Integrating the Healthcare Enterprise White Paper

Cardiac Catheterization Workflow and Evidence Documents Integration Profiles

This white paper provides the reader with information regarding the Cardiac Catheterization Workflow, or simply "Cath", Integration Profile released by IHE Cardiology in Year 1 (2005), and the Evidence Documents Profile used for cath measurements and logs, released in Year 2 (2006).

Problem Statement:
The Cardiac Catheterization lab is a multi-modality mix of many types of equipment from many different manufacturers; as many as a dozen systems from different manufacturers may typically participate in a procedure. In current practice, these systems are unconnected islands, each managing its piece of the patient clinical record. Integration of this data would result in increases in efficiency and reduce the potential for medical errors.

The logistics involved in the performance of a Cardiac Catheterization are complex, especially from a workflow perspective. Evidence-gathering activities may begin before an order is placed; in fact, orders are often not created for a cardiac catheterization procedure due to its frequent emergent nature. There is

often no link at all between the catheterization lab and a hospital order entry (CPOE) system, so the chain of procedural management that such a system can provide is broken from the start. Scheduling of labs is often done ad hoc to accommodate emergency cases, and there is no lab status reporting to the schedulers. Furthermore, the procedure itself may include both diagnostic and interventional or therapeutic aspects, and may extend over a long time period (several hours), complicating workflow management.

Data is typically acquired from each of the in-lab systems independently without any time synchronization, and any documentation of simultaneous acquisition of information from various pieces of equipment must be entered manually in the procedural record. Acquired data may be stored in proprietary forms separately by each unit, creating a fragmented record of the procedure that is unusable for subsequent analysis. Measurements and analyses made in the lab cannot be shared electronically, requiring manual copying and re-entry of data into clinical reports or into submission forms for mandated data registries.

In emergent cases, priority must be given to patient care, and frequently the identity of the patient is not established until after the procedure. Finding all the cath data results and updating them to the corrected patient ID is a major task for cath lab administrators.

Use Case and Scope:
The Cardiac Catheterization use cases focus on the continuity, integrity and integration of basic patient, order, and procedure data across all of the participating computer systems. These Profiles deal specifically with consistent handling of patient identifiers and demographic data, including that of an emergent patient presentation where the actual patient identity may not be established until after the beginning of the procedure, or even a significant time after the completion of the procedure. It also specifies the scheduling and coordination of procedure data across a variety of imaging, measurement, and analysis systems, with provisions for reliable storage in an archive. IHE is a multi-year initiative and subsequent years will address additional Cath workflow issues such as reporting and data gathering for outcomes analysis.

Examples of use cases identified in the IHE Cardiology Technical Framework include:

Ideal Case: IHE describes the ideal situation when a patient is pre-admitted and registered in the Hospital Information System. An order is generated for a procedure which is then scheduled. Demographics and procedure information are transmitted accurately to the hemodynamic and angio systems. Images are securely stored to an archive and can be displayed at any imaging workstation. Cath measurements, performed anywhere, and/or the procedure log are

correctly associated and securely stored with the study as discrete, structured data which can be interpreted by another workstation[1] and incorporated into a final report.

John Doe in ED: Almost all institutions measure "door to balloon time". It is critical that, when pulling a patient from the Emergency Department (ED) to the cath lab, time is not wasted verifying that all of the information systems are set up correctly prior to beginning the procedure. IHE recognizes this situation and enables patient care to be the highest priority by automating the reconciliation of all procedure data after the patient has been stabilized. The patient identification can occur before, during, or after the procedure and, still, the hemodynamic logs, images, and measurements will all be properly and automatically updated with the patient's correct name and demographics.

Cath Measurements: Cath measurements (quantitative arteriography and ventriculography, hemodynamics, and intravascular ultrasound measurements) and the procedure log have historically been printed to paper and inserted into a patient's folder. To use those measurements or log data, cardiologists typically had to retype the information into a separate reporting system. A technologist had to re-enter measurements for a registry or clinical trial.   The IHE Evidence Documents Profile provides for the accurate patient identification, measurement definitions and structure, and secure storage of cath measurements and procedure logs.

