology at BWH for the past 15 years. He cofounded the Center for Evidence-Based Imaging (CEBI), a multidisciplinary translational research center, in 2003 and continue to serve as its Director. He is a practicing abdominal radiologist. He completed his clinical training at BWH in 1995, and his research and leadership training in clinical effectiveness, health policy and management culminating in a Master of Public Health (MPH) degree from the Harvard School of Public Health in 2003. He has extensive experience in using innovative health IT and change management tools and strategies to effect health system clinical transformation.



David Kreda

HMS-DMBI, S4S Project

Since 2010, David Kreda has worked on several Harvard DBMI healthcare informatics projects. From 2010 to 2014, he served as Translation Advisor to the SMART Health IT project at Harvard Medical School and Boston Children’s Hospital, collaborating with external medical and informatics experts, EHR vendors, regulators, software developers and user experience designers. Mr. Kreda oversaw concept, design, and development work for several SMART apps, including the Pediatric Growth Chart (a 2013 Red Dot Design Award winner), the Genomics Advisor, the Diabetes Monograph, and the Disease Monograph. He also helped guide the early SMART on FHIR work while it was getting its first industry attention. In 2012 and 2013, he co-led the SMART C–CDA Collaborative, whose findings (in a published paper) influenced aspects of Meaningful Use Stage 3. In 2014 and 2015, he helped negotiate a first-of-its-kind data sharing and use agreement among a dozen academic centers in the NIH-funded Undiagnosed Disease Network (UDN). Since 2016, Mr. Kreda has been part of Harvard’s NIH-funded Sync for Science (S4S) effort, where he is responsible for general project management as well as developing workflow guidelines to help vendors deliver a common experience for patients to share their EHR data electronically with research projects, including, in particular, the All of Us Research Program. Mr. Kreda has co-authored a number of peer-reviewed informatics journal articles. He is active in both the HL7 Clinical Genomics Work Group and the Variant Modeling Collaboration, an independent “tiger team” developing a variant data specification that could serve both research and clinical system needs. Earlier in his career, Mr. Kreda worked at McKinsey, SunGard, and Reuters, while consulting independently in several areas in information technology, as well as co-founding a charitable services technology start-up. He has a BA in Economics from Yale University



Lonnie Kurlander

Medal

Prior physician-in-training at Boston University. During my medical training, I discovered my passion for Healthcare Information Technology (HCIT). Co-founder and CEO at Medal working to build infrastructure that can improve outcomes, reduce costs, and meaningfully improve the health care industry.



David Litwack, PhD

FDA

Dr. Litwack received a B.S. in Chemistry from the University of Chicago, and a Ph.D. in Biology from MIT. After postdoctoral studies at the Salk Institute for Biological Studies, he joined the faculty of the University of Maryland School of Medicine as an Assistant Professor in the Department of Anatomy and Neurobiology and a member of the Program in Neuroscience. In that role, Dr. Litwack directed an NIH-funded lab that studied the role of transcription factors in

neurogenesis in the mammalian brain and in human embryonic stem cells, and was a founding member of the School's Center for Stem Cell Biology and Regenerative Medicine. In 2010, Dr. Litwack was awarded an AAAS Science and Technology Policy Fellowship in NCI's Office of Biorepositories and Biospecimen Research. During this fellowship, he led several efforts to develop policy and programs to advance the use of biobanking for personalized medicine. In 2012, Dr. Litwack joined the Personalized Medicine Staff of the Office of In Vitro Diagnostics and Radiological Health at the FDA, where he develops policies to guide the review of investigational biomarker tests, companion diagnostics, and next generation technologies.



Virginia McFerran, MS

Optum, Inc

Virginia McFerran is President of Optum Analytics, leading an integrated team that delivers software, analytics, tools and services to customers seeking insights to manage performance and health quality to achieve transformational goals. Solutions provided by Optum Analytics include population health managed services, tools for improving operational efficiency, and software that supports value-based care and organizations making that transition. Previously, Virginia served as the Chief Information Officer of the UCLA Health System, where she led the development, implementation, and operation of information systems and enterprise change initiatives.

Under her leadership, UCLA achieved the prestigious HIMSS Stage 7 award, for which less than one percent of US hospitals qualify. Prior to joining UCLA, she was the CIO at Cornell Medical Center in New York City, and held leadership positions at The Salk Institute and Microsoft. Virginia is on the Board of Directors for Douglas Emmett, Inc., the UCLA Center for Translational Science Institute, and The Dream Foundation. Virginia holds an MS in Administration from Seattle University and a BA in Latin from the University of Georgia.



Lori McLean

Polyglot Systems

Lori McLean joined Polyglot in 2013 and serves as its CEO, working to deliver on Polyglot's mission:- To improve medication adherence and health literacy for high risk patients. Meducation solutions ensure that all patients can understand their medication instructions, regardless of English proficiency, vision or hearing impairment, or reading ability. As the healthcare industry recognizes the staggering impact of poor patient communications, Meducation makes patient-specific medication instructions engaging and easy to understand. Lori McLean's current role builds on 20 years of international business experience. Most recently, she led Cloud Solution Sales for technology company Avaya. At Nortel Networks, Lori held various leadership positions including General Manager of Alliances, VP Canada Region and VP Americas Marketing. Prior to that, Lori led a French telecoms joint venture from start up to #2 market share in France. Lori received an Engineering degree from the University of British Columbia, and is currently based in Durham, NC.



Andy McMurry, PhD

Medal

Andrew McMurry is an expert in secondary use of electronic health records to enable population scale clinical investigations. Dr. McMurry was the lead architect for Harvard's Shared Health Research Information Network (SHRINE), which provides federated search systems of over 10 million de-identified patient samples, thousands of clinical phenotypes, and 60 health institutions. Dr. McMurry's model architectures have been cited by FDA's Sentinel Initiative for drug surveillance and the CDC for population health monitoring.



James Murray, MS, CPHIMS

CVS Health

James D. Murray, MS, CPHIMS is Vice President, at CVS/MinuteClinic, part of CVS Health. He is responsible for the all systems and solutions to support over 1100 walk in medical clinics. Mr. Murray works to support a medical practice of over 2800 providers by enabling the efficient use of technology in the clinical setting. MinuteClinic maintains a strong focus on collaboration with medical systems in the community. The integration of medical records with their affiliate institutions across the country helps to improve continuity of care and enable communication around all aspects of a patient's care. Mr. Murray has over 25 years' experience in Healthcare Information Technology. He has served many roles at Brigham and Women's as well as Massachusetts General Hospital. Prior to joining CVS Jim worked at Partners Healthcare as a Technology Architect. Mr. Murray is on the faculty at Harvard School of Public Health and Norwich University. He holds a Master of Science in Medical Informatics from Northwestern University and Bachelor of Arts degree in Economics from the University of Nebraska.



