

# **Images, Electronic Health Records, and Meaningful Use: A Vision for the Future**

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## **Executive Summary, Discussions, and Recommendations**

### **EXECUTIVE SUMMARY: MOVING TOWARD MULTIMEDIA ELECTRONIC HEALTH RECORDS: HOW DO WE GET THERE?**

The National Institute of Biomedical Imaging and Bioengineering (NIBIB) and the Office of the National Coordinator for Health Information Technology (ONC) co-sponsored a workshop in January 2011 to consider the opportunities and implications for health care when electronic health records (EHRs) contain multimedia data. The workshop provided a venue for a diverse group of stakeholders to share their vision and perspectives on both technical and practical implementation issues and how these issues may inform the future development of the definition of Meaningful Use of Electronic Health Records under the Health Information Technology for Economic and Clinical Health Act, 2009. The meeting was specifically not for policy development regarding Meaningful Use. Drawing from this diverse group of health care providers, patient advocates, health system leaders, payers, and commercial vendors, this workshop report presents a summary of their viewpoints and concludes with possible pathways toward multimedia electronic health records.

When considering meaningful use of images, participants considered it important to focus on the goal of creating value and efficiency in health care and that health outcome should be the driving force toward that goal. Participants also recognized that electronic health records should be patient-centered and controlled. While safeguarding patient privacy, they also note that it is crucial to be able to access health information regardless of location to enable care providers to make decisions based on comprehensive, relevant data on the patient, including image data, at the point of care. European countries, for example the United Kingdom, have substantial experience with the national adoption of electronic health record systems. There is a cultural acceptance of unique patient identifiers and patient photographs in such records, and in so doing, the U.K. National Health Service has reduced the barriers for exchanging health information electronically and managing patient data from multiple care providers. Nonetheless, technical challenges remain for these countries, especially in the transmission of large image data files across low-bandwidth networks.

#### **Images Are Not Ancillary Data**

Imaging is routinely used for screening, surveillance, diagnosis, and as part of therapy. Thus, images and associated reports are central to tracking and providing best advice to all citizens. Images do not necessarily need to be directly included with the records if they can be linked in a way that is completely transparent to the user. Images (and other data) can be distributed at multiple sites outside the physician's office or the health center, though there should be one source of truth for patient information that can draw from a federated information system.

It is important to note that images and features extracted from them and other metadata, such as genomic and proteomic data, compose part of the patient database available for a variety of analytics, decision support, development of prediction models, and other research purposes.

### **Multiple User Interfaces for Different Needs**

Image data are produced and/or used by different specialties, ranging from dental x-rays, dermatology photographs, and pathology slides to computerized tomography scans for oncologists and magnetic resonance images for cardiologists. However, each specialty has different requirements for viewing and interpreting images. For cardiologists, images are needed in real time, and multiple images may be taken in order to accurately align the structural defects with functional aberrations. For orthopedic and neurosurgeons, intra-operative images are needed, but historical images may be used for reference. Obstetric and gynecologic physicians deal with a patient population that is mobile, going from one practice to another. For these providers, images must be transportable between providers and annotated in order to have consistent readings and interpretations. For primary care physicians, the focus is on information exchange with the patients whose records should include prescriptions, medication management, immunization records, clinical and laboratory data, image data and patient-specific health education. Among the specialties, radiologists have different requirements: frequent viewing, electronic ordering of procedures, facilitation of report generation, and support for rapid notification of the ordering physician in cases of time-sensitive critical findings. The widespread use of imaging by tertiary care requires portable data sets with associated metadata that can be viewed and interpreted in a context-sensitive way and shared with other members of the health care team.

### **Sharing Image Data Improves Care**

Image sharing across institutions is critical to reducing unnecessary, redundant procedures as well as providing comprehensive access to data to enable good patient care. Unnecessary procedures and variability in execution result in increased radiation exposure, which is of serious concern to patients and medical centers and must be addressed. Solutions to these issues are emerging. For example, decision support order entry in hospital workflow systems has demonstrated reduction in the variation of ordering rates for radiological services, resulting in reduction of low-utility procedures.

NIBIB sponsors several projects on image sharing. Preliminary results show that enterprise-level sharing of data with patient control and consistent with the Integrating the Healthcare Enterprise (IHE) profiles and Digital Imaging and Communications in Medicine (DICOM) and Health Level Seven International (HL7) standards can be achieved. One project uses industry-supplied personal health records, cloud technology, and an edge server for patient and individual provider access at each institution in the network.

