

Buying an Integrated Electronic Health Record How to Require an IHE and Open Standards Solution

Based on the Academy's Special Requirements for EHRs in Ophthalmology^[1]

In purchasing the components of an electronic medical office, seamless integration of the Electronic Health Record (EHR), Practice Management System (PMS), and eye care instruments is critical to a successful outcome. IHE Eye Care is specified as an essential requirement for interoperability in the Academy's publication entitled "Special Requirements for Electronic Health Records in Ophthalmology."^[1] This publication is intended to help ophthalmologists to identify important features when searching for EHR systems, stimulate vendors to recognize and incorporate these functions into systems, and assist federal agencies to develop future guidelines regarding meaningful use of EHRs. More broadly, the Academy believes that these functions are elements of good system design that will improve access to relevant information at the point of care between the ophthalmologist and the patient, enhance timely communications between primary care providers and ophthalmologists, mitigate risk, and ultimately improve the ability of physicians to deliver the highest-quality medical care.

Interoperability is an important concept, representing the ability to exchange data freely among information systems and devices, regardless of the vendor or brand. This will create opportunities for important advances in medical care, data accessibility, clinical research, disease registries, and public health. The importance of interoperability extends beyond exchange of patient data for referral or consultation. Interoperability is also important within a single practice for communication between the EHR system and various ophthalmic imaging and measuring devices. Ophthalmology EHRs should conform to accepted, vendor-neutral standards and profiles for representation and transfer of data from ophthalmic instruments and devices. Accessibility to original measurement data will allow ophthalmologists to review and use clinically-relevant findings within the EHR, without the risk of error associated with manual data transcription. The Academy-sponsored IHE (Integrating the Healthcare Enterprise) Eye Care Domain has worked to leverage open standards (i.e. DICOM¹ and HL7²) to specify an integration approach to meet the needs of Eye Care. To achieve seamless integration, products must support one or more of the IHE Eye Care (EYECARE) use cases, which are referred to as "profiles".

Below we describe briefly the most important things that you need to know before purchasing each component of an integrated electronic office. You will see that every section requires either **Basic** or **Advanced** Eye Care Workflow. Eye care workflow is a fundamental requirement for managing data flow throughout the system. These are the functions you will gain by choosing Advanced, rather than Basic Eye Care Workflow:

- Tracking procedure order status - establish when the procedure has been started, completed, or cancelled
- Automatic transfer of procedure codes to the billing system – optional, must be specified separately

¹ Digital Imaging and Communication in Medicine: A medical standard which defines the structure of medical images, measurements, associated meta-data and how these digital objects are communicated from one device to another.

² Health Level 7 - Standards for electronic interchange of clinical, financial, and administrative information among health care oriented computer systems.

ELECTRONIC HEALTH RECORD INTEROPERABILITY

The key benefits that IHE provides the EHR:

- A conduit between your PMS and instruments
- Patient demographics passed to the instruments, allowing staff to select the patient’s name from a worklist and obviating error inherent in redundant manual data entry
- Automatic correction of patient demographics in your EHR when modified by the PMS
- Generation of physician’s procedure orders that are automatically passed to the instruments

Most of the benefits provided by IHE arise from the requirement that vendors support an “actor” called the Department System Scheduler/Order Filler. To require this actor, include the following wording within your RFP (Request For Proposal):

“The EHR shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as a Department System Scheduler/Order Filler Actor”

There are some optional functions that IHE can bring to an EHR that **must** be specified since they are not mandatory. The following table provides a brief summary and how to ask for these optional functions in your RFP:

Optional Function	RFP Wording
View patient appointment schedule and request patient appointments from within the EHR	The EHR shall support the IHE {Basic or Advanced} Eye Care Appointment Scheduler Integration Profile as an Appointment Requester Actor
Provide text instructions to the technician when requesting a procedure	The EHR shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as a Department System Scheduler/Order Filler Actor with the Patient Instructions Option
Automatic transfer of procedure codes to the billing system (only available in Advanced Eye Care Workflow)	The EHR shall support the IHE Advanced Eye Care Charge Posting Integration Profile as a Department System Scheduler/Order Filler Actor
Create, transfer, and receive clinical documentation in standardized format.	See “Clinical document interoperability” below

CLINICAL DOCUMENT INTEROPERABILITY

The key clinical document related benefits that IHE provides your EHR:

- Create clinical documents (i.e. exam notes) that can be viewed in another system
- Receive and utilize clinical documents created by another system
- Transfer clinical documents employing standards defined in meaningful use