Ziad Obermeyer, MD

Brigham and Women's / Harvard Medical School

Ziad Obermeyer is an assistant professor at Harvard Medical School and a practicing emergency physician at the Brigham and Women's Hospital, both in Boston. His research leverages electronic health data, in combination with analytic tools from the field of machine learning, to study clinical decision making for critically ill patients, at key points in their disease trajectories. He is a recipient of an Early Independence Award from the NIH Common Fund, and a faculty affiliate at the Institute for Quantitative Social Science and ideas42.



Eliel Oliveira

Louisiana Public Health Institute

Eliel serves as the Informatics Director of REACHnet, a PCORnet Clinical Data Research Network (CDRN) at the Louisiana Public Health Institute (LPHI). He spearheads all the healthcare data acquisition activities along with the design of innovative mobile technologies that are used to more efficiently identify and recruit patients in clinical trials. Prior to his work at REACHnet, Eliel served as the Director of Technology at the

Louisiana Cancer Research Consortium where he was instrumental in the implementation of clinical trials, biorepositories, genomics and other biomedical systems needed to advance cancer research. Eliel is also the co-founder and CEO of eNre, Inc. which is an early stage startup created to commercialize the mobile and social medical technologies developed at LPHI. eNre's platform efficiently engage and recruit patients in clinical trials in and out of the clinic settings by using standardized healthcare data. Eliel has started and sold technology companies throughout his career by merging his technical, entrepreneurial and clinical research competencies. He is a professor of Healthcare Informatics at Tulane University School of Medicine and his research interests are focused on interoperable methods of data extraction from disparate sources and healthcare data standardization and analysis approaches.



Ted Quinn, MBA

ACT.MD

I am a founder of ACT.md and work as the CEO of the next generation platform for team-based care. Team-based care is the job of working with all stakeholders in care (including the patients and caregivers) to ensure everyone on the team understands: team composition, the care plan, the state-of-play, and how we measure/improve how care is happening. Its project management for patients; fundamentally transforming care delivery by leveraging and improving existing workflows. It's simple, intuitive, and powerful.



Imran Qureshi

Health Catalyst

As Chief Software Development Officer, Imran is responsible for all software development at Health Catalyst, the leading Healthcare Analytics software company whose products are used in 250+ hospitals and 2,500+ clinics to manage care for 70 million patients. Imran came to Health Catalyst from Acupera, where, as CTO, he led the team that built the care management platform that is now implemented in Ascension, Montefiore, Kaiser and other health systems. Prior to that, he was VP of Engineering at CareAnyware where he led development of the largest cloud based EHR for Home Health and Hospice. He also spent 12 years at Microsoft including building slideshow for PowerPoint and building the email experience for Hotmail. He holds several patents and has a Computer Science degree from Stanford University. He lives in the San Francisco Bay Area with his wife, Elsie, and 11 year old twins, Zane and Malaya.



Matt Reid

AMA

Natalie Kates is a product manager hell-bent on making the healthcare system serve and support Americans everywhere. Natalie was first exposed to the absurd labyrinth that is healthcare data 8 years ago when she led the design and development of a tool to help hospitals automate their financial assistance processes. Since then, she's focused on building accessible products that address systemic data and infrastructure challenges while solving critical user problems. Now at the United States Digital Service she's coming up with ways government can use technology to better solve the tremendous challenges facing our nation's healthcare system.



Chesley Richards, MD

CDC

In these two roles, Dr. Richards is a key advisor to the CDC Director and oversees the National Center for Health Statistics (NCHS) and the Center for Surveillance, Epidemiology and Laboratory Services (CSELS) with activities that include the MMWR, Vital Signs publications, the Epidemic Intelligence Service and other scientific training programs, the Guide to Community Preventive Services, and a broad range of cross cutting epidemiology, public health surveillance, and laboratory services. Dr. Richards earned his M.D. from the Medical University of South Carolina, an M.P.H. in Health Policy and Administration from University of North Carolina at Chapel Hill and is a graduate of the Epidemic Intelligence Service (EIS) at CDC, the Cancer Control Education Fellowship at UNC Lineberger Cancer Center and the Program on Clinical Effectiveness at Harvard School of Public Health. He completed Internal Medicine (Medical College of Georgia), Geriatric Medicine (Emory University) and General Preventive Medicine and Public Health (UNC Chapel Hill).



Mauricio Santillana, PhD

Boston Children's Hospital

Mauricio Santillana is a faculty member in the Computational Health Informatics Program at Boston Children's Hospital, an Instructor at Harvard Medical School, and an associate at the Harvard Institute for Applied and Computational Sciences. Mauricio enjoys working with clinicians in the design of decision-making support tools. Mauricio is a physicist and applied mathematician with expertise in mathematical modeling and scientific computing. He has worked in multiple research areas frequently analyzing big data sets to understand and predict the behavior of complex systems. His research modeling population growth patterns has informed policy makers in Mexico and Texas. His research in numerical analysis and computational fluid dynamics has been used to improve models of coastal floods due to hurricanes, and to improve the performance of global atmospheric chemistry models. In recent years, his main interest has been to develop mathematical models to improve healthcare. Specifically, he has leveraged information from big data sets from Internet-based services (such as Google, Twitter, Flu Near You) and electronic health records (EHR) to predict disease incidence in multiple locations worldwide and to predict outcomes in hospitalized patients. Dr. Santillana has advised the CDC and the White House on the development of population-wide disease forecasting tools. Mauricio received a B.S. in physics with highest honors from the Universidad Nacional Autonoma de Mexico in Mexico City, and a master's and PhD in computational and applied mathematics from the University of Texas at Austin. Mauricio first joined Harvard as a postdoctoral fellow at the Harvard Center for the Environment and has been a lecturer in applied mathematics at the Harvard SEAS, receiving two awards for excellence in teaching.



Neil Sarkar, PhD

Brown University

Neil Sarkar is the Founding Director of the Brown Center for Biomedical Informatics, Associate Professor of Medical Science, and Associate Professor of Health Services, Policy & Practice at Brown University. The underlying hypothesis in Dr. Sarkar's research is that the integration of unlinked data leads to new information that can be used to inform knowledge about underpinning phenomena in biology and health. Dr. Sarkar's work has been funded by sources such as the National Science Foundation, the Ellison Medical Foundation, the Medical Library Association, and the National Library of Medicine at the National Institutes of Health. An internationally recognized leader, Dr. Sarkar is an elected Fellow of the American College of Medical Informatics, a member of the Board of Directors of the American Medical Informatics Association, and has served on the editorial boards for the leading journals in biomedical informatics (including the Journal of the American Medical Informatics Association, the Journal of Biomedical Informatics, and Methods of Information in Medicine [for which he is an Associate Editor]). He has been an author on over 90 peer-reviewed articles, which span topics from comparative genomics using phylogenetic approaches to population-level trend detection and predictive modeling in clinical and public health contexts.