### **Standards, Interoperability, and Bandwidth Are Key**

Imaging services for a medical center go well beyond the institution and its electronic health record system. The imaging community has demonstrated success with the development and implementation of DICOM standards, which have now been adopted worldwide. As we consider

standards for exchanging other types of data, it would be beneficial to learn from the experiences with DICOM and IHE and support these efforts for standards and interoperability. We should raise questions about what additional standards are needed in order to exchange large image files. Good bandwidth and speed are necessary, and there are currently a number of approaches to maximize bandwidth. For example, compression of files and streaming files for just-in-time use in addition to others.

### **What is the path forward?**

There is general consensus that multimedia data will be a critical component of electronic health records in the near future, given the potential benefit to quality of care and the rapid penetration of advanced technologies in routine care. Furthermore, participants voiced strong support for including imaging in the meaningful use definition of examination results. However, they also caution that there should be incentives that address imaging needs. These incentives may include report turn-around (use of speech recognition for report generation), use of Picture Archiving and Communication Systems (PACS) for image management, availability of images to referring physicians, reasonable access for patients to imaging services (2 to 3 days for routine outpatient imaging), use of dashboards for department management, quality indicators (including critical and sub-critical notifications), cumulative radiation doses, and image sharing with other institutions. Certification of EHR systems should acknowledge specialty support for standards such as IHE, DICOM, and HL7 and functions such as image sharing and imaging-related decision support.

## **DAY 1: VISION**

### **Overview of Meaningful Use**

Dr. Joshua Seidman, Office of National Coordinator for Health Information Technology (ONC), Department of Health and Human Services, presented an overview of meaningful use.

- The Health Information Technology Policy Committee's five priorities are to:
  - Improve quality, safety, and efficiency and reduce health disparities.
  - Engage patients and families in their health care.
  - Improve care coordination.
  - Improve population and public health.
  - Ensure adequate privacy and security protections for personal health information.
- Dr. Seidman also discussed the background for the Notice of Proposed Rulemaking and the issuance of the final rule.
- He presented the notable differences between the Medicare and Medicaid electronic health records programs.

### **Discussion**

- Dr. Keith Dreyer (Massachusetts General Hospital) noted that both the Centers for Medicare and Medicaid Services (CMS) and ONC include 10 to 15 requirements that are not relevant to radiologists; it seems wasteful to require purchase of new technologies and equipment that will never be used.
- Dr. Seidman responded that it is important for data to be able to flow to all providers, which necessitates that the providers use the same tools to produce data.

### **Panel I: A Multimedia Vision of the Future**

#### **The Multimedia Electronic Health Record (EHR) of the Future**

Dr. Robert Greenes, Arizona State University, presented a history of the EHR and electronic medical record (EMR), outlined the differences between the two and discussed the future of the multimedia record.

- EMRs are episode- and enterprise-focused, while EHRs are longitudinal, comprehensive, and patient-centered. EHRs can also serve as a lifetime record for the patient.
- Challenges arise when each provider creates a new EMR for the same patient. All of these individual EMRs could be combined into one EHR that would contain all of the patient's health information in one location. However, interoperability of the systems and data is a major barrier.
- Advantages to an EHR include the ability to access it from anywhere in the world and from multiple devices (e.g., iPhone, iPad, desktop computer, Android, etc.) and the ability of providers to utilize information and test results from one another.

- EHRs can be multimedia, combining traditional medical imaging with information from inpatient or in-home monitoring devices, as well as with video or interactive imaging.
- The future of EHRs will depend on the interoperability of data systems and the availability of resources to move technology development forward.
- Features extracted from images, as well as the image data themselves, become part of an expanded database that can be used for decision support, predictive modeling, and research purposes.

## **Clinical Imaging**

Dr. Ron Arenson, University of California, San Francisco (UCSF), discussed how clinical imaging fits into the multimedia vision of the future. His presentation focused on the growth of imaging, the importance of clinical images, decision support order entry, image sharing, wet-read modules, patient identification modules, and future directions of clinical image sharing.

- Imaging is now central to diagnosis and treatment in that practically all patients, both inpatient and outpatient, receive imaging studies.
- Imaging is used by a number of clinical departments including obstetrics, radiation oncology, cardiology, vascular surgery, orthopedics, neurology, neurosurgery, pulmonary, ophthalmology, ENT, general surgery, and urology. Additionally, many departments create their own images.
- While picture archiving and communication systems (PACS) are closely interfaced with radiology information systems (RIS), they are still largely separate from EHRs.
- Currently, most EHRs have an image viewer that pulls images from separate PACS and cannot support image reconstruction or other forms of advanced imaging.
- Vendors of EHR are concerned about image size, image complexity, and demands on network resources.
- NIBIB, through a contract with the Radiological Society of North America (RSNA), is sponsoring an image-sharing project that will enable the sharing of images and reports with patients and across institutions, using patient permissions to control access to images, thereby avoiding HIPAA concerns.
- At UCSF, a wet-read module has been developed as an add-on to PACS. This provides immediate preliminary interpretations of imaging studies to emergency departments, intensive care units, and other sites where time is critical.
- There are several questions to consider.
  - Will the current separation of PACS/RIS and EHR persist?
  - Is there a trend toward the use of a single PACS at each institution?
  - Will EHR of the future offer image reconstruction, image and data sharing, decision support order entry for imaging, and wet-read or patient ID modules?
  - How important will Integrating the Healthcare Enterprise (IHE) be to systems integration today and in the future?

