

Summit on Color in Medical Imaging
Silver Spring, MD, USA
May 8-9, 2013



Patient Photographs in the Electronic Health Record

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EHR2011

Images, Electronic Health Records, and
Meaningful Use

NIH NIBIB Workshop: Jan 10-11, 2011

The goal of this workshop was to understand the value of access to images as part of the meaningful use of electronic medical records.

Electronic Medical Record (EMR) vs Electronic Health Record (EHR)

- EMRs are episode and enterprise focused
- EHRs are longitudinal, comprehensive, and patient-centered.
- EHRs can also serve as a lifetime record for the patient.

R. Greenes, Arizona State Univ.



Photographs in the EHR:

- 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. [R Greenes]
- Always attach the date, patient identification, and format to every image. Whenever possible, also attach information on anatomical location, laterality, scale, and color saturation. [S Eccles, NHS UK]
- Organizations have strongly encouraged vendors to move to the DICOM format; DICOM is compatible with JPG, but JPG does not have metadata attached.
- 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.

This is the only mention of color in the final summary document !

selected comments from the meeting summary

Support for ICC Color Management is not identified !



Clinical Photography Examples

- Dermatology
- Reconstructive Surgery
- ER Abuse documentation
- Wound Management (Trauma Surgery)



Lyme Disease
Delayed Rash
US CDC



Clinical Photography Examples

- Dermatology
- Reconstructive Surgery
- ER Abuse documentation
- Wound Management
(Trauma Surgery)

Ear Reconstruction
following Ca Surgery
E. Funk, MD





Clinical Photography Examples

- Dermatology
- Reconstructive Surgery
- ER Abuse documentation
- Wound Management
(Trauma Surgery)



5 YO Child Abuse

L. Ricci MD, Medscape Ref

Clinical Photography Examples

- Dermatology
- Reconstructive Surgery
- ER Abuse documentation
- **Wound Management (Trauma Surgery)**

Triathlon Bike Fall
XAVIER UNIVERSITY
WOUND CARE CASE STUDY

Dorsal Left Forearm Distal Wound



Day 1 (7/25/01)



Day 2 (7/26/01)

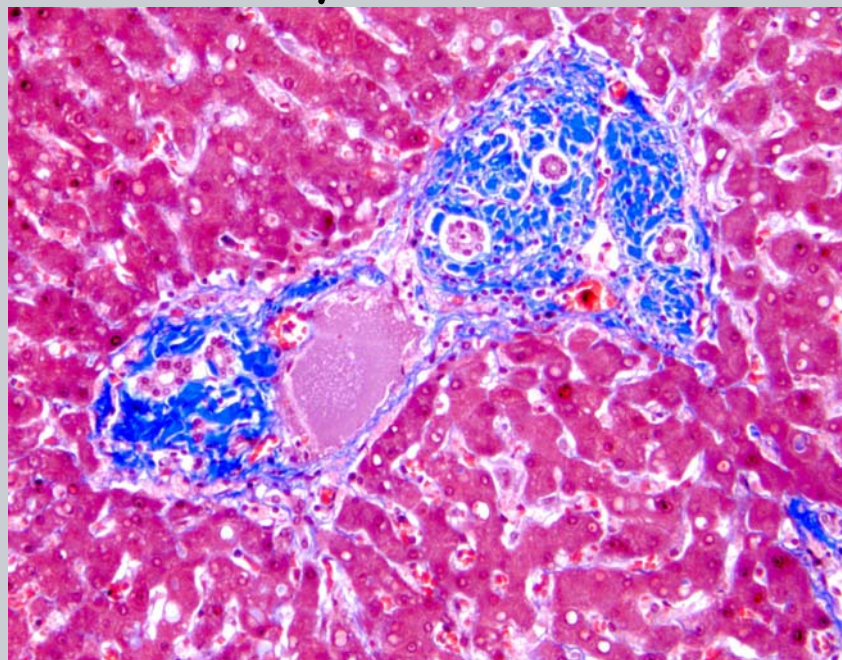


Day 3 (7/27/01)



We consider here only clinical photographs.

