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Master of Management in Clinical Informatics, Duke University: The Fuqua School of Business  
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## *Duke University's Inaugural Informatics Conference*

### *Meaningful Use: Technology as a Base for Healthcare Transformation*

*March 11, 2010*

**Presentations and Discussions with Stakeholders**

**Duke University: The Fuqua School of Business  
Master of Management in Clinical Informatics  
Duke Center for Health Informatics**



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### Meeting Organizers

**William (Ed) Hammond, PhD** Director, Duke Center for Health Informatics (DCHI)  
**Kevin Schulman, MD, MBA** Director, Health Sector Management Program, Fuqua School of Business;  
Associate Director, Duke Clinical Research Institute (DCRI)  
**Asif Ahmad, MS, MBA** Chief Information Officer, Duke University Health System (DUHS)

### Meeting Participants

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Chief Information Officer, DUHS

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Head, Clinical Analytics, Quintiles

**Patrick Cannoles**  
Client Results Executive, Cerner

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General Manager, IBM Global Healthcare & Life Sciences Industry

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Chancellor for Health Affairs and CEO, DUHS

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Professor of Medicine, Associate Vice Chair for Quality, Duke University Medical Center; Associate Director and Director of Cardiovascular Research, DCRI

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Associate Chief Information Officer, Enterprise Analytics and Patient Safety, DUHS; Associate Director, DCHI

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Vice President of Education, SAS

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Professor, School of Information and Library Science, University of North Carolina, Chapel Hill

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**John Shagoury, MBA**  
Executive Vice President, General Manager, Healthcare Division, Nuance Communications, Inc.

**Thomas Jepsen**  
Chair, IEEE-USA Medical Technology Policy Committee

**William W. Stead, MD**  
Associate Vice Chancellor, Health Affairs; Chief Strategy and Information Officer, McKesson Foundation Professor of Biomedical Informatics and Medicine, Vanderbilt University Medical Center

**David Tanaka, MD**

Professor of Pediatrics, DUHS

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Family Medicine, Duke University Medical Center

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Duke Translational Medicine Institute; Assistant  
Professor of Medicine, Duke University Medical  
Center

**Alan Ying, MD**

Director of the Board, KLAS Enterprises; Visiting  
Scholar, Fuqua School of Business

**Meeting summary written by Patricia A. French**

## Meaningful Use: Technology as a Base for Healthcare Transformation March 11, 2010

Asif Ahmad, Ed Hammond, and Kevin Schulman hosted the “Meaningful Use: Technology as a Base for Healthcare Transformation” conference at Duke University’s Fuqua School of Business.

The American Recovery and Reinvestment Act of 2009 (ARRA) authorizes the Centers for Medicare & Medicaid Services (CMS) to provide reimbursement incentives for eligible professionals and hospitals who become “meaningful users” of certified electronic health record technology. The new Duke Center for Health Informatics (DCHI) aims to implement three key strategies to achieve its mission of enhancing the meaningful use of informatics and technology to improve healthcare: (1) focusing on outcomes, (2) integrating research into healthcare systems, and (3) involving the medical, nursing, business, and other schools in development of interdisciplinary educational curricula, such as its unique Masters of Management in Clinical Informatics (MMCI) degree program. This inaugural conference was designed to initiate a dialog about the current state of health informatics and technology, explore possible frameworks for research and education, and identify key next steps in the process of advancing the meaningful use of informatics to transform healthcare.

### Keynote Address

**Topic:** From Meaningful Use to Effective Healthcare  
**Speaker:** William W. Stead, MD, Associate Vice Chancellor, Health Affairs; Chief Strategy and Information Officer, McKesson Foundation Professor Biomedical Informatics and Medicine, Vanderbilt University Medical Center

### Panel Discussions

**Topic:** Quality and Safety  
**Moderator:** Jeff Ferranti, MD, MS, Associate Chief Information Officer, Enterprise Analytics and Patient Safety, Duke University Health System; Associate Director, Duke Center for Health Informatics  
**Panelists:** Lesley Curtis, PhD, Associate Professor, Duke University School of Medicine  
Armistead Sapp, Vice President of Education, SAS  
David Tanaka, MD, Professor of Pediatrics, Duke University School of Medicine