Eric Schulz

Cota

Eric Schultz has been at the forefront of disruptive innovation in technology for over 30 years, building innovative products, services and companies. Since the early 80's, building Lotus 1-2-3 and ushering in the age of the PC, he has led breakthrough initiatives in desktop and connected computing, smartphones and the mobile internet, and massive online learning communities, through startups as well as leading companies, including Microsoft and Qualcomm. For the past decade, Eric has focused exclusively on healthcare. His current company, Cota, brings together the fast evolving areas of precision medicine, real-world evidence and value-based care to speed discovery, improve the effectiveness and quality of care, and preserve access for patients.



Nikolai Schwertner, MS, MSEM

MedAppTech

Nikolai is Chief Technology Officer at MedAppTech, a rapidly growing innovations partner providing a suite of services based on the SMART on FHIR and CDS Hooks technologies, including application design and development and strategic consulting. While at Boston Children's Hospital, Nikolai was the lead software engineer of the SMART on FHIR platform.



Omar Serang

DNAexus

Omar Serang has decades of experience building global web services, including leading operations for the AWS Elastic Compute Cloud (EC2). At DNAexus he lead the flagship PMI project, precision FDA, establishing the FDA's foundation for community-sourced innovation in regulatory standards and processes for NGS-based devices and drugs, and incorporating a SMART/FHIR interface for accessing VCF comparisons. Mr. Serang lead the deployment of the Regeneron Genetics Center cloud-based informatics core which supports advanced translational research in partnership with numerous health care providers. He has a background in security and compliance and has managed FedRAMP, ISO 9001 and 27001, CAP/CLIA, 21 CFR Part 11, and ITAR regulated services. Prior to joining DNAexus, Mr. Serang developed the Enterprise I/T Cloud Transformation consulting practice at Amazon Web Services, working with global pharmaceutical, manufacturing, and entertainment companies to drive cloud adoption.



Aziz Sheikh, MD

University of Edinburgh

Dr. Aziz Sheikh is Professor of Primary Care Research & Development and Co-Director of the Centre of Medical Informatics at The University of Edinburgh. He has long-standing interests in health IT policy and leveraging the potential of digital data to improve the quality, safety and efficiency of healthcare and to promote population health. Aziz has together with colleagues held grants of over \$65m and has over 950 peer-reviewed publications. He is Co-Director of Harvard Medical School's Safety Quality Informatics Leadership (SQIL) program. Aziz holds fellowships from 7 learned bodies, including the American College of Medical Informatics (ACMI). In 2014, Aziz was made an Officer of the Order of the British Empire by Her Majesty Queen Elizabeth II for services to medicine and healthcare.



Jeremy Sohn

Novartis

Jeremy joined Novartis in 2015 as VP, Head of Digital Business Development & Licensing supporting Novartis' Digital Medicines program. In 2016, Jeremy also served as Global Head of Digital Development, Novartis Pharma.

Jeremy is a serial software entrepreneur with more than 15 years of experience founding and managing healthcare and technology companies. Prior to Novartis, Jeremy was Managing Director at MPM Capital where he led the firm's digital-health investment strategy. At MPM, Jeremy founded two companies, CentrosHealth (acquired by Clinical Ink) and

TriNetX. In 2011, Jeremy co-founded GrapeVine, a software company that optimizes how organizations connect with their target communities. From 2007-2011, Jeremy was COO and VP, Strategy & Corporate Development for North Plains Systems, where he led the company's growth and eventual sale to Accel-KKR. In 2000, he co-founded an open-source operating system company, Wasabi Systems.



Justin Starren, MD, PhD, FACMI

Northwestern University

Justin Starren, M.D., Ph.D., FACMI, is Associate Professor of Preventive Medicine and Medical Social Sciences at the Northwestern University Feinberg School of Medicine. He is also founding Chief of the Division of Health and Biomedical Informatics, Deputy Director of the Northwestern University Clinical and Translational Sciences Institute (NUCATS) and Director of the Feinberg Center for Data Science and Informatics (CDSI). Dr. Starren's research focuses on the translation of computer and informatics research into real-world solutions. Dr. Starren leads the EHR integration workgroup of the Electronic Medical Records and

Genomics (eMERGE) project, focusing on the integration of genomic decision support into clinical care. He has served as chair of the CTSA Informatics Key Function Committee and now co-chair the Informatics Domain Taskforce Lead Team. He is PI of a nine-site consortium integrating patient reported outcomes data into EHRs: EHR Access to Seamless Integration of PROMIS (EASI-PRO). He also leads the doctoral programs in Health and Biomedical Informatics, serves on the university Big Data Taskforce and oversees a variety of bioinformatics, research computing, and data sciences for NUCATS. He is a member of the board of the American Medical Informatics Association (AMIA), and a Fellow of the American College of Medical Informatics. health and finding creative ways to use technology to help people get, and stay, healthy.



Marissa Stroo

Duke

Marissa Stroo is the Associate Director of Research Data for the Duke Office of Clinical Research and a Senior Advisor for the Duke Mobile Application Gateway. The Mobile Application Gateway provides end-to-end support for faculty and staff at Duke interested in mobile or web applications for research or clinical purposes. Marissa has an MMCi from Duke and an undergraduate degree from the University of Oregon. Prior to her current position, she conducted research in the Department of Community and Family Medicine at Duke, and at the VA. She has also worked as a database developer and a consultant. She is particularly interested in population health and finding creative ways to use technology to help people get, and stay, healthy.



Jonathan Sullivan

United States Digital Service

Jonathan Sullivan is an Internet, mobile and IT pioneer who has been involved in the digital world for over 25 years. Jonathan currently serves as a digital product strategist with the United States Digital Service, working on the API strategy and implementation for the Quality Payment Program at the Centers for Medicare & Medicaid Services. Jonathan has lead the development, execution and management of digital services across a range of industries including healthcare, financial services, government, non-profit, fashion, education, and "dot com" start-ups. His portfolio includes work for the Executive Office of the President of the United States, Fannie Mae, The Health Management Academy, DARPA, Georgetown University, McGraw-Hill, Hair Cuttery, Playbill, and Stuart Weitzman. In his spare time, Jonathan has enjoyed serving as a founder and leader in several non-profit organizations. He also has an active personal life with his wife and two children outside of Washington, D.C. Jonathan holds a B.A. in Government from Dartmouth College.