Color images in medical specialties such as Ophthalmology and Pathology use specialized equipment and analysis methods for which industry PACS solutions are available.



Liver - Masson Stain.

Paxcam image gallery



Retinal fundus image showing age-related macular degeneration.

National Eye Institute, NIH
Ref#: EDA22



Acquisition

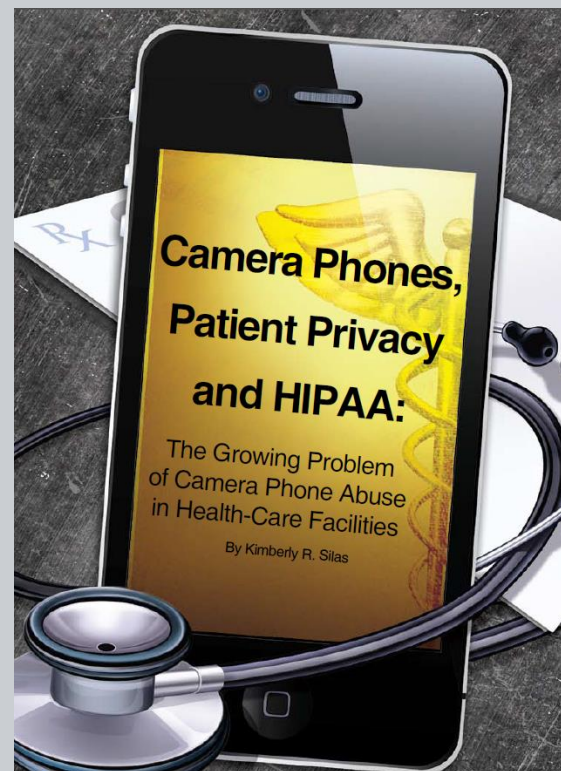
- Flash illumination with low ambient illuminance is essential for consistent color.
- ICC color profiles can easily be generated for specific flash camera systems used with established firmware parameters





US HIPPA regulations

- Photographs should be immediately uploaded to the EMR/EHR and deleted from the recording device memory.
- Policies should prohibit the use of cameras with ad hoc storage on non-compliant devices.



VANDERBILT UNIVERSITY MEDICAL CENTER



Information Privacy and Security
Patient Photography

May I take a picture of the patient for treatment purposes?

Yes, you may take a picture but you must upload the picture into the patient's medical record immediately then delete the picture from the device on which the picture was taken.

KR Silas, Louisiana Bar Journal, Oct 2011

Among emerging technology, "no single device has produced as much health privacy angst as cell phones that double as cameras."