Key benefits provided by IHE arise from the requirement that vendors support two “actors” called Content Consumer and Content Creator. IHE Eye Care is working to create standardized clinical documents, the first of which is “General Eye Evaluation” for processing exam notes. In addition IHE Content Profiles have been created to address eye surgery: “Cataract Profiles (Cataract-PreOp, Cataract-Op, Cataract-PostOp) and General Eye Care Operative Note (Eye-Op)”. To require these actors include the following wording within your RFP (Request For Proposal):

“The EHR shall support the IHE General Eye Evaluation Content Profile as a Content Creator and as a Content Consumer”

And

“The EHR shall support the IHE Cataract Content Profiles (Cataract-PreOp, Cataract-Op, Cataract-PostOp) and General Eye Care Operative Note (Eye-Op) Content Profile as a Content Creator and as a Content Consumer”

An EHR supporting the Content Consumer actor **must** specify one or more of the following:

Content Consumer Option	RFP Wording
View Option – human readable display, data remains on the network	The EHR shall support the IHE General Eye Evaluation Integration Profile as a Content Consumer with the view option
Document Import Option – EHR stores the document	The EHR shall support the IHE General Eye Evaluation Integration Profile as a Content Consumer with the view option and with the document import option
Section Import Option – EHR copies document sections into local data structure	The EHR shall support the IHE General Eye Evaluation Integration Profile as a Content Consumer with the view option and with the section import option
Discrete Data Import Option – storage of the structured content of one or more document sections	The EHR shall support the IHE General Eye Evaluation Integration Profile as a Content Consumer with the discrete data import option

The ability to transfer clinical documents employing standards defined in meaningful use requires that vendors support one of the IHE profiles listed below. To require these profiles, include the following wording within your RFP (Request For Proposal):

Document Transfer Option	RFP Wording
Cross-Enterprise Document Sharing (XDS) – document sharing using a coordinated infrastructure (document registry/repository)	The EHR shall support the IHE Cross-Enterprise Document Sharing (XDS) Integration Profile as a Document Source and Document Consumer
Cross-Enterprise Document Reliable Interchange (XDR) – point to point document exchange in the absence of XDS infrastructure	The EHR shall support the IHE Cross-Enterprise Document Reliable Interchange (XDR) Integration Profile as a Document Source and Document Recipient
Cross-Enterprise Document Media Interchange (XDM) – enables document interchange by several standard media - i.e. physical media, secure email	The EHR shall support the IHE Cross-Enterprise Document Media Interchange (XDM) Integration Profile as Portable Media Importer and/or Portable Media Creator supporting <with one or more of the options below> <ul style="list-style-type: none"> • USB option • CD-R option • ZIP over Email option • ZIP over Email response

PRACTICE MANAGEMENT SYSTEM INTEROPERABILITY

The key benefits that IHE provides the PMS:

- Patient demographics will be entered only once in the PMS and automatically loaded into the EHR. The EHR will automatically pass the demographics to the instruments. This eliminates the frequently erroneous re-entry of information on devices (e.g., visual field machine, fundus camera, etc.)
- Corrections or other changes made to patient demographics on the PMS will be updated automatically in the EHR and storage server (e.g., PACS³)

Most of the benefits provided by IHE arise from the requirement that vendors support an “actor” called ADT/Patient Registration. To require this actor, include the following wording within your RFP (Request For Proposal):

“The PMS shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an ADT/Patient Registration Actor”

There are some optional functions that IHE can bring to a PMS that **must** be specified since they are not mandatory. The following table provides a brief summary and how to ask for these optional functions in your RFP:

Optional Function	RFP Wording
Receive procedure codes from the EHR to generate procedure billing (i.e., PMS supports billing)	The PMS shall support the IHE Eye Care Charge Posting Integration Profile as a Charge Processor Actor
Automatic patient demographics and account updates to the billing system (i.e., separate billing system)	The PMS shall support the IHE Eye Care Charge Posting Integration Profile as an ADT/Patient Registration Actor
Generate orders from the PMS and synchronize with the EHR	The PMS shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Order Placer Actor
Provide text instructions to the technician when requesting a procedure.	The PMS shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Order Placer Actor with the Patient Instructions Option

³ Picture Archiving and Communication System: A network of computers responsible for the storage and display of medical images, measurements and related data. Originally used by radiology departments, PACS products can be found in cardiology, pathology and ophthalmology departments or clinics.

EYE CARE INSTRUMENT INTEROPERABILITY

There are many types of instruments supported by IHE and DICOM such as fundus cameras, external cameras, slit lamp biomicroscopes, specular microscopes, operating microscopes, optical coherence tomographers (OCT), retinal thickness analyzers, confocal scanning laser ophthalmoscopes, Scheimpflug cameras, keratometers, auto refractors, phoropters, lensometers, ultrasound devices, axial length measurement devices, and visual field devices.