Jonathan Teich, MD, PhD

Brigham and Women's Hospital

Jonathan Teich is an emergency physician at Brigham and Women's Hospital, assistant professor of medicine and emergency medicine at Harvard, and clinical architecture leader for health information systems in developing countries with OpenMRS. Dr. Teich founded the Clinical Informatics R&D department at Partners Healthcare, developing two generations of innovative electronic health records, CPOE and CDS systems that cut adverse medication events in half. He was founding Chief Medical Officer of Healthvision, a startup pioneering web-based health information exchange, and most recently served as Chief Medical Informatics Officer for Elsevier, the world's largest publisher of scientific and health information, where he led vision, strategy, and design for knowledge-based tools and CDS supporting provider- and patient-driven care. Dr. Teich has authored over 100 publications in medical informatics and healthcare IT. He is a co-author of the book, *Improving Outcomes with Clinical Decision Support: An Implementer's Guide*. He co-chaired the HHS-sponsored Roadmap for National Action on Clinical Decision Support: An Implementer's Guide.



Anne Travis, MD

Wolters Kluwer / UpToDate

I am the Senior Director for Advanced Clinical Decision Support (ACDS) - Editorial at UpToDate, which is part of Wolters Kluwer Health. I am also a practicing gastroenterologist at Brigham and Women's Hospital and an Assistant Professor, Part-time at Harvard Medical School. UpToDate provides clinicians with evidence-based medical information for use at the point-of-care. I joined UpToDate in 2009 as a Deputy Editor for Gastroenterology and Hepatology. In 2014, I assumed the role of Co-director of Editorial Quality, where I focused on making our content more accessible through initiatives such as increasing the use of algorithms. In

2015, I took over as the clinical lead for our ACDS projects, which lead to my current position as the Senior Director for ACDS – Editorial. Our ACDS solutions aim to integrate the medical information in UpToDate directly into a clinician's workflow. Our goals include decreasing unwanted variability in healthcare, improving patient outcomes, and decreasing costs. Our solutions include interactive tools that help clinicians quickly find the answers to their clinical questions, taking into account patient-specific factors. My role includes overseeing clinical content development, exploring additional ACDS opportunities, and working with our informatics team to integrate our solutions into electronic medical records.



Joris Van Dam, PhD

Novartis

Joris van Dam is Strategic Projects Leader at Novartis, where he has developed and executed a number of digital innovation projects in pharmaceutical research and development over the past 6,5 years. Among other, Joris drove the launch of the Trials of the Future program at Novartis, the Patients-2-Trials Consortium (a pharma consortium project to facilitate clinical research navigation for patients), the Clinical Research Collaboration with Walgreens (running interventional clinical trials at local Walgreens Healthcare clinics), TriNetX (a platform for using electronic medical records for study planning and design),

CentrosHealth (a platform for patient engagement Apps in clinical trials), and a mobile platform for bedside data collection for clinical trials in Africa. Since last year, his work focuses on digital therapeutics, i.e. the use of systems to treat medical disease. Prior to joining Novartis, Joris spent 7 years at Janssen, the pharmaceutical group of Johnson and Johnson, where a.o. he worked in partnership with the Bill and Melinda Gates Foundation to launch a mobile health platform for improving treatment of HIV patients in various regions across India. Joris has a PhD in Computer Science from the University of Amsterdam, and spent 7 years in consulting before joining the pharmaceutical industry.



Shyam Visweswaran, MD, PhD

University of Pittsburgh

Dr. Shyam Visweswaran is an Associate Professor of Biomedical Informatics at the University of Pittsburgh with training in informatics, artificial intelligence and clinical neurology. His research interests include the application of artificial intelligence and machine learning to problems in the Learning Health System with a specific focus on developing learning electronic medical records (EMRs), precision medicine and personalized modeling, enabling reuse of EMR data for research, and data mining and causal discovery from genomic and clinical data. He serves as the Director of Clinical and Translational Informatics, Director of the

Center of Clinical Research Informatics (CCRI), and Co-Director of the Center of Clinical Informatics (CCI). He also serves as the Director of the Biomedical Informatics Core for the University of Pittsburgh Clinical and Translational Science Institute (CTSI), and as a PD/PI for the Pitt Precision Medicine Initiative that is a component of the Cohort Program of President Obama's Precision Medicine Initiative.



Kavishwar Waghlikar, MD, PhD

Harvard Medical School / MGH

Kavishwar Waghlikar, MD, PhD, is Assistant in Laboratory of Computer Science at MGH and Instructor in Medicine at Harvard Medical School. His research is focussed on knowledge representation and information extraction for phenotyping applications, which includes clinical decision support (CDS), and quality analysis. The objective of his research is to develop a framework for natural language processing (NLP) enabled CDS. The framework consists of methodologies and tools that will facilitate rapid development of apps for secondary use.



Thomas Wagner

Quest Diagnostics

Thomas Wagner joined MedPlus, the healthcare IT subsidiary of Quest Diagnostics, in 1999 as Vice President, Strategic Planning. Most recently, he serves as the leader of Architecture and Design for the company, responsible for architecture, design, technology assessments, product research, market trends and competitive analysis.. He reports directly to Lidia Fonseca, Senior Vice President and CIO for IT within the organization. During his time at Quest, Mr. Wagner lead teams that created many of the customer-facing products for Quest Diagnostics. These products include: • Care360, the web-based solution for ordering and resulting, ePrescribing, and EHR functionality • Care360 Hub and Data Exchange supporting the EMR interface to Quest • Modular Portal

Design enabling our next generation client-facing applications



Angela Walker, MS

Eli Lilly and Company

Angela is an Innovation Lead at Eli Lilly and Company. For the past 15 years, she has been focused on bringing game-changing solutions to Lilly's clinical development practices. Angela's expertise has been centered on clinical data flow, and has led several modernization projects designed to improve clinical data capture and information exchange. She is currently focused on applying Telehealth practices to clinical trials and aims to make participating in clinical trials a better experience for both patients and investigators.



Jonathan Wilt

Ochsner Health System

Jonathan Wilt is the Chief Technology Officer of innovationOchsner, an innovation lab and accelerator founded by Ochsner Health System in 2015 to reimagine and revolutionize the experience and delivery of healthcare in a way that dramatically enhances quality and access, decreases cost, and improves patient satisfaction and engagement and caregiver efficiency. He leads the product development team and is responsible for overall technology strategy, analytics and data integration. Wilt started his career as a technical

engineer at Epic Systems where he acted as a technical manager and legacy data conversion advisor for Epic implementations. He later founded a boutique software consulting company that focused on EMR optimization, data integration and maintainability. His company started working with Ochsner Health System in 2011, and he joined Ochsner full time in 2014 as the AVP for the newly created Ochsner Center for Innovation. He holds a B.S. in Physics from the University of Notre Dame.