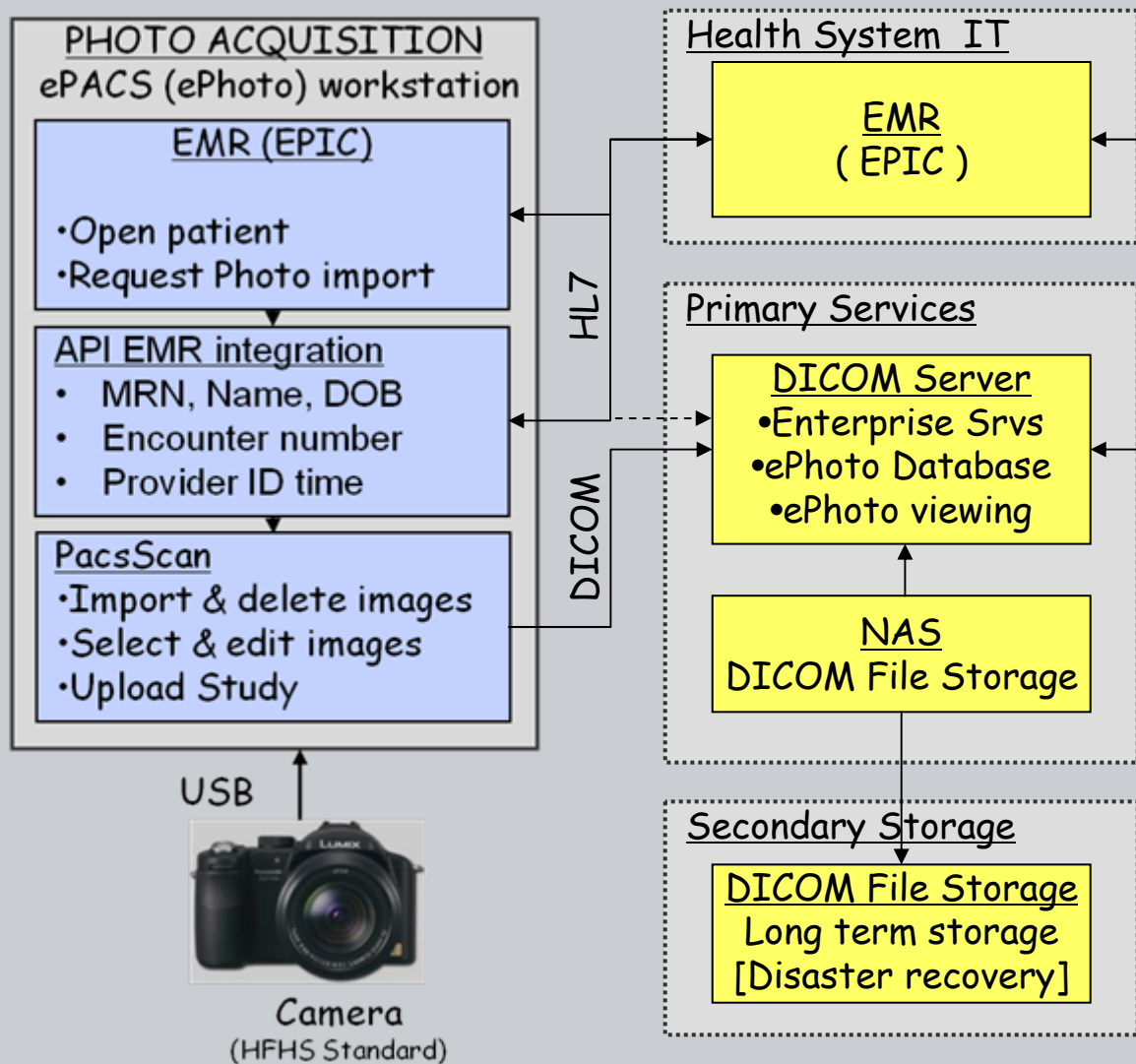
Acquisition Software

- **Information associated with each photo study.**
 - Patient Name, ID, DOB, Sex .. (EMR consistent)
 - Attending Physician (associated with EMR encounter)
 - EMR Accession number (unique for study in PACS)
- **Information associated with each image.**
 - Anatomic body part (consistent with protocol)
 - Photographic conditions (ICC profile, distance, ..)
- **Camera image upload.**
 - Import from camera and delete. (WiFi, tethered, ..)
 - Export to EMR (PACS, DICOM, JPEG, ..)



Acquisition

Acquisition Software



- Practitioner initiates photo acquisition application from the EMR at the patient level.
- API integration communicates demographic data.
- API assigns a unique encounter number used as the study accession number.
- Images are selected, identified for body part, annotated, and uploaded in DICOM format.