## **The Path to Meaningful Use of the EMR: A Mayo Clinic Perspective**

Dr. David Mohr, Mayo Clinic, discussed the Mayo Clinic's implementation of electronic medical records from 1995 through the present.

- The Mayo Clinic transitioned to a completely paperless medical records system in July 2004. Key factors in the system are ease of use, ease of learning, and efficiency. The system includes a patient and referring physician internet portal to manage appointments, prescriptions, billing and payments, and communication with the primary care provider. Additionally, applications have also been created for mobile phones.
- The challenges for meaningful use include how to manage the information, data integration, interoperability of systems, and knowledge management. Each of these areas was discussed in further detail.

### **Panel I Discussion**

- It is important that images are properly incorporated into the future of electronic medical data, whether through meaningful use or not; it is unclear how radiologists will fit into this incorporation.
- The process should not start with technology solutions; it should start with identifying the quality and efficiency of care benefits that are to be achieved. The types of data and technology solutions to be used should follow from that premise.
- The first data types to be addressed should be (1) those that are the most important and costly to share and (2) those that are already standardized, such as DICOM. Meaningful use is about reducing cost to society; repetition of tests would be reduced if the data were available on some kind of health information exchange.
- A standardized single patient identifier would be the best way to facilitate information exchange between institutions, but it is not politically acceptable at this time. The public is uncomfortable with that level of linking. However, by using other data and parameters, it is already possible to match patient data with a very high degree of confidence. Even with unique identifiers at Mayo Clinic, there are problems.
- The many systems for data capture and storage currently in use must be brought together with consistent standards.
- Currently, private practices and large institutions are energized by the ways in which new technology standards will help their practices, but radiologists are not easily able to ensure that their needs are being met in a way that improves accuracy and efficiency of imaging and reading images. The meaningful use criteria that are tangential to people who conduct imaging should be replaced with criteria that improve the quality of image appropriateness and distribution.
- Separate criteria for different specialties might be called for in the meaningful use requirements. It could be beneficial to highlight the distinction between direct patient care and supportive patient care, though even that breaks down in radiology, some of which is direct patient care.

- It is important to focus on developing some basic tenets with respect to the integrity of the images and the ability to provide an environment that allows clinicians to consume them safely and in the proper context.
- Data integrity and consistency of definitions are huge issues, within institutions as well as across institutions, and must be addressed in order to successfully develop a process for extraction and meaningful use of that data.
- These issues are not technical. The real problems are the rules, regulations, and cumbersome governance model in place, which must be harmonized to more effectively use existing technological solutions. On the other hand, since regulations are not going to change easily or soon, meaningful use must be put in place with the existing regulations.
- The patient safety issues relevant to imaging data are much the same as those for text alphanumeric data. However, without reports, images might be misinterpreted. Often viewers do not provide the most robust image sets available, and many images are not accessible in electronic health records. Other issues of patient safety are not image-centered: patient identification, misinterpretation of data due to lack of background information, difficulty tracking cumulative radiation dose, etc.
- Issues of maintenance and certification must also be discussed, as they directly relate to quality indicators and patient safety. There are also robust opportunities for physician education if the EMR liaisons with literature from subspecialty organizations, educational resources, specialty boards, state licensing authorities, etc. The health information system at Brigham and Women's Hospital, for instance, has robust feedback and decision support software. Some providers in a practice setting may not take time to read references. Another tactic is to develop a self-study curriculum customized to individuals to respond to inefficiencies they are encountering.

## **Panel II: Meaningful Use of Images in Primary Care**

### **Meaningful Images: Meaningful Use, Images, and Primary Care – USA 2011**

Dr. David Kibbe discussed meaningful use from the perspective of the American Academy of Family Physicians.

- Over the past 40 years, there have been major changes in the way that people receive and access information – from mainframe computers in the 1960s to the mobile internet computing prevalent today.
- There are now more smart phones than desktop computers, an important factor to consider in the discussion of the use of EHRs.
- EHRs must have the capabilities for e-prescribing, determining drug-drug interactions, allergy warnings, and medication lists.
- The system must be capable of recording demographics, smoking status, and vital signs as well as transmitting health information to the patient; it should also allow for the incorporation of clinical laboratory data, provide patient-specific education and clinical summaries to providers, and maintain an immunization registry and biosurveillance data.