Profile Benefits:
IHE provides benefits to many of the users in a cath department, specifically:

Cardiologists
Patient care is improved and cardiologists' time is saved by:

- Making sure the patient is cared for immediately without concern for completing the proper paperwork first
- Reducing delays in charge posting
- Automatically synchronizing time on all systems within a cath lab so that data can be time-tagged to at least 1/10th second accuracy, so that simultaneous events recorded on different systems can be identified
- Providing cath measurement and hemodynamic procedure log interoperability – complete the preliminary cath measurements on a workstation or transfer the procedure log as structured data to the reporting workstation for the final report

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[1] Note that the ability to display hemodynamic waveform data on a workstation is not yet specifically included in the IHE Cardiology Profiles, but may be specified in future editions of the IHE Technical Framework.

Cardiology Administrators and Technologists
Cath lab workflow is improved and time is saved by:

- Reducing time and errors from entering data into multiple systems in the cath lab
- Assuring correct patient demographics and procedure code information
- Automating the correction of demographics in cases such as patient identified mid- or post-procedure (reduces or negates the need to a person to "fix" studies and data)
- Maintaining the status of the procedures real-time so that the cath lab flow manager can better utilize the facilities
- Accurately identifying data to facilitate data collection later (e.g., registries or outcomes analysis)
- Managing and simplifying RFP's and purchases
- Allowing selection of the "best solutions" from multiple vendors and reducing vendor integration issues, rather than the restriction of a single vendor all-encompassing solution

Cardiology IT Staff
Other IT projects can come to fruition when time is saved in the cath lab by:

- Automatically assuring that all images are securely stored to the archive prior to deletion at the angio system
- Avoiding the implementation and maintenance costs for "one-off" integration interfaces to each device
- Ensuring proper functioning of a multi-vendor environment
- Reducing "switching costs" when new equipment is purchased

Patient
The patient also benefits from systems integration in the cath lab by:

- Removing the need to wait while demographics are entered into the various cath lab systems and old reports are pulled.
- Enabling better patient care because the interpreting physician can more accurately assess interim changes.
- Providing cath reports more readily to other care team members within and outside a hospital or office network.

How the Cath Integration Profile actually works:
IHE defines "actors" which are responsible for performing certain roles. Vendor products in the marketplace often implement more than one IHE actor.

The key Actors in the Cath Workflow and Evidence Documents Profiles, and examples of products which might implement them, are:

- ADT, such as a Hospital Information System (HIS)
- Order Placer, such as a CPOE system or HIS
- Departmental System Scheduler/Order Filler, such as a Cardiology Information System
- Acquisition Modality, such as an Cath device (angio system, hemodynamic system; transthoracic, intravascular or intracardiac ultrasound)
- Image Manager/Archive, such as a PACS system, image viewing device, etc.
- Evidence Creator, such as an application that performs measurements on a modality or workstation