**Topic:** Global Health  
**Moderator:** Krishna Udayakumar, MD, MBA, Duke Translational Medicine Institute; Assistant Professor of Medicine, Duke University Medical Center  
**Panelists:** Jose-Marie Griffiths, PhD, Professor, School of Information and Library Science, University of North Carolina at Chapel Hill  
Ed Hammond, PhD, Director, Duke Center for Health Informatics  
John Murphy, MPH, PhD, Head, Clinical Analytics, Quintiles

**Topic:** Care Coordination  
**Moderator:** Asif Ahmad, MS, MBA, Chief Information Officer, Duke University Health System  
**Panelists:** Patrick Cannoles, Client Results Executive, Cerner  
Daniel Pelino, General Manager, IBM Global Healthcare & Life Sciences Industry  
Hoda Sayed-Friel, Vice President, Marketing, MediTech

**Topic:** Population and Public Health

**Moderator:** Eric Peterson, MD, MPH, Professor of Medicine, Associate Vice Chair for Quality, Duke University Medical Center; Associate Director and Director of Cardiovascular Research, Duke Clinical Research Institute

**Panelists:** Thomas Jepsen, Chair, IEEE-USA Medical Technology Policy Committee  
Jim O'Brien, MBA, Director, Network Strategy, CIGNA Healthcare  
Harry Reynolds, Director, IBM Health Plan Transformation, Global Healthcare & Life Sciences Industry  
Alan Ying, MD, Director of the Board, KLAS Enterprises; Visiting Scholar, Fuqua School of Business

**Topic:** Patient-Centered Care

**Moderator:** Jimmy Tcheng, MD, Medical Knowledge Architect, Duke Translational Medicine Institute; Professor of Community and Family Medicine, Duke University Medical Center

**Panelists:** Lidia Fonseca, MBA, MBI, Chief Information Officer, LabCorp  
Sean Hogan, MBA, Vice President, Healthcare Delivery Systems, IBM Global Healthcare & Life Sciences  
David McCallie, MD, Vice President, Medical Informatics, Cerner  
John Shagoury, MBA, Executive Vice President, General Manager, Healthcare Division, Nuance Communications, Inc.

#### **Final Session**

**Topic:** Moving Forward: Next Steps

**Moderators:** Asif Ahmad, MS, MBA, Chief Information Officer, Duke University Health System  
Ed Hammond, PhD, Director, Duke Center for Health Informatics  
Kevin Schulman, MD, MBA, Director, Health Sector Management Program, Fuqua School of Business; Associate Director, Duke Clinical Research Institute

## Context

The presentations and discussions focused on strategies to increase and enhance the meaningful use of certified electronic health record (EHR) technology in response to the provisions of the American Recovery and Reinvestment Act of 2009 (ARRA).

The meeting was held at The Fuqua School of Business at Duke University. In all, representatives from 67 organizations attended, comprising informaticists, healthcare providers, researchers, vendors, payers, policymakers, and educators. The purpose of the meeting was to review the current state of meaningful use of EHR data; explore possible frameworks for future research, education, and applications regarding EHR technology; and identify key next steps in the process of advancing the meaningful use of EHR to transform healthcare.

In his keynote address, Dr. William Stead provided context for the EHR provisions of ARRA, summarizing its goals and describing current issues regarding healthcare information technology (HCIT) in the US healthcare system.

Key themes of Dr. Stead's presentation and the following discussions are outlined below.