- It is important that EHRs be capable of supporting transmission of images in universally acceptable formats and include photographs.

### Electronic Image Use in the U.K.

Dr. Simon Eccles, National Health Service, gave the United Kingdom perspective on electronic image use.

- Always attach the date, patient identification, including photograph, and format information to every image. Whenever possible, also attach information on anatomical location, laterality, scale, and color saturation.
- Ease of use of EHR is crucial.
- Consider ways to handle transmission of movies and other very large images files.
- As the industry moves toward multi-slice CT images, consider how to handle transmission and reconstruction of these large files.
- Carefully consider shared image rules.

### **Panel II Discussion**

- Rules about format allowance applied too strictly will strangle creativity in the market; rules applied too loosely may result in too many formats that will eventually become obsolete. The supply/vendor market will help provide internal policing of formats.
- In other industries, metadata have been attached to discrete packages of information. It should be decided what metadata are needed to transfer data, as well as what component content standards will be required.
- A major complaint heard from primary care providers and specialists in the U.K. is about slow bandwidth speed and the use of central or regional archiving data stores versus local stores; speed is very slow at peak times when data are being requested from central/regional data stores. Other problems have been related to learning how to use the system and work without wet film.
- DICOM went a long way toward standardizing the format for radiological images and metadata associated with them; other types of images should be standardized in a similar way. More pressure from the user community would help move the industry toward adoption of IHE profiles. However, IHE is not attuned to the needs of the small practice. Ease of use by practitioners is critical.
- Using images (photographic, etc.) to document conditions and wounds creates interesting challenges. Many things a physician does cannot be imaged, including taking the patient's medical history. Dr. Eccles suggested health care is underusing, rather than overusing, non-radiological imaging. The vendor market is immature; vendors should be thinking globally about ease of use as critically important.
- This is an opportunity for imaging to become part of primary care – if it is easy for providers to use. If it is difficult to integrate into their practice, they will not do it. The



expense of using imaging and imaging-related technology will entice providers to share data rather than order excessive images.

### **Panel III: EHR and Images in Specialty Care**

#### **Orthopedic Surgery**

Dr. Thomas Barber, Kaiser Permanente, presented issues from the orthopedic perspective.

- Orthopedic surgery-related imaging has several special considerations, including specific storage and time frame requirements. Often, comparison with images that are several years old is required, and easy access through PACS or an EMR is essential. Increasingly dynamic shoulder and knee videos are important for diagnosis and documentation. Images should have DICOM wrapping, be easy to upload, and be accessible over time. Access to images from home is essential for orthopedic surgeons.
- For intraoperative pictures, an interface with the EMR to allow DICOM wrapping is critical.
- Any system must interface with and allow templating with appropriate magnification markers.
- Images must be accessible even when the network and EMR system are down. Also critical is the ability to share images with others, particularly hospitals who may not share the orthopedist's PACS or EMR system.
- If integrated with EMR, care must be taken to avoid problems with orders; in some systems, images cannot be linked or displayed unless there is a corresponding order for that film or image.

#### **Obstetrics and Gynecology**

Dr. Elena Gates, University of California, San Francisco, discussed images, EHR, and meaningful use in obstetrics and gynecology.

- Four of the most important issues in imaging for obstetrics and gynecology are documentation, transportability, consultation, and decision support.
  - In addition to images from ultrasound, CT, MRI, and mammography, relevant images include photographs taken during surgical and office procedures. Images should have significant annotation, and procedure reports should contain links to relevant images.
  - Obstetric images must be transportable; most women go to multiple care sites, and multiple types of images are used. There is a strong need for temporal integration of different images.
  - Decision support will be increasingly important as ultrasound becomes a core component of general obstetrics/gynecology office practice.
  - Gynecology sees a highly mobile population, and chronic conditions are prevalent. There must be access to images, perhaps through a patient portal.

- Complex clinical situations and the need for second opinions and sharing of intraoperative findings require consideration of telemedicine and alternate means of consultation.

### Cardiology

Dr. Anthony DeMaria, University of California, San Diego, reported on imaging from a cardiologist's perspective.

- Real-time images are crucial.
- For cardiac images, structure does not always follow function. Therefore, one needs to image multiple structures to detect dysfunction such as myocardial perfusion/ischemia, myocardial viability or scarring, coronary stenosis, coronary plaque composition, and cellular/intracellular targets.
- Images – entailing motion and three-dimensionality – are fundamental to cardiac care. Integrated imaging is needed to allay the disparity between structure and function, different types of images (noninvasive and invasive) from multiple sites (hospital, office), and different types of images going to multiple sites (ward, intensive care unit, clinic/office, operating room).
- Cardiologists use data/information from registries and national databases.