Epic Hyperspace - SRO-LD** >HOSPITAL - WITS - KTAZD2256 WITSGG2

Desktop **Action** Patient Care Scheduling HIM Reg/ADT Surgery CRM/CM Reports Report Mgmt Tools Admin Help What's New

- Back
- Epic
- Wkp
- FYI
- Graphs
- Growth Chart
- Health Maintenance
- Images
- Letters
- Questionnaires
- Reference
- Flowsheets
- Classic SmartForms
- Admission Navigators
- Discharge Navigators
- Nursing Handoff/Transfer
- PDC Navigator
- Procedure Navigator
- OB Navigator
- Dialysis Navigator
- Problem

- Cumulative Dose Tracking
- Default Actions
- PacsSCAN**
- Medications

Encounter	Grease Board	Master Daily Schedule	Print					
Age	Sex	DOB	Allergies	Isolation	Code	Attending	LOS	kp
A*	37 yrs	F	1/3/1973	Not on File	None	Xtestb, Onliamb*	159days	Ina

C:\ology-images

Preview

Click on a thumbnail to preview

266757b.jpg Cyt006.jpg

Cyt008.jpg derm266724a.jpg

dERMcoum2.jpg Gastro-1.jpg

Click on a thumbnail to preview. Select a checkbox to import.

Browse C:\ology-images

Select All Clear All OK Cancel



Body Part: defined lexicon with codes

ePhotoDB@localhost

File Register Admin Package

Patient Macro Micro

Search

1

Import Find

Last_Name Flynn Set Clear

Diagnosis Set Clear

Search Key Last_Name,Flynn Clear

Order by Distribution Register

Order by

ID Last_Name

Diagnosis Age

Result

Export Edit Delete Micro

No.	DB	ID	First Name	Last Name	BirthDay	Sex	Patient Note	D
1	ePhotoDB	EP1722	Michael	Flynn	1945-04-06	m	ePhoto developer	0
2	ePhotoDB	EP1722	Michael	Flynn	1945-04-06	m	ePhoto developer	0
3								

Distribution

Name l_foot

Order 30

Cancel Revert OK

tkDerm

- Manabu Inuzuka, Japan
- <http://sourceforge.net/projects/tkderm/>
- Runs on Windows, Macintosh and Linux (Tcl/Tk).
- Uses PostgreSQL as a database server.
- It relates data with photos automatically based on time stamps of photos.



Acquisition Software - Issues

- Very few available applications.
- None provided all needed functions.
 - Image deletion after upload.
 - EMR integration for demographics, diagnosis et. al.
 - Coded body part assignment.
 - ICC profile association

- Ideally, all camera & flash systems used with specific camera settings would have ICC profiles
- Acquisition software would identify the camera & flash system used and send the ICC profile.