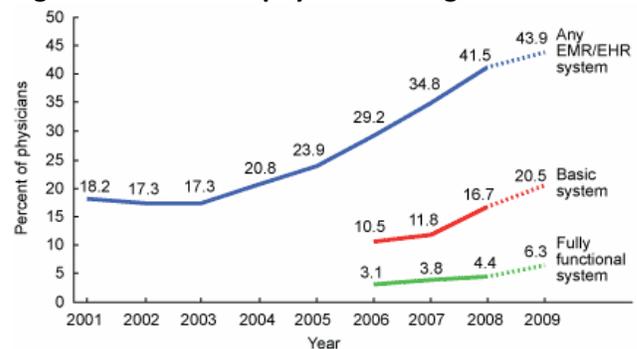
### Background and Context

The ARRA authorizes Medicare and Medicaid to provide reimbursement incentives to professionals and hospitals who become "meaningful users" of certified EHR technology. It calls for a phased implementation, beginning in 2009 and concluding in 2016. After this time, the financial incentives will convert into penalties, if providers have not begun to use EHR technology.

Only a minority of US providers use such technology at present. As of 2008, only 9% of hospitals and about 17% of physicians were using at least a basic EHR system.

Current efforts to increase the use of HCIT won't be enough to achieve the vision of 21st-century

**Figure. Office-based physicians using EHR**



healthcare, and they might eventually set back the cause. Success will require emphasis on the following factors, among others:

- Comprehensive data on conditions, treatments, and outcomes
- Cognitive support for healthcare providers to integrate patient-specific data, evidence-based medicine (EBM) guidelines, and research results
- Tools to manage a portfolio of patients, highlighting problems as they arise
- Rapid integration of new instrumentation, biological knowledge, treatment modalities, and so on into a "learning" healthcare system
- Accommodation of growing heterogeneity of locales for provision of care
- Empowerment of patients and families in effective management of healthcare decisions and their implementation

### The Ideal HCIT System

The numerous barriers to HCIT use include fragmented records, user interfaces that mimic paper rather than harnessing human factors engineering to optimize screen entry/viewing, poor integration with legacy systems, lack of research integration into patient care, and long implementation and frequent down times.

Perhaps the largest hurdle to overcome is the fact that HCIT systems tend to focus on transaction data—orders, lab results, etc.—whereas humans are conditioned to recognize patterns.

Components of an ideal HCIT system would

require a paradigm shift for optimal use, as illustrated in the table below.

**Table. Paradigm Shifts for an Ideal HCIT System**

Current		Ideal
One integrated dataset	➔	Integrated datasets from multiple sources
Data captured in standard terminology	➔	Raw signal annotated with standard terminology
Single source of “truth”	➔	Multiple related signals interpreted
Seamless transfer among systems	➔	Visualized collective output of all relevant systems
Provider updates EHR during visits	➔	Provider and patient work together on shared EHR
System provides transaction-level data	➔	System provides cognitive support
Work processes programmed, adapted through nonsystematic workarounds	➔	People, process, technology work together as one system

Clearly, the computational approach will need to be matched with the increasing complexity of the data. Aggregate EHRs will require development into “dashboards” that providers and patients can use easily and intuitively, to include sample orders, EBM “advisors”, and work lists.

A systems approach will also need to be employed for optimal use of HCIT. This approach allows visualization of actual versus expected results in real time, provides for iterative refinements, and incorporates repeated assessments of effectiveness (outcomes) in a continuous quality-improvement process. The ideal to strive for in such systems is to provide EBM 100% of the time in 100% of patients.

**The Future**

Ideal systems will be able to capture and incorporate new knowledge as it emerges. For example, future systems might include evidence

from genome-wide association studies, to predict whether a specific patient will respond to a proposed therapy or to predict a patient’s risk of events based on phenotypic evidence. Obviously, data to identify and correlate such patterns must first be captured. Thus systems must link discovery directly with practice.

When developing HCIT systems, precise definitions become critical for ease in analysis and cross-platform studies. Each function should reflect one process step, to avoid freezing the workflow and to allow specific measurements of effectiveness.

“If it can’t be measured, it can’t be improved.” For HCIT systems, variables that can be measured include

- Ease of learning: training time, time to peak efficiency
- Ease of use: time to complete fields, error rate, sensitivity and specificity for conditions
- Cognitive support: proportion of users handling new data correctly
- Adaptation to change: time to deployment
- Effectiveness: proportion of alerts overridden, number of adverse events after alert overrides, number of adverse events without alerts

Research challenges for the future include development of patient-centered cognitive supports, modeling systems, data sharing and collaborations, managing data at scale, and automating the full capture of physician-patient interactions.