### Neurosurgery

Dr. Joseph Neimat, Vanderbilt University Medical Center, discussed use of imaging in neurosurgery.

- Different clinical scenarios require differing degrees of image access. Universal access systems should be flexible to allow for limited or complete image transfer. The ability to combine imaging and clinical data may become an important need for future applications.

### Neurology

Dr. Barney Stern, University of Maryland, reported on use of imaging in neurology.

- For stroke care, image orders are often protocol-based.
- Increasingly, there is more use of imaging within the context of consultation.
- There are increasing collaborations between neurologists, neurosurgeons, neuro-interventionalists, neurocritical care physicians, and emergency medicine physicians.

### **Panel III Discussion**

- From a functional standpoint, it would be great to enable different providers/specialists at various sites to look at an image concurrently.
- The PACS system should be linked to the EMR and not necessarily part of the EMR; when they are on separate servers, there is variability in resolution, etc.

- Decision trees linked to images can be very helpful in ordering tests, making diagnoses, etc.
- It is critical to be able to evaluate a patient and his/her images across specialties.
- Organizations have strongly encouraged vendors to move to the DICOM format; DICOM is compatible with JPG, but JPG does not have metadata attached. Also, some vendors comply with DICOM more successfully than others. Whichever format is chosen to be the standard, it must be rapid and understandable. It will also be necessary to provide education on how to use these platforms.
- Firewalls, incompatibility with organizational systems, and other technical glitches are the sources of much frustration.
- Much of the existing knowledge base about images, platforms, and formats has been confined to radiology, and other specialties have not been informed of best practices. For example, dentists and ophthalmologists use DICOM images, and improved sharing of best practices would be helpful. Also, radiologists tend to think in terms of studies, while other specialists tend to think in terms of patient encounters; this can result in selective archiving and documentation. The guidelines should delineate exactly what constitutes a study. Credentialing may also help. Incentives should be aligned to produce a study with images and the associated reports.
- Information technology experts and clinicians must be involved in these discussions so that the system is not developed in isolation.

#### **Panel IV: Stakeholder Perspectives**

##### **Patient Perspective**

Ms. Maureen Rigney, Lung Cancer Alliance, offered the patient perspective.

- Increased imaging and electronic records both improve and complicate care. Having the patient community's input is vital.
- Advocacy and support organizations can help make the process easier for patients and enable them to understand HIPAA restrictions by continuing to meet with them.
- A method of approving transfer of records without having to physically sign for them should be instituted.

##### **Health Information Organizations – When Does Image Exchange Make Sense?**

Dr. Mark Frisse, Vanderbilt University Medical Center, provided the health information organization (HIO) perspective on imaging and EHRs.

- HIOs should focus on what they can do uniquely; some may closely resemble community health information networks, while others may not be primarily general “exchanges.” Most HIOs should not be distracted by image issues; some HIOs may be “image HIOs.”
- Structured image reports could be part of meaningful use and are essential for meaningful care.
- Meaningful use inclusion is not essential to assure image exchange.

## **Payers' Perspective**

Dr. Reed Tuckson, UnitedHealth Group, represented the payer's perspective.

- Developing meaningful use EHR criteria for imaging is essential. Much greater attention must be paid to quality and cost efficiency outcomes measures as they relate to overuse, underuse, and misuse of imaging.
- The ability to track and gauge performance over time for conditions such as acute back pain management and preventable admissions or re-admissions would help keep costs down.
- Imaging considerations are essential components to outcomes that require meaningful health information technology; desirable outcomes require efficient exchange of imaging data and integrated imaging decision support capabilities.
- The emergency room, operating room, recovery room, and intensive care unit should be integrated, in part with shared imaging and decision support, to prevent unnecessary hospital admissions.
- The system should facilitate care management and outcomes reporting, facilitate radiation dose registries, and advance the ability to connect with third-party applications.

## **Integrated Care Providers**

Dr. Nina Schwenk, Mayo Clinic, discussed images, EHRs, and meaningful use from the integrated care provider perspective.

- Transportability of images is necessary to help address the issue of duplicative studies – for both safety and cost reasons.
- When contemplating meaningful use of images, it is important to understand what has and has not been achieved with Stage I of meaningful use and address the issues surrounding health information exchange across state boundaries. There is a need to understand what additional standards should be in place to exchange large image sets; avoid imposing inefficiencies on efficient care delivery systems; and address patient identification on a national level.

## **Panel IV Discussion**

- The records are the patient's records; however, many providers are not based at major academic centers and would rather repeat tests than use what another provider ordered. Every state has different laws regarding consent and authorization; a national standard could be helpful. Portability of patient-centered information among networks would also be beneficial.
- Both rewards and punishments will be necessary for transfer of records and images. The responsibility may fall to the insurance carrier, Medicare, and/or the patient.
- The average American cannot afford rising health care costs.
- There will likely be several indicators that a payer system crash is coming, including significant changes in benefit design that limit the networks that patients can use; a huge

entrepreneurial leap in alternative delivery systems; and a government decision that health care must be consistent.