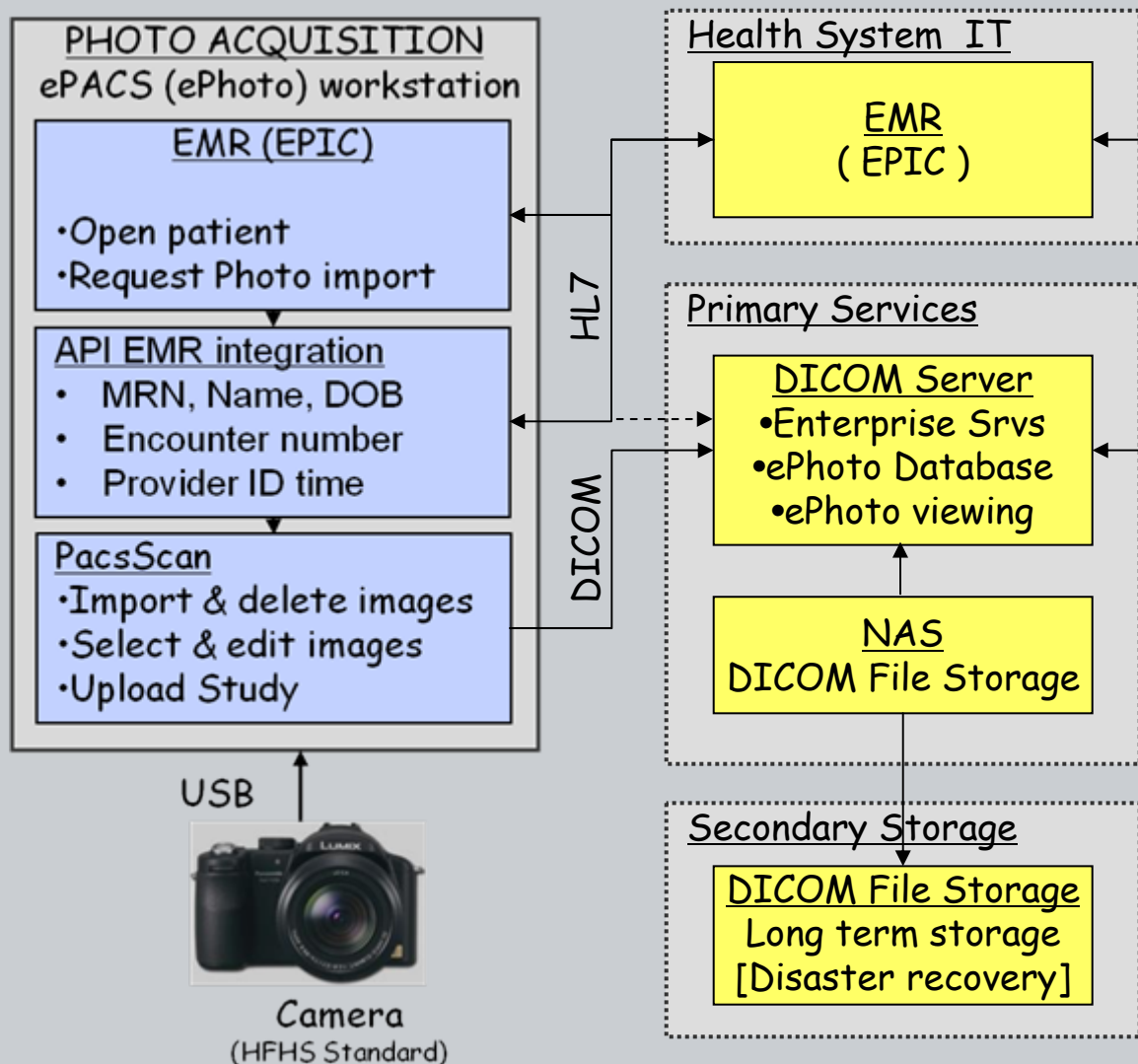


Photo Storage

- Documents in EMR are inadequate
 - No study organization or body part codes
 - No analytics support for image search
 - Inadequate viewers
- DICOM Storage services apply nicely
 - Well developed industry with numerous suppliers.
 - Recognized standard for object structure and communication.
 - HIPPA compliant with support for patient media.
 - Advanced viewer functionality.



DICOM Storage Server



- Storage Class Provider (SCP) service for photo object in DICOM standard format.
- Query/Retrieve services for specialized applications.
- Export for interchange in using an IHE profile.
- Support for viewer applications with audit trails showing who has viewed a study.



Storage

Audit Record

Philips iSite Viewer

PHILIPS

Patients

	Patient Name	MRN	Exam Date
↓	Flynn, Michael	2009SIIM	4/1/2009 11:35:56
	OT - Physics Test Studies, IRB # TestPhysics (OT); Acc: 2009SIIMaRGB; ...		4/1/2009 11:35:56
	OT - Physics Test Studies, IRB # TestPhysics (OT); Acc: 2009SIIMsRGB; ...		4/1/2009 11:34:45