Daniel Yang, MD

Gordon and Betty Moore Foundation

Daniel Yang MD is the incoming Patient Care Fellow in Diagnostic Excellence at the Gordon and Betty Moore Foundation. In this role he is responsible for identifying strategic opportunities for improving the safety and accuracy of diagnosis. Prior to this role, he was a health systems design fellow at the Clinical Excellence Research Center (CERC) at Stanford University working with Dr. Arnie Milstein. Daniel is an internist and hospitalist having completed his residency training at UCSF.



Joshua Young

First Databank

Joshua Young is a father, software engineer, and lifelong computer geek working to help improve healthcare. He earned his master's degree in software engineering from James Madison University in Harrisonburg Virginia. Throughout his career, Josh has served large and small organizations with contributions on everything from enterprise systems to websites to widgets. In 2009, he left Chicago and his beloved Cubs to return home to Indiana and join First Databank to work on solutions that truly make a difference. His current focus is providing the best medical knowledge available at the point of care using the latest in cloud-based technologies.



Dan Zamansky

Amazon

Dan Zamansky is a Lead of New Initiatives within Amazon AI, responsible for identifying opportunities to serve AWS customers' needs through Machine Learning

ditions, saving more than \$1,100 per patient. To meet social needs, collaboration with regional organizations outside the health care sector is often essential. Presbyterian Healthcare Services in New Mexico for instance, works with La Cosecha, a community-supported agriculture program, to grow fruits and vegetables and distribute them to low-income families.

It might seem idealistic to

talk about principles and hopes at a time when elected officials are still focused on what reductions in access to health insurance are politically viable. But the health of millions of Americans remains at risk if leaders simply try to minimize the damage. We think health care is just one area in which Americans are rediscovering the values and principles that matter most to them. These five principles seem

likely to define the goals and nature of collaboration, and asserting them now can guide policy positions in the months ahead.

Disclosure forms provided by the authors are available at NEJM.org.

From the Alliance of Community Health Plans, Washington, DC (C.C.); Press Ganey, Wakefield, MA (T.H.L.); and Harvard Medical School, Boston (T.H.L.).

DOI: 10.1056/NEJMp1700461

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A 21st-Century Health IT System — Creating a Real-World Information Economy

Kenneth D. Mandl, M.D., M.P.H., and Isaac S. Kohane, M.D., M.P.H.

Data generated as a by-product of the day-to-day work of delivery systems are a fundamental currency of the 21st Century Cures Act. How efficiently and effectively we use this “real-world” evidence will shape the way medicine is practiced and the way drugs are approved.¹

In 2009, the Health Information Technology for Economic and Clinical Health (HITECH) Act established an incentive payment program geared toward “meaningful use” of information technology (IT), which ultimately disbursed more than \$34 billion for the promotion and purchase of electronic health records (EHRs). That federal investment was complemented by a substantially larger private investment by physicians and hospitals. Eight years later, however, the U.S. health care system still doesn’t have a usable IT engine that can generate high-quality data, a restriction that may impede progress toward the use

of real-world evidence to advance treatment and research.

Fortunately, lawmakers included in the 21st Century Cures Act a provision that could transform hundreds of existing EHR products certified under the Meaningful Use program into a coherent platform for innovation and transformation, despite the systems’ nonmodular design and disparate data formats. The new law requires that certified health IT products have an application programming interface (API) that allows health information to be accessed, exchanged, and used “without special effort.” Such an interface could allow third-party developers to create functionality that interacts and integrates with other systems in predictable and standardized ways.

APIs are used universally in modern software and are fundamental to products made by Google, Microsoft, Facebook, and Amazon. The Apple App Store

contains hundreds of thousands of apps because developers have a well-documented API that enables them to create software that seamlessly integrates with the operating system of the iPhone. EHR vendors have been slower to adopt APIs than companies in other industries — hence the need for a legislated mandate. The collective interpretation of the API provision and the response to it will shape the way that physicians and patients experience health care for years to come.

As we plan a path forward, it’s worth observing the consequences of prior policies. Although the Meaningful Use program successfully promoted purchases of EHRs — 86% of ambulatory care practices and more than 95% of nonfederal acute care hospitals now own them — the program’s structure led to important shortcomings. The Meaningful Use program dictated to EHR vendors the specific functionality needed

for their products to become federally certified. It also mandated that physicians purchase and use these certified systems to meet specific milestones, first to receive incentive payments and later to avoid payment penalties from the Centers for Medicare and Medicaid Services (CMS). Even if the Meaningful Use criteria had been perfectly conceived, however, market offerings could still have been unresponsive to physician-users' demands. And although the Meaningful Use program was predicated on the emergence of interoperability, the necessary incentives and penalties weren't in place to produce it.

Going forward, the API provision in the 21st Century Cures Act could be leveraged to powerful effect. First of all, if the API is open and standardized across systems, a new form of interoperability will emerge: substitutability. Substitutability would mean that apps could be added to or deleted from an EHR just as they can be on a smartphone — a step that would reflect a shared commitment to the transferability of health care data and knowledge.

A uniform, open, standardized health care API would allow a given app to run on any EHR. This approach would produce game-changing economies of scale and starkly contrast with current conditions, in which nearly all innovative applications require expensive, time-consuming, custom integrations to connect to EHRs. Physicians and patients would have access to a wide selection of software that could connect to their existing systems. Innovators would have a marketplace where they could compete on quality, price, value, and user

experience without mastering the idiosyncrasies of each EHR brand. EHRs would become commodity components in a larger platform that would include other transactional systems and data warehouses running myriad apps, and apps could have access to diverse sources of shared data beyond a single health system's records.

Research, regulatory, and public health organizations could both access data obtained at the point of care and deliver services to physicians and patients through substitutable apps that connect to EHRs, as developers create resources for an “app store” for health and research. Substantial progress has been made toward these goals, but they haven't been achieved on a system-level scale. Researchers working on the Precision Medicine Initiative are collaborating with EHR vendors on a project called Sync for Science (S4S) to address the initiative's need for real-world phenotype and outcomes data for its million-subject cohort. S4S will allow research participants to virtually knock on the door of a health system, connect an app to its EHR, acquire their personal health data, and donate them to the initiative. S4S is one of an increasing number of applications leveraging the SMART Health IT project, which was funded by the Office of the National Coordinator for Health Information Technology (ONC) after we proposed pursuing interoperability through substitutable apps.² To promote an apps ecosystem, the ONC has funded an online app gallery,³ streamlining the process for innovators to publish their health IT applications and providers to discover and assess them.