Finally, academics must be linked to operations. Informatics education and training must be informed by real-world investigations, and informatics research and development in turn should inform operational and decision support systems. Only with a two-way flow of information can “meaningful use” be achieved.

## Quality and safety

**Moderator:** **Jeff Ferranti, MD, MS**, Associate Chief Information Officer, Enterprise Analytics and Patient Safety, Duke University Health System; Associate Director, Duke Center for Health Informatics

**Panelists:** **Armistead Sapp**, Vice President of Education, SAS  
**Lesley Curtis, PhD**, Associate Professor of Medicine, Duke University School of Medicine  
**David Tanaka, MD**, Professor of Pediatrics, Duke University School of Medicine

### Overview

At present, separate systems collect reams of data from medical claims, prescription claims, and provider interactions. The discussion focused on how to adapt such transactional data with the goal of improving patient safety and quality of healthcare.

### Discussion topics

- **The value and limitations of claims data.**  
Claims provide information about procedures, equipment, and services that are reimbursed. An argument can be made that if a service, etc. is not reimbursed, the corresponding data are not captured reliably. Transactional/longitudinal data can therefore be extremely valuable in studies of comparative effectiveness and safety. Substantial limitations exist in these datasets, however; the research question being asked must be appropriately answered by claims data.
- **Leveraging data that are byproducts of care to identify trends, new conditions, etc.**  
Because claims systems are designed for financial rather than medical analysis, new data elements may need to be introduced to answer clinical questions. For entirely new conditions, such as methicillin-resistant *Staphylococcus aureus* infections (MRSA), systems will require new definitions; but for others, existing data elements can be adapted to capture new biological processes for which services are required. However, "biology is analog, not digital." A balance must be struck between the use of structured, if incomplete, data and unstructured data, which can be comprehensive but difficult to aggregate. One advantage of structured data is that it is easier to see if an element (a service, medication, or quality measure) is missing. Unstructured data can be made more accessible through accurate annotation and tagging. Again, the most important consideration is that the available data can truly answer the right research question. Each facility should capture a core set of high-yield data elements that will allow them to measure healthcare safety and quality.
- **Fostering "inquisitive minds."**  
Business-improvement strategies such as Six Sigma can be helpful in the healthcare arena, but leadership is required to engage staff at all levels of care, teach them to ask "why?", and to encourage ownership of HCIT processes. Leaders must first advocate for HCIT and show providers the potential value to the facility, to the providers themselves, and the patients. Then tangible pilot models can be created that reflect user input and human factors engineering. After algorithms have been developed, user input remains critical to avoid overload and diffusion of focus. Creative partnering with industry is a possibility, teaming clinicians with a quantitative person to train them in the strengths and pitfalls of using data for clinical care. Another option might be to develop a cross-specialty program for graduates of computer science, engineering, or medical/nursing/pharmacy schools, to produce professionals that can assist facilities in developing HCIT systems.

## Global health

**Moderator:** Krishna Udayakumar, MD, MBA, Duke Translational Medicine Institute; Assistant Professor of Medicine, Duke University Medical Center

**Panelists:** John Murphy, MPH, PhD, Head, Clinical Analytics, Quintiles  
Jose-Marie Griffiths, PhD, Professor, School of Information and Library Science, University of North Carolina at Chapel Hill  
Ed Hammond, PhD, Director, Duke Center for Health Informatics

### Overview

The healthcare and HCIT systems of developing countries differ from those of developed countries in numerous ways. HCIT systems might be valuable in reducing international disparities in care and in gaining a better understanding of global health trends. This discussion covered various opportunities and barriers to the international use of health informatics.