Exam Audit Trail -- Webpage Dialog

Exam Audit Trail for Accession Number: 2009SIIMaRGB

close

06/23/2009					
Time	Status	Report Status	Event	Who / Notes	
12:08 PM	S		Exam scheduled	by Interface, ADT, manually, as exam RES122 / in HFH-1FP-MO for 06/23/2009 12:08 PM	
12:08 PM	I		Exam begun	by Interface, ADT at 04/01/2009 11:35 AM	
12:11 PM	I		Image viewed	by Flynn, Michael	
12:12 PM	I		Image viewed	by Flynn, Michael	
12:14 PM	I		Image viewed	by Flynn, Michael	
12:18 PM	I		Image viewed	by Flynn, Michael	
12:54 PM	I		Image viewed	by Peck, Donald	
06/26/2009					
Time	Status	Report Status	Event	Who / Notes	
1:21 PM	I		Image viewed	by Flynn, Michael	
07/23/2009					
Time	Status	Report Status	Event	Who / Notes	
1:40 PM	I		Image viewed	by Flynn, Michael	
09/30/2009					
Time	Status	Report Status	Event	Who / Notes	
9:37 AM	I		Image viewed	by Rauch, Phil	
01/12/2010					
Time	Status	Report Status	Event	Who / Notes	
11:13 AM	I		Image viewed	by Flynn, Michael	
11:34 AM	I		Image viewed	by Flynn, Michael	
11:35 AM	I		Image viewed	by Flynn, Michael	
11:35 AM	I		Image viewed	by Flynn, Michael	
05/03/2013					
Time	Status	Report Status	Event	Who / Notes	
12:00 PM	I		Image viewed	by Flynn, Michael	
12:02 PM	I		Image viewed	by Flynn, Michael	
12:02 PM	I		Image viewed	by Flynn, Michael	
12:02 PM	I		Image viewed	by Flynn, Michael	



Storage Servers - Issues

- Numerous available DICOM servers.
 - Most provide all needed functions.
 - DICOM Storage Class Provider (SCP).
 - Full function viewers (Web accessible)
 - Query/Retrieve Service.
 - Storage of ICC profile in image objects
 - However,
 - Viewers do not support color management
 - Currently no EXIF tags in DICOM image objects
- An IHE profile could address color management
 - New DICOM tags could be considered by the DSC.