- Mayo Clinic uses a master patient identifier, as do all of the foreign countries that have moved forward in EHR development. Using a unique identifier must be voluntary to succeed.

## **DAY 2: IMPLEMENTATION OPPORTUNITIES AND CHALLENGES**

### **Panel V: Toward Implementing a Multimedia EHR**

#### Creating the Visual EHR: A Vendor Perspective

Mr. Scott Porter, Cerner, discussed development of the visual EHR from the vendor perspective.

- A common standard/infrastructure must be developed, with interoperability, image sharing, and patient-supplied images. To be adopted, the system must add value, cannot increase clinician workflow time, and must simplify technology for both the end user and information technology staff.
- Cerner's position is that there should be a single archive, a single source of truth. Archiving, while tightly integrated to the EHR, is separate from viewing. This is the only way to maximize patient safety and provide true meaningful use for imaging throughout the enterprise. It is also the only way to provide a true, comprehensive longitudinal patient record including all multimedia data.

#### Health Care System Perspective

Dr. Keith Dreyer, Massachusetts General Hospital, provided the health care system perspective.

- Federal agencies should include medical imaging in Health Information Technology for Economic and Clinical Health Act (HITECH) care goals, with emphasis on quality, safety, cost, and outcomes; employ meaningful use constructs whenever possible; and create a distinction between medical imaging creators and medical imaging consumers.
- ONC should include "images" in the meaningful use definition of exam results. Electronic, rather than paper, ordering of imaging should be required. Clinical decision support of imaging should be available. Medical image systems should have several requirements, including critical communication management; urgent notification and recommendation follow-up; report and image connectivity; radiation dose registry compliance; and archival, display, and access requirements. The requirement to purchase systems that measure excluded eligible professionals should be relaxed.
- CMS should embrace clinical decision support for imaging through a demonstration project for imaging clinical decision support, support of initiatives for clinical decision support rule sets, and reform of payment rules based on clinical decision support.
- The Food and Drug Administration should develop a radiation dose registry with patient-centric exposure monitoring. Image storage and access requirements should be developed, as well as consumer-based mobile visualization standards for devices such as iPhones and iPads.

- NIBIB should demonstrate the value of existing technologies through clinical decision support, image sharing initiatives, critical communications, and consumer access; promote standardization of existing technologies; and foster a common understanding of imaging throughout various governmental agencies, Congressional oversight committees, the White House, and the Office of Management and Budget.

### **VA Experience with VistA: A Nationwide Multi-Specialty Image System**

Dr. Ruth Dayhoff, U.S. Department of Veterans Affairs, described the VA experience with VistA, its nationwide, multi-specialty image system.

- The VA is the largest integrated health care network in the U.S., with 152 medical centers and over 1,000 outpatient clinics nationwide. Images from virtually all specialties are integrated into the VA EHR. Uniform methods are used to capture, store, transmit, and access images. A networked, federated approach allows seamless access to images across the country.
- The VA has a fully electronic health record that integrates documents and images. The Computerized Patient Record System (CPRS) handles textual information; while the VistA Imaging System supplies multimedia information including images, video, and scanned documents. Telemedicine is supported across the VA system, and images are exchanged between the VA and the Department of Defense.
- Approximately 1.7 billion images are currently available online in the VA system. Images are stored in a wide variety of locations. Patients are often treated at multiple facilities.
- Online images are linked to clinical reports including medical procedures, consults, surgical operation reports, radiology studies, pathology examinations, and progress notes.
- Telemedicine is facilitated by the use of image sharing. Patients in a remote location can have their images screened by a remote specialist and the findings entered into the EHR.
- Remote Image Views allows a clinician to view all of the images for a patient, no matter where those images reside in the VA network.

### **Startup/Innovator Perspective**

Mr. Michael Ferro, Merrick Ventures, gave an innovator's perspective on meaningful use and imaging in EHRs.

- Consumers need a true personal health records system to own their personal health records, control who sees their records, share their records, and have all of their data – including images. This system should be automated, not self-service.
- Consumers need images to enable meaningful visits with the right specialists, change doctors without fear, track and influence personal radiation dosage, and empower them to seek out second opinions.
- Electronic diagnostic images must become part of meaningful use.
- Consumers should not be charged for electronic health record release of information for personal use from publicly funded EHRs.

- Populating the EHR with images will have macroeconomic impacts as well, including the creation of meaningful and useable personal health record systems; health e-commerce, facilitated by consumers having control of their personal health information; and the health e-consumer, enabling transparent collaborative health care. Entrepreneurs will seize this moment to develop the health e-commerce industry.