### Discussion topics

- **Global data systems.**  
To gain a true picture of global health and disease, accurate counts are critical at the population, community, family, and patient levels. Systems must be able to identify patients, integrate new data, and integrate data across populations for analysis. Standardization of datasets is required to perform these processes. At the same time, regulatory and privacy requirements differ around the world. A total of 72 countries have expressed interest in creating personal health records for each citizen, but each nation has different primary purposes: for some, it is to capture population statistics; for others such as the U.S., it might be to identify trends in diseases. The use of data for research projects requires still further considerations. How to balance the importance of uniform versus local systems, and clinical versus research data, in creating a sustainable model of global data capture will require a concerted international effort, as will addressing the issue of lack of access to appropriate HCIT in many countries.
- **Global access to healthcare.**  
Many locations in the U.S. and around the world lack access to adequate healthcare. Healthcare informatics can be used to assess whether new business models, such as mobile clinics, might be a way to address this issue. HCIT systems also might be valuable in identifying ways to cut costs in healthcare, allowing scarce resources to be distributed more effectively. Innovations and systems developed by international nonprofit and industry groups might be adapted for use in less developed countries, facilitating research projects, data capture, and provision of care.
- **Educating the global healthcare workforce.**  
The healthcare workforce around the world lacks the skills and knowledge needed to develop and use HCIT effectively. The academic infrastructure has not helped in this regard, with its “silo” mentality and prolonged specialty degree programs. What is required for the future are multidisciplinary programs and services that leverage existing technologies—open-source, Web-based platforms; cellphone-based EHRs, etc.—to accommodate students and practitioners at all levels who are in remote locations and who have limited resources. Social-networking approaches also might have value. Educational programs will need to be more nimble in general if they are to keep pace with technological advances.

## Care coordination

**Moderator:** Asif Ahmad, MS, MBA, Chief Information Officer, Duke University Health System

**Panelists:** Hoda Sayed-Friel, Vice President, Marketing, MediTech  
Patrick Cannoles, Client Results Executive, Cerner  
Daniel Pelino, General Manager, IBM, Global Healthcare & Life Sciences Industry

### Overview

The goal of care coordination is to exchange meaningful clinical information among members of the healthcare team. When performed effectively, it enhances patient outcomes and safety while reducing duplication of efforts and redundancies. The group discussed how this approach differs from the traditional “multiple separate providers” model of healthcare with regard to HCIT.

### Discussion topics

- **A focus on the patient, not the place of care.**

The patient’s medical record should encompass all care received, from office to emergency department to acute care to rehabilitation to skilled nursing to hospice, and all of the transitions in between. The EHR should be available to all providers and to the patient or authorized representative(s). It should reflect real-time data to the extent possible, so that all caregivers have access to the entire picture at all times. With complete data, members of the healthcare team can better plan current and future interventions. Creating such a portable, interoperable record presents many challenges, however. One hospital alone can be using dozens of different applications at multiple release levels, all of which would require reconciliation with the data and systems in use at other local and regional facilities, at a minimum. Nonetheless, the main barrier to implementing coordination of care is not the technology; rather, it is a matter of taking responsibility for creating such systems at the community, regional, and national levels. In locations that have achieved coordination of care, resource use has greatly decreased and patient satisfaction has greatly increased. One option may be to start coordination of care systems within large companies, and then expand them to larger pools of patients. Empowerment of such “patient care homes” can reduce resource use and improve patient outcomes.

- **The role of the patient.**

In the financial industry, customers have access to all of their financial data from multiple institutions, although the institutions do not share information with each other. Similarly, EHR vendors provide patient-centered data, but facilities withhold information from each other and the workflow is not aligned to provide coordinated information to the patients (especially from departments such as nursing, radiology, physical therapy, etc.). A framework must be developed for common architecture and integration of data from multiple facilities, in a format that is useful to patients. The Duke HealthView portal is an example of such a patient “dashboard,” which allows access to billing history, insurance information, laboratory results, medication lists, vital signs, and allergies. Even this portal does not include data from all of the facilities in the Duke network, however. In addition, once awareness is created at the patient level, how precise does the information need to be? What about patients who have dementia, who are irresponsible, who do not want to know their data, or who cannot make good decisions? What about cases of possible abuse and privacy concerns? Can patient ownership be balanced against system ownership of the data, and if so, what regulatory requirements will need to be developed? All of these issues will require exploration and resolution before coordinated care records can be universally implemented.