Today, it is possible in early-

adopter settings to connect third-party apps from an app gallery to proprietary commercial EHRs using a standard API. Although the 21st Century Cures Act didn't specify an open standard for the API or mandate that all certified health IT run substitutable “plug-and-play” apps, such requirements could be established through regulation. The SMART specification — which incorporates the increasingly popular Fast Healthcare Interoperability Resources (FHIR) standards inspired by modern APIs — is already used by multiple health systems,⁴ and the Argonaut Project, an initiative focused on open interoperability standards, has spearheaded incorporation of SMART and FHIR APIs into major EHR products. Regulators thus have concrete, viable options for enforcing a uniform API specification. Without such a specification, each health system and IT vendor might need to develop a different integration pathway — a violation of the 21st Century Cures Act's requirement that information be obtainable and usable through an API “without special effort.”

Until now, health systems and physicians have largely been passive participants in the Meaningful Use program and have rarely been in a position to demand from IT vendors the functionality they need. This arrangement has contributed to high rates of physician dissatisfaction with the Meaningful Use program and minimal innovation beyond what has been delivered by vendors. We believe that an open API with access to all core data resources and turnkey integration of apps should be required in all contracts with EHR suppliers. In a

recent survey, a majority of physicians indicated that they were very or extremely likely to buy apps extending their EHR system's capabilities.⁵ Furthermore, whereas the Meaningful Use program applied only to CMS payments, we encourage private payers to also provide incentives for a standard open API as a mechanism for integrating decision-support apps to drive best practice and allow documentation of outcomes and value. App developers could ask their customers to allow integration with health system data through a standard API, rather than through expensive one-off projects.

If we make it our goal for a

given app to be able to run on any EHR in the U.S. health care system, we minimize the risk that the 21st Century Cures Act will produce only local successes and scores of balkanized, disparate apps. We also maximize the opportunity for the United States to become a leader in developing new health care applications for clinicians and patients with varying needs and ensuring the safe and timely flow of information for patients, care providers, and researchers.

Disclosure forms provided by the authors are available at NEJM.org.

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1. Califf RM, Robb MA, Bindman AB, et al. Transforming evidence generation to support health and health care decisions. *N Engl J Med* 2016;375:2395-400.
2. Mandl KD, Kohane IS. No small change for the health information economy. *N Engl J Med* 2009;360:1278-81.
3. SMART Health IT Project App Gallery (<https://apps.smarthealthit.org>).
4. Bloomfield RA Jr, Polo-Wood F, Mandel JC, Mandl KD. Opening the Duke electronic health record to apps: Implementing SMART on FHIR. *Int J Med Inform* 2017;99:1-10.
5. American Medical Association. Digital health study: physicians' motivations and requirements for adopting digital clinical tools. September 2016 (<https://www.ama-assn.org/sites/default/files/media-browser/specialty%20group/washington/ama-digital-health-report923.pdf>).

DOI: 10.1056/NEJMp1700235

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Letter to a Young Female Physician

Suzanne Koven, M.D.

This past June, I participated in an orientation session during which new interns were asked to write self-addressed letters expressing their hopes and anxieties. The sealed envelopes were collected and then returned 6 months later, when I'm sure the interns felt encouraged to see how far they'd come.

This exercise, in which the intern serves as both letter writer and recipient, both novice and veteran, offers a new twist on an old tradition. In 1855, James Jackson published *Letters to a Young Physician Just Entering Upon Practice*. More recent additions to this epistolary canon include Richard Selzer's *Letters to a Young Doctor*, which appeared in 1982, and *Treatment Kind and Fair: Letters to a Young Doctor*,

which Perri Klass published in 2007 on the occasion of her son's entry into medical school.

When I started my internship 30 years ago, I wasn't invited to share my hopes and anxieties in a letter — or anywhere else, for that matter. In fact, I recall no orientation at all, other than lining up to receive a stack of ill-fitting white uniforms, a tuberculin skin test, and a hasty and not particularly reassuring review of CPR.

Perhaps the memory of my own abrupt initiation explains my response as I sat at the conference table watching the new interns hunched earnestly over their letters: I was filled with longing. I wanted so much to tell them, particularly the women — more

than half the group, I was pleased to note — what I wished I'd known. Even more, I yearned to tell my younger self what I wished I'd known. As the interns wrote, I composed a letter of my own.

Dear Young Female Physician:

I know you are excited and also apprehensive. These feelings are not unwarranted. The hours you will work, the body of knowledge you must master, and the responsibility you will bear for people's lives and well-being are daunting. I'd be worried if you weren't at least a little worried.

As a woman, you face an additional set of challenges, but you know that already. On your urology rotation in medical school, you were informed that your pres-

approach tailored to the particular clinical realities of target populations.

Such tailoring will complicate strategic planning and investments in population health management and accountable care capabilities. Even for health systems that have experience with alternative payment models, assuming responsibility for new populations will require an in-depth understanding of the clinical characteristics and care-utilization patterns of high-risk subgroups and identification of evidence-based programs and tactics for managing their care. The required up-front investments will be substantial. Thus, it will be important for payers to understand that demonstrated competence in caring for specific high-risk populations does not obviate the need for contracts to provide adequate financial incentives and security to support investments in new care-management capabilities.

The implications for the roles of individual physicians are quite

different. Depending on their specialty and panel composition, physicians may see patients ranging from the full spectrum of their health system's high-cost patients to a single subgroup. Physicians in ACOs, therefore, have a critical role in engaging patients and matching them with specific programs according to clinical need. Furthermore, front-line clinicians can help system leaders identify and test new strategies for high-cost patients and provide insights into care needs at a level of nuance and granularity that cannot be gleaned from claims or electronic health data.

Focusing on high-cost patients has become an attractively simple approach to improving care and reducing costs. But this policy panacea is challenged by the reality that patient demographics, health needs, and utilization patterns vary substantially among populations. Optimizing investments in this area will require improving analysis of which patients are amenable to care-delivery interventions and prioritizing

interventions according to the specific needs of subpopulations.

The views expressed in this article are those of the authors and do not necessarily represent the views or policies of their institutions.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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1. Hong CS, Abrams MK, Ferris TG. Toward increased adoption of complex care management. *N Engl J Med* 2014;371:491-3.
2. Cohen S, Ueberoi N. Differentials in the concentration in the level of health expenditures across population subgroups in the U.S., 2010. Statistical brief 421. Rockville, MD: Agency for Healthcare Research and Quality, 2013.
3. Brown RS, Peikes D, Peterson G, Schore J, Razafindrakoto CM. Six features of Medicare coordinated care demonstration programs that cut hospital admissions of high-risk patients. *Health Aff (Millwood)* 2012; 31:1156-66.
4. Druss BG, Walker ER. Mental disorders and medical comorbidity. Research Synthesis Report 21. Princeton, NJ: Robert Wood Johnson Foundation, 2011.
5. Coughlin TA, Long SK. Health care spending and service use among high-cost Medicaid beneficiaries, 2002-2004. *Inquiry* 2009-2010;46:405-17.