The key benefits that IHE provides instruments:

- Technicians can select a patient’s name from a worklist on the instrument that was supplied by the EHR - eliminates redundant and often erroneous manual data entry on the instrument and keeps demographics consistent among PMS, EHR, and instruments
- Patient demographics and procedure information placed into the instrument’s data - ensures accurate matching between patient and data wherever in the world those images or measurements are used
- Create and store data in an open standard format (DICOM) - eliminates proprietary solutions that may limit or prevent access to existing data when purchasing new software in the future

Most of the benefits provided by IHE arise from the requirement that vendors support an “actor” called the Acquisition Modality. To require this actor include, at the minimum, the following wording within your RFP (Request For Proposal):

“The <type of the instrument> shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Acquisition Modality Actor”

There are some optional functions that IHE can bring to an instrument but they **must** be specified since they are not mandatory. The following table provides a brief summary and how to ask for these optional functions in your RFP:

Optional Function	RFP Wording
Display text instructions to the technician from an ordering physician	The instrument shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Acquisition Modality Actor with the Patient Instructions Option
Create standard DICOM PDFs for display of non-DICOM data	The instrument shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Acquisition Modality Actor with the Encapsulated PDF Option for Evidence Documents
Label images to indicate position in the retina	The instrument shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Acquisition Modality Actor with the Relative Image Position Coding Option
Document stereo relationship between images	The instrument shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Acquisition Modality Actor with the Stereo Relationship Option
Keep the EHR updated on the procedure status: in progress, completed or cancelled	The instrument shall support the IHE Advanced Eye Care Workflow Integration Profile as an Acquisition Modality Actor

CONNECTING NON-DICOM INSTRUMENTS TO THE EHR

Understanding how to purchase new instruments with IHE functionality or asking for upgrades to existing instruments can be accomplished by reading the section entitled “Eye Care Instrument Interoperability”.

A commonly asked question is:

“Can I connect a proprietary non-standard device to an EHR using open DICOM/IHE standards?”

The answer is “YES”!

This is accomplished by purchasing a device supporting the IHE Acquisition Modality Importer Actor. This product interface (Actor) provides the same benefits as eye care instruments that support IHE internally with one difference; it converts the non-DICOM output from the instrument into DICOM format. The data may be exported in: a DICOM PDF document, a “snapshot” of a DICOM image (called Secondary Capture), or as actual DICOM discrete data.

The detailed benefits that IHE enables in a non-DICOM instrument are documented in the “Eye Care Instrument Interoperability” section. Reminders of the key benefits are:

- Technicians can select a patient’s name from a worklist on the instrument that was supplied by the EHR - eliminates redundant and often erroneous manual data entry on the instrument and keeps demographics consistent among PMS, EHR, and instruments
- Patient demographics and procedure information placed into the instrument’s data - ensures accurate matching between patient and data wherever in the world those images or measurements are used
- Create and store data in an open standard format (DICOM) - eliminates proprietary solutions that don’t translate to other manufacturers and may make you unable to access your own data when purchasing new software in the future

When purchasing an interface to an instrument that does not support DICOM/IHE, include the following wording within your RFP (Request For Proposal):

“The <type of the non-DICOM instrument> shall provide an interface that supports the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Acquisition Modality Importer Actor”

EYE CARE DATA STORAGE SERVER INTEROPERABILITY

An onsite or leased online server that complies with IHE and open standards (DICOM and HL7) is required to store images and measurement data from office instruments. The server may belong to an existing image management system (e.g., PACS) not integrated within the EHR, or belong to an integrated storage system which is already part of the EHR. DICOM (open standard format) compliance in this system is an absolute requirement for IHE interoperability.

The key benefits that IHE enables for the storage server (PACS):

- Provide storage of images in one location from ALL instruments
- Provide storage of measurement data in one location from ALL instruments (e.g., visual field device, autorefractor, lensometer)
- Respond to queries about availability of particular images and/or measurement data, and to requests to retrieve them. These are the key benefits to IHE:
 - ✧ View all the data for a particular patient in one place, regardless of its origin
 - ✧ View information over a long period of time (i.e., images/measurements created six months ago for the same patient)
- Automatically correct patient demographic errors when corrected on the PMS - this is accomplished via the EHR
- When new DICOM standards address more instruments, the DICOM/IHE storage server should require only a MINOR upgrade to accommodate them. This is in contrast to the much larger upgrade required for vendor-specific, proprietary storage servers.