## Population and public health

**Moderator:** **Eric Peterson, MD, MPH**, Professor of Medicine, Associate Vice Chair for Quality, Duke University Medical Center; Associate Director and Director of Cardiovascular Research, Duke Clinical Research Institute

**Panelists:** **Thomas Jepsen**, Chair, IEEE-USA Medical Technology Policy Committee  
**Alan Ying, MD**, Director of the Board, KLAS Enterprises; Visiting Scholar, Fuqua School of Business  
**Jim O'Brien, MBA**, Director, Network Strategy, CIGNA Healthcare  
**Harry Reynolds**, Director, Health Plan Transformation, IBM Global Healthcare & Life Sciences Industry

### Overview

Public health in the U.S. comes from a tradition of limiting the spread of disease, with promotion of wellness emerging as a mission only much later. This discussion focused on how informatics can be applied to population-level concerns to improve public health and reduce disparities in delivery and outcomes.

### Discussion topics

- **Evolution of public health groups.**

In the 18th and 19th centuries, the focus of public health efforts was on population-level control of communicable diseases such as cholera and typhoid. With improved sanitation and the development of antimicrobials, public health groups could then turn to other, more regional concerns. For example, the Centers for Disease Control and Prevention (CDC) were created in 1946 for the sole purpose of eradicating malaria. Over time, public health groups emerged at the city, county, state, and federal levels. Each with its own approach. These diverse entities now must be coordinated into a single architecture to capture and analyze the real-time data needed to address today's issues.

- **Re-engineering public health entities for the greatest good.**

As noted, disparate public health entities must be merged at multiple levels. One approach is to "start small" with local clinicians and facilities. This approach was successfully tested in North Carolina, which in 2004 provided the funding to connect 100 hospitals so they could share 30 to 150 clinical data points with each other and with the state's public health department office. However, it remains the only state to do this. To get the comprehensive data required for accurate estimates of disease states, medical errors, or healthcare disparities, federal and state mandates will be required to expand such systems. The public health system may be able to take advantages of changes spurred by EHR provisions of ARRA, in terms of the system-level infrastructure (data standards, connectivity) and application infrastructure (decision support) that will be required.

- **Resolving tension between personal privacy issues and the public good.**

Healthcare data have intrinsic value to organizations when used as competitive intelligence, and the patient often has little to no say in how these data are used. Each US state has its own privacy regulations in addition to HIPAA requirements. Policies will need harmonization at the federal versus state level, and we will also need to consider border states. In North Carolina, \$50,000 was required for each of the 100 hospitals in the test program to install the infrastructure for data sharing, and patient identifiers were removed with the permission of the governor. Public health groups will likely need to define the value of data collection/sharing systems first, then define privacy and consent parameters for state governments, facilities, providers, insurers, and patient groups to "buy in" to these programs.

## Patient-centered care

**Moderator:** Jimmy Tcheng, MD, Medical Knowledge Architect, Duke Translational Medicine Institute; Professor of Community and Family Medicine, Duke University Medical Center

**Panelists:** Lidia Fonseca, MBA, MBI, Chief information Officer, LabCorp  
Sean Hogan, MBA, Vice President, Healthcare Delivery Systems, IBM Global Healthcare & Life Sciences  
David McCallie, MD, Vice President, Medical Informatics, Cerner  
John Shagoury, MBA, Executive Vice President, General Manager, Healthcare Division, Nuance Communications, Inc.

### Overview

Patient-centered care involves engaging the patient in their care. This session focus on the role that informatics might play in the delivery of quality patient-centered care.

### Discussion topics

- **Patient access to medical information.**

One of the care goals specified in the meaningful use criteria is to “provide patients and families with timely access to data ... to make informed decisions and to manage their health.” Interpretation of this requirement is ongoing and contentious among the various stakeholders, but the goal remains to provide understandable data upon which patients can act. Some centers have explored innovative ways to accomplish this goal, such as dictating a discharge summary in front of the patient while also using speech-recognition software to generate a transcript. Thus patients have a record they can refer to later, reducing the number of follow-up calls placed to clinicians. Surveys also can be used effectively in routine care to elicit improvements in systems. In one example, 30% of Duke patients with cancer were found to have sexual distress but had not raised the issue. Patients are now routinely asked about this and other stressors, and clinical research projects are ongoing to address sexual issues.