DOI: 10.1056/NEJMp1511131

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Time for a Patient-Driven Health Information Economy?

Kenneth D. Mandl, M.D., M.P.H., and Isaac S. Kohane, M.D., Ph.D.

As patients strive to manage their own health and illnesses, many wonder how to get a copy of their health data to share with their physicians, load into apps, donate to researchers, link to their genomic data, or have on hand just in case. To seek diagnosis or better care (see table), many patients are taking steps outside traditional doctor-patient relationships. Some join 23andMe to obtain genetic information. Others bring data to the Undiagnosed Diseases Network at the National Institutes of Health (NIH).

Patients are coalescing with others with the same disease in what the Patient Centered Outcomes Research Institute calls patient-powered research networks. But such patients have found no easy way to get copies of their electronic health records (EHRs).

In 1994, when the World Wide Web was only 2 years old, Massachusetts Institute of Technology computer scientist Peter Szolovits, presaging the consumer health information technology (IT) movement, proposed, in the Guardian Angel Project, using the Web for

patient management of health and health data. Yet getting patients electronic copies of their health records has remained an elusive goal. Industry giants have scars to show for their attempts. Why have the barriers been so high? And what is the path to a patient-driven health information economy?

In 1998, we developed the Personal Internetworked Notary and Guardian (PING, later called Indivo), an NIH-funded system for automatically and continuously updating a patient-controlled data repository.¹ Indivo downloaded

Selected Reasons for Pursuing Patient-Controlled Data.

Need or Purpose	Explanation
Complete data	A patient-controlled health record, updated after each health encounter, would provide a complete view of the patient (in contrast to that available in institution-specific electronic health records).
Data sharing for coordinated care	In the absence of other effective mechanisms, patients may be the best vehicle for making data available to their clinicians and family.
Use of data by intelligent software or apps	Patient-controlled data repositories, properly configured, could be the nexus of patient-facing apps for care management, participation in research, and data sharing.
Support of diagnostic journeys	Patients and families with undiagnosed or difficult-to-treat conditions are now manually assembling complex data sets, including genomic data, to present to researchers and clinicians.
Data donation	Under myriad consent and authorization models, patients are increasingly figuring out how to contribute data to research.
Patients as reporters	The patient is a source of data that are complementary to the information found in institutional records; bidirectional data exchange with patients could become a cornerstone of the medical record.
Additional pairs of eyes	Patients can identify and correct errors in the medical record.
Social networking	Health data are a basis for finding other patients with similar conditions or genomic variants.

automatic updates from EHRs and enriched them with patient annotations. These repositories, controlled by patients and sharable with others, were meant to drive an ecosystem of third-party apps.² After we demonstrated Indivo to technology companies in 2006, Google and Microsoft launched similar personally controlled health records — Google-Health and Microsoft Healthvault. Walmart and other employers offered Indivo as an employee benefit. Yet today most U.S. patients still don't have electronic copies of their records.

One explanation is the wider adoption of a competing technology: patient portals, offering a view of a subset of EHR data.³ Many portals are “bolt-on” features from EHR vendors; others are homegrown. In its criteria for achieving stage 2 “Meaningful Use” of health IT, the Office of the National Coordinator for Health Information Technology attempted to promote data access by requiring health care organizations to provide 50% of their patients with timely access after health care encounters. Patients were invited to use portals at all their providers' practices (a solu-

tion that caused a condition sometimes called “hyperportalosis”). Since the measure of success was that 5% of patients “view, download, or transmit” their health information, most implementations defaulted to view-only. Hence, the data are unavailable to patients, other providers, and third-party apps; virtually no apps in the Apple or Google stores have access to health system data.

Federal regulation defining a patient's right to health data has failed to ensure access. Since 1996, the Health Insurance Portability and Accountability Act (HIPAA) has required health care organizations to provide patients with access to any data that are “readily producible,” in the format the patient requests. Organizations haven't responded. Ironically, HIPAA is one of the most commonly cited reasons for *not* transmitting patient data. The patient right was reasserted under the Health Information Technology for Economic and Clinical Health Act — with a similarly negligible effect on data sharing.

“Data liquidity” — flow among data generators and customers — carries risks. Competitive intelligence might be released about,

for example, high-value markets or hospital-acquired infections. Some organizations fear security breaches or leakage of patients from their provider network. Transferring data to another product may jeopardize the EHR vendor's business model, as vendors may have trouble retaining customers if exclusivity is broken.

And technological approaches have fallen short. Under the Meaningful Use program, the intended lingua franca for data liquidity was the Consolidated Clinical Document Architecture, but it was never sufficiently standardized to support robust document exchange.⁴ The Blue Button, a Veterans Health Administration technology that allowed veterans to easily download their EHR data, was ably marketed but never matured.

Now, intersecting trends have set the stage for a fresh start. Nearly two thirds of Americans own smartphones, with online access, apps, and both local and cloud storage of data. As health care reimbursement shifts toward risk-based contracting, providers seek to understand the totality of patients' experience, which requires aggregating data across

Steps toward Creating a Patient-Driven Information Economy.

1. Both the Centers for Medicare and Medicaid Services and private insurers can offer strong incentives for health care organizations to provide data to patients after encounters through a standardized electronic mechanism — initially one encounter at a time, but eventually with automatic updates.
2. Federal health IT policy can promote, and health systems purchasing IT can demand, a uniform, standard, public API for health data that can catalyze the development of an ecosystem of apps, for both clinicians and patients, that run on health data. The Meaningful Use Stage 3 Final Rule is the first major step in this direction, requiring certified EHR technology to provide an API through which patients can have access to their EHR data in a timely fashion.
3. The research community and regulatory agencies can vet a set of online reference tools that define, by demonstration as well as specification, how consent can be delivered for global or narrowly defined transfer of patient data to and from patient-controlled data repositories; essential functionality will include roles for guardians and proxies as well as easy ways to change the scope of, or revoke, consent.
4. The health care system can adopt a rigorous authentication framework, borrowing approaches from other sectors of e-commerce, so that we can identify patients and allow them to obtain and use their data.

care silos. As the clinical research infrastructure accommodates pragmatic studies and incorporates patient-centered outcomes in therapeutics development, patients are increasingly asked to report on adverse events and end points and donate health data to trials. Fortunately, the belief that it's dangerous to allow patients access to health data is slowly dissolving, with the advent of programs such as Beth Israel Deaconess Medical Center's Open Notes, in which doctors and patients jointly read and create chart entries.