In the best case example where a patient is registered ahead of time, an order is created, and the procedure is scheduled in advance, the Cath workflow transactions would appear as follows.
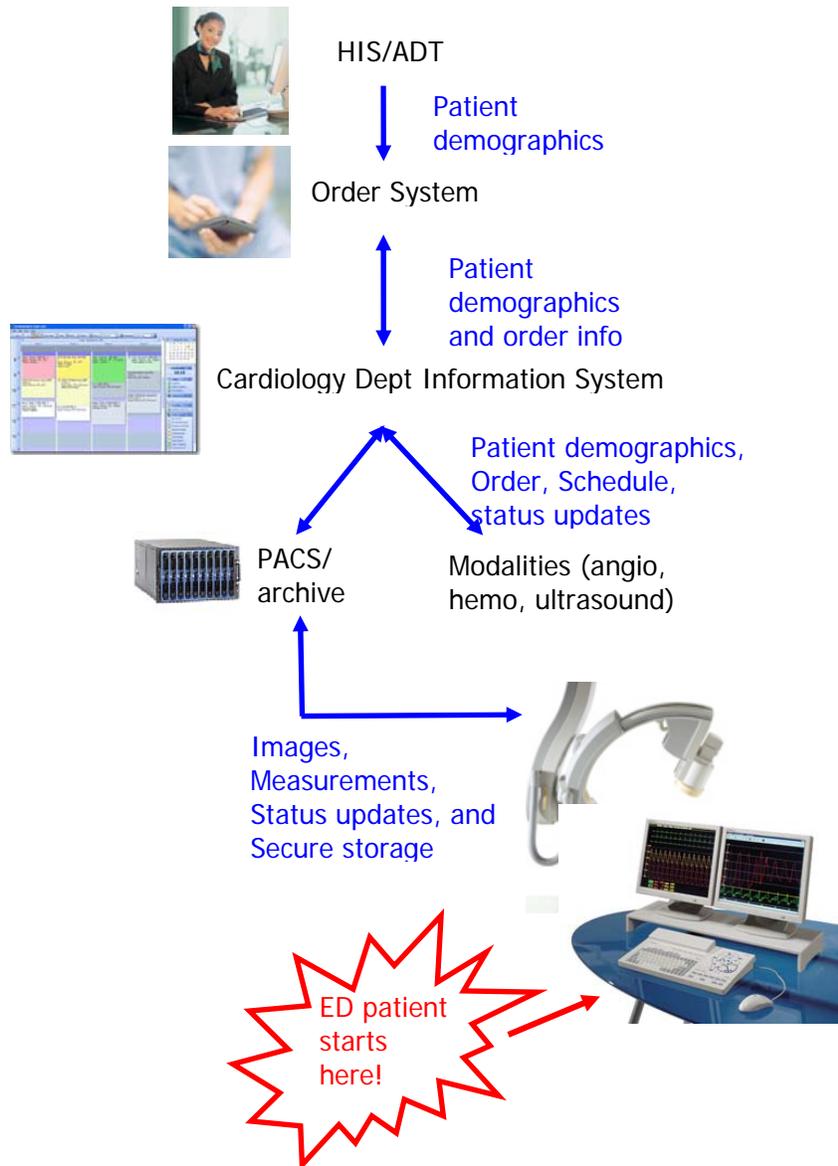
The transactions in this diagram use existing standards such as HL7 and DICOM. The Cath Workflow Integration Profile also takes into account situations such as an ED patient being brought directly into the cath lab.   For more detailed information, please see the IHE Cardiology Technical Framework document.

Purchasing Using IHE:
One of the key concepts of IHE is the ability to definitively describe interfaces with a single sentence.   Using the statements below mitigates the need for hundreds of pages of technical documentation, interface engines, and on-site testing. For example, the following statements should be included in any request for proposal (RFP):

"The **angio system** shall support the IHE Cardiac Catheterization Workflow Profile as the Acquisition Modality and Image Display Actors. Additionally, the modality system shall support the Evidence Documents Profile as an Acquisition Modality Actor with the Cath Option."

"The **Cardiology Information System** shall support the IHE Cardiac Catheterization Workflow Profile as the Order Filler/Department System Scheduler Actor."

"The **Cardiology PACS** shall support the IHE Cardiac Catheterization Workflow Profile as the Image Manager and Image Display Actors and the Evidence Documents Profile as the Image Manager, Image Display, and Evidence Creator Actors with the Cath Option."

Other related Profiles to consider include Displayable Reports (DRPT), Retrieve ECG for Display (ECG), Retrieve Information for Display (RID), Portable Data for Imaging (PDI), and Cross-Enterprise Document Sharing (XDS).

Summary:
IHE Integration Profiles improve patient care and reduce errors and unnecessary work in the cath lab. It is worth your time to learn more about IHE.   See www.ihe.net or www.acc.org/ihe.htm .

Consider joining the "IHE Cardiology Users' Group" which holds web seminars, teleconferences, and other educational opportunities on an informal basis.   For more information, send an email to ihe@acc.org.