### **Panel V Discussion**

- The central question is the extent to which innovation must be coupled with meaningful use provisions to ensure that doctors receive payment/reimbursement.
- RSNA's Imaging Project is attempting to take current standards and push them to the consumer using EHR technology. Additional HIPAA constraints raise the cost, but the technology is almost there. Mr. Ferro suggested that the project is focused too much on the provider and not enough on the consumer.
- The consumer is the key. In other industries, relatively small government interventions have led to massive changes in the market. Dr. Eccles urged the use of small levers with large effects rather than attempting strict control of all aspects of the process.
- It will be necessary to find a balance between proscriptive approaches and openness.
- Many providers work directly with and advocate for patients; what is good for the provider is good for the patient.
- A consumer-based EHR that interfaces correctly with the provider-based system is another option for moving health information to the consumer. Provider-based EHRs need different added values than what is appropriate for the consumer. A patient portal would allow patients to input information before seeing the provider.

### **Panel VI: Interoperability and Standards**

#### **Standardization of IT Architectures and Imaging Information Exchange**

Mr. Charles Parisot, GE Healthcare, discussed the various aspects of standardization of information technology architecture and information exchange.

- Key considerations are to optimize clinical staff productivity, enable informed decision making, enable online imaging orders, empower patients, and improve access to health care through the use of telemedicine.
- DICOM has been standardizing image content since 1993, with worldwide use since 1995. DICOM covers a number of medical specialties and a wide variety of images and data.

#### *Discussion*

- In recent years, compliance with DICOM standards has degraded tremendously. DICOM may not be the ideal, but compliance should be encouraged.
- Paris, France, has interconnected 250 hospitals with sharing of prior images and clinical decision support system. The city demonstrated a savings of €1.5 billion.

## DICOM and the Pathology Community Experience

Dr. Bruce Beckwith, North Shore Medical Center, described DICOM and the pathology community experience.

- It would be useful to be able to correlate slides with other images (e.g., gross specimen, endoscopy, radiology).
- Pathology systems need to become more image-, rather than report-, centric.
- EMRs must be able to accept or connect to images and display correctly, keeping in mind security, credentialing, optimized viewers, etc.

## Integrating Words and Pixels

Mr. Don Dennison, Agfa Healthcare Corporation, discussed the value of images in the emergency room setting.

- Images are best embedded in the EHR when they are displayed directly in the EHR interface, with no download of any kind and using any client operating system and popular browser.
- When viewing large datasets, the creation of key images is critical, as is fast access to study metadata and initial image display. The server-side advanced visualization should be embedded in a single interface, and specialty applications should be launched in context.
- Emergency providers must be able to access images and EHR data inside and outside of the hospital without using a computer. Tablets and smart phones are convenient for peer-to-peer, radiologist-to-clinician, and patient consults. The ideal method of delivering images to a mobile device would require no application download and would be updated or configured to connect to the server directly. There would be no compatibility issues between the client and server versions, and no patient data would be cached. Information technology staff must have complete control over access to data.
- When considering integrating the health care enterprise for interoperability, organizations should select systems that adhere to the IHE Technical Framework, which will provide greater interoperability among systems and facilities. A number of key IHE Integration Profiles and Actors (Systems) should be considered, and developing a strategy for deploying these systems is equally important. A medical image repository can provide clinical and operational benefits.

## **Panel VI Discussion**

- Data must be gathered from multiple sources. All images must have metadata attached to them, but the metadata should be accessed as one piece of information rather than individual pieces of data. Grouping and packaging data implies a specific intention on the part of the image creator and is critical. De-aggregation of data should be conducted at the point of care.
- This is a global discussion, and the U.S. should be talking with experts in other countries who have tackled these issues.



## **Panel VII: Bandwidth and Connectivity**

### **Small and Rural Practices**

Dr. Michael McGill, Internet 2, discussed meaningful use of health networks in small and rural practices.

- Good bandwidth is necessary. Speed is often equated to bandwidth, but reliability – including packet loss – is equally or more important. Packet loss is a design characteristic of all internets that causes congestion, signal degradation, corrupted packets, faulty hardware, and corrupted/faulty network software.

### **How Much Bandwidth Is Enough?**

Dr. Paul Chang, University of Chicago, presented background and ideas for maximizing bandwidth.

- Bandwidth can be maximally leveraged through compression, just-in-time use (streaming), server-based rendering (i.e., thin client), and optimized presentation/progressive disclosure.
- We need a care-pulled scenario to contend for image requirement in EMR, not just from a technology push case.