Moreover, there's now a huge amount of electronic data (albeit a subset of what's needed); 95% of U.S. hospitals and 54% of office practices use certified health IT. And EHRs and hospitals are implementing data-access standards such as the Fast Health Interoperability Resources (FHIR) and the Substitutable Medical Applications Reusable Technologies (SMART) Health IT apps interface. Finally, large-scale undertakings such as President Barack Obama's Precision Medicine Initiative are promising to return participant-level data to study subjects.

Sensing an opportunity, Silicon Valley has picked up the gauntlet. In 2015, Apple released

HealthKit, which provides a simple interface for devices including heart-rate monitors and pulse oximeters, creating a de facto data repository under patients' control. Companies such as We Are Curious are creating communities of people seeking answers to health questions. Amazon, Microsoft, and Google are collaborating with health care systems to store big data in the cloud.

Patient expectations have finally caught up with Szolovits's aspirations for a "guardian angel" digital assistant that cares for a patient over a lifetime. Consumers expect to have their data available and sharable. Other industries have embraced similar principles: in response to customer demand, for example, Facebook now enables users to download their own data.

A patient-controlled health-record infrastructure can support the development of highly desirable health system qualities. First, it allows a patient to effectively become a health information exchange of one: as data accumulate in a patient-controlled repository, a complete picture of the patient emerges. If patients can obtain their data wherever they go, they can share them with physicians as needed — rather than

vice versa. We believe the Meaningful Use program would have been more successful if it had rewarded clinicians for storing data in patient-controlled repositories rather than in EHRs that fragment data across the health care system.

The need for a copy of one's data is most obvious in life-and-death situations in which patients have failed to find answers in their health care system. Journeys like Matt Might's search for a diagnosis of his son's genetic condition suggest that patients may be among the most sophisticated users of health data.⁵ Might, a computer scientist, connected with a research team using whole-exome sequencing to discover that his son had two different mutations in the *NGLY1* gene. Those invaluable sequence data were extremely difficult to obtain and share.

Such activated patients, however, represent the tip of an iceberg of dissatisfaction with health care and need for greater data access and control. The requisite technology is no longer mysterious or expensive; it's a set of commodity-level toolkits for data exposure, transfer, and storage. Successful translation of these technologies into a productive health information economy awaits only cooperation from data producers and purveyors.

The government can help stimulate such participation, and Meaningful Use 3 does require providers to make data available for patient access over an application programming interface (API). But whether or not the Meaningful Use program survives the backlash against it, IT purchasers can demand uniform, useful implementation of an open API. Health care providers and patients can advocate for and collaborate

in developing key enabling policies and toolkits (see box) that leverage an API for patient data access.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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1. Mandl KD, Szolovits P, Kohane IS. Public standards and patients' control: how to keep electronic medical records accessible but private. *BMJ* 2001;322:283-7.
2. Mandl KD, Kohane IS. Tectonic shifts in the health information economy. *N Engl J Med* 2008;358:1732-7.
3. Halamka JD, Mandl KD, Tang PC. Early

experiences with personal health records. *J Am Med Inform Assoc* 2008;15:1-7.

4. D'Amore JD, Mandel JC, Kreda DA, et al. Are Meaningful Use Stage 2 certified EHRs ready for interoperability? Findings from the SMART C-CDA Collaborative. *J Am Med Inform Assoc* 2014;21:1060-8.
5. Mnookin S. One of a kind. *The New Yorker*. July 21, 2014:32-8.

DOI: 10.1056/NEJMp1512142

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Gifts

Anna Reisman, M.D.

We buried my sister Deborah quickly, in accordance with Jewish tradition, two states away in the family plot in New Jersey. A handful of us gathered around the rectangular hole by the graves of grandparents and great aunts and uncles, recited the prayer for the dead, trudged through blowing brown leaves, ate sandwiches at the diner next door, and drove back to Connecticut. My sister Lisa said it felt weird to be leaving her behind. But she won't really be alone, I said, and we giggled at the idea of Deborah there amidst all those arguing relatives for eternity.

Deborah's voice, however, wouldn't be part of the arguments. Born with tuberous sclerosis, which causes benign brain growths and, in her case, seizures and severe intellectual disability, Deborah never learned to speak. For the last 25 years of her life, she lived in a group home in Connecticut, spending most of her time sitting on a favorite brown leather chair, legs tucked under her, eyes focused on nothing in particular.

Deborah was elegant in her own way, slim with thick, shiny, dark hair. In her skinny jeans and Aeropostale sweatshirts, she

looked like a pretty teenager even in her 40s. Sometimes she was willing to interact with family, housemates, and caregivers — clapping her hands excitedly in imitation of me or one of my kids, tolerating a game of catch (from her armchair, with a half-deflated yellow basketball), or standing and grasping my forearm en route to the snack cabinet.

Most of the time, she avoided eye contact. Though she'd bend her head down to accept a kiss, she wasn't comfortable being touched. After one visit involving a chocolate doughnut and some hand holding and ball tossing, my son, then 13, confided in me his belief that if he tried hard enough to connect with her, she'd snap out of it and start talking. I knew that feeling; I'd had it pretty much my whole life.

When, a few days after the burial, Lisa told me she was ready to start planning a memorial service, I balked. It had been an awful few months — really, an awful year — and I wanted to move on. Over the spring, through the summer, and into the fall, an aggressive and ugly cancer had sapped Deborah's energy, and nobody knew how to interpret her howls and moans. Was this pain?

Should we give her more morphine? Was she anxious, or constipated, or hungry? She rattled her primary care doctor, who would call me when something was wrong and talk, doctor to doctor, sparing no grisly detail. One morning, I paced in an empty parking lot in the glaring sun outside a conference center, trying to get cell-phone reception; the doctor's voice was coming in choppy, something about bleeding and oozing, and I remember feeling a cloud of anxiety expanding painfully in my chest and wondering if this was the beginning of the end. But it wasn't, for quite a while — until it was.

When home hospice wasn't enough to ease Deborah's pain and agitation, we moved her to inpatient hospice. She faded quickly. The muscles of her hands shrank and flattened. She slept a lot, her mouth wide open. Oddly, she seemed more comfortable making eye contact than ever before. Perhaps it was the morphine or the Ativan.

Still, it was hard to imagine how the drugs could sufficiently dull the frustration and puzzlement she must have felt over her inability to get out of bed. Simply grasping a spoon of lemon ice