Most of the benefits provided by IHE for storage servers arise from the requirement that vendors support an “actor” called the Image Manager/Image Archive. To require this actor, include the following wording within your RFP (Request For Proposal):

“The storage system (e.g., PACS) shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Manager/Image Archive Actor”

There are some optional functions that IHE can bring to a storage system but that must be specified since they are not mandatory. The following table provides a brief summary and how to ask for these optional functions in your RFP:

Optional Function	RFP Wording
Ensure correct patient demographics when ordinary IHE workflow processes have not been followed.	The storage system shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Manager/Image Archive Actor with the PPS Exception Management Option
Notify other components of your electronic office that images or measurements are available for viewing or other functions	The storage system shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Manager/Image Archive Actor with the Instance Availability Notification Option
Display stereo relationship between images	The storage system shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Manager/Image Archive Actor with the Stereo Relationship Option

DISPLAY WORKSTATION INTEROPERABILITY

The key benefits that IHE enables for the display workstation:

- Viewing of images and measurements from all connected DICOM (open standard format) instruments in your clinic, such as fundus cameras, OCT machines, keratometers, etc.
- Viewing of images and/or measurements from different vendors on one display workstation
- Query and retrieval of images and/or measurement data from storage servers (e.g., PACS) - ability to query and retrieve current images and/or measurements plus data from older procedures
- View and compare images and/or measurement data between studies both current and historical.
- Derivation of reconfigured images or measurements from the original studies and storage in the same location as the original images or measurements

Most of the benefits provided by IHE for display workstations arise from the requirement that vendors support an “actor” called the Image Display. To require this actor, include either of the following sections within your RFP (Request For Proposal), depending upon what you are requiring in the other components of your electronic office:

“The Display Workstation shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Display Actor”

The types of images and measurements displayable on a workstation may differ among vendors’ products. Therefore, a list of the specific images and measurements that are DICOM supported is required, e.g. fundus photos, OCT images, keratometry measurements, visual acuity measurements, visual fields, PDF documents, etc.

For those images and measurements not currently supported by the display workstation vendor or for instruments newly standardized in DICOM, a software upgrade is typically needed.

There are some optional functions that IHE can bring to a display workstation but that must be specified since they are not mandatory. The following table provides a brief summary and how to ask for these optional functions in your RFP:

Optional Function	RFP Wording
Display DICOM PDFs of non-DICOM data	The display workstation shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Display Actor with the Encapsulated PDF Option for Evidence Documents
Label images to indicate position in the retina	The display workstation shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Display Actor with the Relative Image Position Coding Option
Display stereo relationship between images	The display workstation shall support the IHE {Basic or Advanced} Eye Care Workflow Integration Profile as an Image Display Actor with the Stereo Relationship Option

GLOSSARY

Digital Imaging and Communication in Medicine (DICOM):

A medical standard which defines the structure of digital images, measurements, and associated meta-data and how these digital objects are communicated from one device to another.

The goals of DICOM are to achieve compatibility and to improve workflow efficiency between imaging systems and other information systems in healthcare environments worldwide. Connectivity works because vendors cooperate in testing via either scheduled public demonstrations, over the Internet, or during private test sessions. DICOM covers specialties such as radiology, cardiology, ophthalmology, dentistry, pathology, radiation therapy, and more. DICOM is accepted throughout the world as the medical imaging standard for connectivity.

Health Level 7 (HL7)

Standards for electronic interchange of clinical, financial, and administrative information among health care oriented computer systems.

HL7 provides standards for interoperability that improve care delivery, optimize workflow, reduce ambiguity and enhance knowledge transfer among all of our stakeholders, including healthcare providers, government agencies, the vendor community, fellow standards organization and patients.

Integrating the Healthcare Enterprise (IHE)

IHE Eye Care is a healthcare specialty “domain” sponsored by the American Academy of Ophthalmology. IHE is an initiative of the Radiological Society of North America (RSNA) and Healthcare Information and Management Systems Society (HIMSS) that brings together healthcare professionals and industry to improve the way healthcare systems interoperate to share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care. Systems developed in accordance with IHE communicate with one another better, are easier to implement, and enable care providers to use information more effectively. (www.ihe.net).

Picture Archiving and Communication System (PACS)

Networked computers responsible for the storage and display of medical images, measurements and related data. Originally used by radiology departments, PACS products can be found in cardiology, pathology, and ophthalmology departments or clinics.

References

1. Chiang MF, Boland MV, Brewer A, et al. Special Requirements for Electronic Health Record Systems in Ophthalmology. *Ophthalmology* 2011;118:1681-1686.

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