- **Role of healthcare providers and facilities.**

Patient-centered care is that which offers the maximum possibility of a good outcome for the specific patient. Providers should be alert to behaviors derived from patient-centered care, to suggest improvements. Facilities also must enable the time needed for provider-patient interactions to be effective. Systems must be able to capture data regarding individual insights and aggregate these for consumption. From a patient perspective, medical care might best be approached from a wellness standpoint first—screening and risk assessment—and then proceed to management of chronic conditions with follow-up and compliance measures. With the advent of genomics, treatments can truly begin to be tailored to the individual.

- **Role of HCIT**

Ideally, every person would have a cumulative health record available on demand. Who would pay for it and maintain it, are complex but necessary questions yet to be addressed. “Meaningful use” specifies EHR components, e.g., problem lists, medication lists, procedures, etc., but there is little agreement on the structure and format of these data or how to identify patients and reconcile records across existing systems. Add to this the question of patient access: although they are the ultimate stakeholders, their memories can be unreliable and the amount of data they provide might overwhelm providers. Nonetheless, HCIT should not be the limiting factor in this regard. An option might be to use a Google search-type function, which can answer general questions about prior medication use or procedures.

## Moving forward: next steps

**Moderators:** **Asif Ahmad, MS, MBA**, Chief Information Officer, Duke University Health System  
**Ed Hammond, PhD**, Director, Duke Center for Health Informatics  
**Kevin Schulman, MD, MBA**, Director, Health Sector Management Program, Fuqua School of Business; Associate Director, Duke Clinical Research Institute

### Overview

This discussion summarized the main points presented at the conference and suggested possible next steps to be taken in the academic, clinical, research, and vendor arenas.

### Discussion topics

- **Cross-industry collaborations.**

The conference represented a valuable initial dialog among the various stakeholders: clinicians, insurers, government entities, policymakers, HCIT vendors, educators, researchers, and patients. In the current healthcare system, the delivery and documentation of care are fragmented, separated into silos. This results in inefficiencies as well as potential danger to patients. Leadership is needed to develop portable, scalable standards and systems for HCIT sharing and application, perhaps looking to the banking industry for examples of how privacy and security issues are addressed. We must understand the problems to be solved, and what and who are the drivers of the current system. If a current law, technology, or policy is rate-limiting, then it should be changed.

- **Change management**

Moving from the current anticompetitive, provider-based model of healthcare to a more distributed, coordinated model will represent a major change worldwide, and many are resistant to the additional training and resources that will be required to accomplish the transition. Targeted educational efforts and financial incentives will facilitate this evolution of healthcare, but dedicated change agents will also be required. Only 6 of the ~5000 healthcare systems in the U.S. use EHRs at present. Their workforces, governing boards, and thought leaders all will need formal training, in addition to the capital expenditures needed to satisfy the criteria for meaningful use of healthcare data and to offer patients a valuable experience.

### Next steps

- Possibly develop a certificate/diploma/executive program for MBAs or MDs, or a 1-day online refresher course for people in industry
- Introduce EHR technologies into the curricula of schools of nursing, medicine, pharmacy, and allied health professions, with classes serving as living laboratories for the HCIT vendors
- Incorporate data into exam rooms via the use of white boards, screens, etc.
- Create use cases for graduates of the MMCI program to act as change agents, consultants to industry, etc. and use the findings to refine the curriculum
- Create an advisory board for DCHI, to include representatives from industry, foundations, nonprofits, community physicians, patients, and other groups
- DCHI: Perform multidisciplinary research using DUMC as a test case, collaborating with vendors and other groups to evaluate systems
- Reapply data collected during routine care to refine decision support systems, spur critical thinking