## **Panel VII Discussion**

- A natural outgrowth of interconnectivity is consulting with physicians in other countries. U.S.-based physicians are reluctant to consult outside of the country for fear of legal issues. Radiologists are also anxious about being replaced by virtual radiology services. Embracing information technology as a value-add system can help protect radiologists from easy replacement.
- Standards allow physicians a structure within which to spend less time and resources on imaging details.

## **Summary Discussion: Implementation Considerations**

- Image data is critical for providing quality health care. Images are not ancillary but are central to all medical records because they capture information that cannot be easily summarized in text. The meaningful use of EHRs should embrace multimedia data in all of its criteria, from the definition of laboratory data through to the ability of consumers to upload complex data sets from health monitoring devices.
- Meaningful use of electronic health records by specialty practice, for example by radiologists, should depend on their scope of practice and different capabilities. For example, radiologists require regular access to images and therefore have different requirements for ordering and reviewing procedures compared to primary care physicians; also, in general, radiologists do not prescribe drugs. It is important for meaningful use consideration to integrate all data: alphanumeric, image, and other data forms into a comprehensive patient management.

- It is possible to segregate radiology from other specialties in meaningful use criteria and create separate criteria that are relevant for radiology and could make significant contributions to safety, quality, and cost-effectiveness.
- Radiologists created IHE but have done a poor job of educating non-radiologists about the system. Methodologies that the vendor and informatics communities have used to build IHE systems could serve as a model for EHR development.
- Meaningful use for radiologists is about more than images; any new system should incorporate non-imaging requirements such as informatics systems to provide prompting and reminders, context, and communications tools.
- Image data is an integral part of the EHR, but it is not necessary that the data itself be in the EHR; it can be linked.
- Access to images is not as meaningful without linking to the associated structured report and metadata. Meaningful use criteria should describe expectations for the linking and management of data and metadata.
- It will be important to pay attention to management of metadata and data that precede the creation of images. Access to images is not as meaningful without linking to the associated structured report and metadata. Meaningful use criteria should describe expectations for the linking and management of data and metadata.
- Every patient has his/her own system of health care. Integral parts of this unique system are providers, laboratories, and images. If the institutional system is truly patient-centered, there should be rewards and punishments to bring management of images into the patient's system of care. What is important to the patient is the motivating force for everyone in the health care system.
- The proposed Stage 2 and 3 criteria state that providers should use EHRs to document each episode of patient care and the system to generate notes; this is the reverse of an assumed purpose of EHRs – to use context to facilitate the creation of notes.
- Meaningful use should also encompass standards and plans for improving the national bandwidth infrastructure. The system should be flexible enough to allow the private sector to build on existing processes and infrastructure.
- Sharing of medical images should build on the current CD-based system and not attempt to build an entirely new system from scratch.
- The meaningful use criteria for medical images and image sharing should not be half-formed; if the criteria are not fully developed, providers will not keep to particular standards closely enough to allow interoperability.
- If a goal is to create an environment for next-generation EHRs, it is important to build requirement and architectural essentials into meaningful use criteria.
- It would be a mistake, however, to attempt to prescribe the architecture of the integrated presentation of images; the architecture will come out of the goals. Importantly, images and reports should be presented together.

- Certification of EHR systems should acknowledge specialty support for standards such as IHE, DICOM, and HL7 and functions such as image sharing, and imaging-related decision support.
- There has been a consistent statement from the stakeholders at this meeting that implementation needs to move forward in a step-wise fashion. Dr. Parisot strongly recommended that ONC and NIBIB move this process forward to the appropriate committees.
- The longevity of EHRs is contingent upon the average clinician's experience with the system. ONC and NIBIB should take time to speak to clinicians, academics, and doctors in private practice who see many, many patients each week and ask them how the proposed system will affect them on a daily basis. The perspectives of these different practitioners will likely be stratified by age, career stage, and familiarity with electronic information technologies; the perspective of a recently out of residency clinician will be very different than the older, more experienced doctor.
- Health care is provided by multiple providers at multiple sites; ideally, these providers will be gathering electronically at one point in time. There must be ways to share images with non-radiologist providers. The diverse range of data formats employed by different technologies, and in particular image types, should not be a barrier to information exchange.
- Image sharing among health care providers and between health care providers and consumers is critical to reducing unnecessary procedures as well as promoting good patient management. Unnecessary procedures and excess radiation exposure are serious issues that need to be addressed. Electronic decision support based on evidence-based medicine can reduce variation in ordering as well as unnecessary procedures.
- Technology should leverage efficiency, not slow down the user's existing workflow. At the least, it should be time-neutral. The goal of EHRs is to facilitate, not impede. Meaningful use criteria are a jump-start of technology adoption that will help make health care more efficient and safer. Meaningful use criteria should be simple, targeted, and not overreaching.
- Management of this change will be important to ensure continued patient safety.
- The health consumer perspective must be taken into account in the final decisions regarding meaningful use.