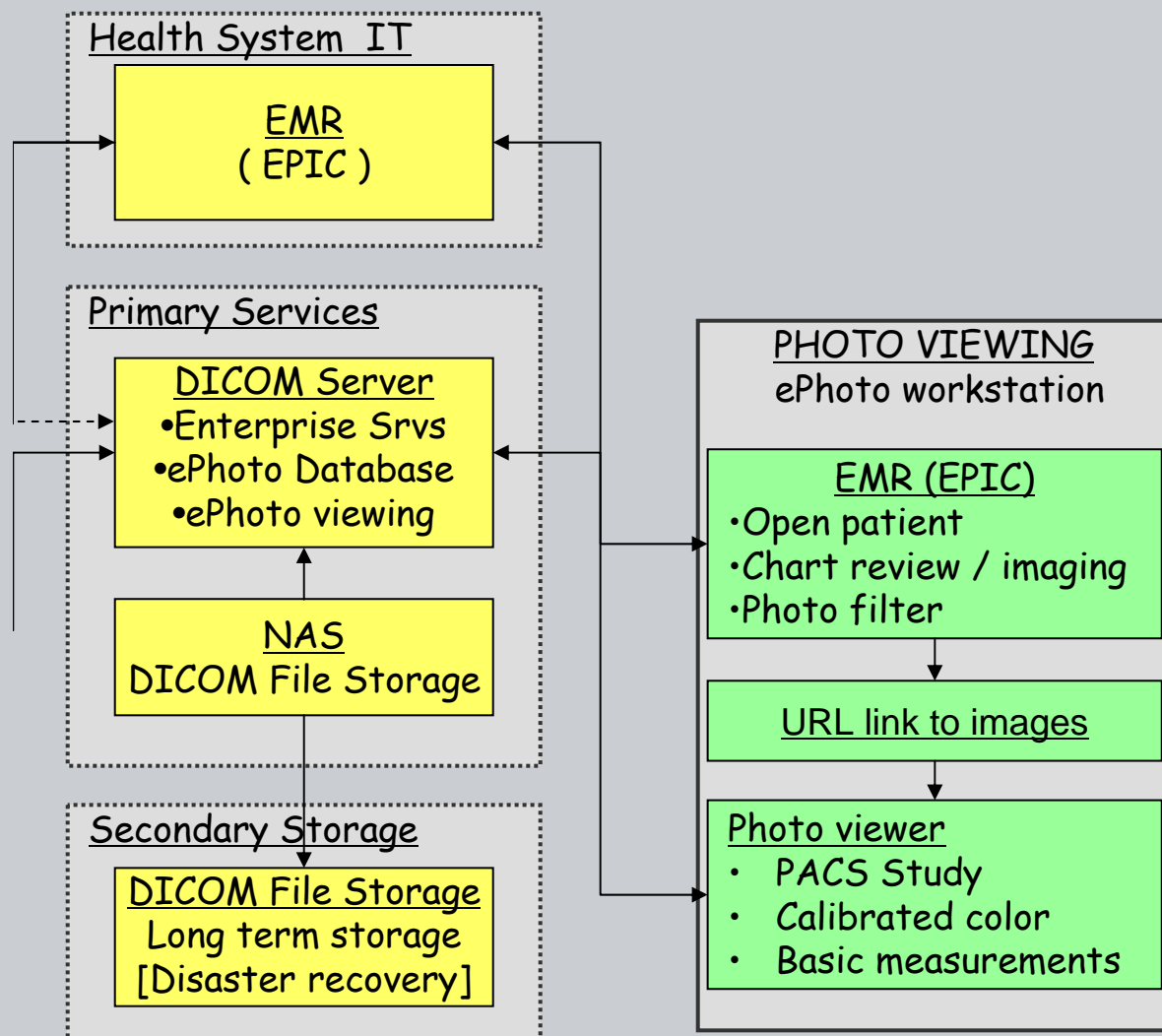


Image viewers

- Authenticated access to view patient images
- Organize all images in a study by body part.
- Provide comparison of current and prior images for the same body part.
- Mouse controlled zoom and pan with robust interpolation.

Photo Viewer

- Practitioner accesses (with authentication) patient information in the EMR.
- Photo study is identified as having been acquired on a particular date.
- Using a URL link, a photo viewer is opened with the identified study
- Prior studies are available for comparison.





Epic integration with photo viewer

Kaiser, San Francisco

Epic Inpatient Home Go to the next activity (Ctrl+2) Wkpoonegg, Twntythr lii

Wkpoonegg, Twntyth* MRN 110012949640 Room/Bed 3353/3353-A* Age 37 yrs Sex F DOB 1/3/1973 Allergies Not on File Isolation None Code None Attending Xtestb, Onliamb* LOS 159days

Chart Review Last refresh:

Filters Refresh Select All Deselect All Review Selected CIPS RAD

Encounter IP/ED Enc Notes Lab Meds **Imaging** Card Surg Episodes Ltrs Proc Oth Ord Scans Cont Care Misc

No filters applied Digital Photo

Date	Test	Department	Status
08/27/2010	DIGITAL PHOTO, TELEDERM	SFO3W	Final result
07/29/2010	DIGITAL PHOTO, IMAGING	SFO3W	Final result
07/14/2010	DIGITAL PHOTO, IMAGING	SFOMED	Final result
05/04/2010	XR CHEST, PA AND LATERAL	SFO3W	Future

Epic Inpatient Home Wkpoonegg, Twntythr lii

Wkpoonegg, Twntyth* MRN 110012949640 Room/Bed 3353/3353-A* Age 37 yrs Sex F DOB 1/3/1973 Allergies Not on File Isolation None Code None Attending Xtestb

Image Report

PACS Images Link DIGITAL PHOTO, TELEDERM (Order# 15338361)

PACS Images [Show images for DIGITAL PHOTO, TELEDERM \[229111\]](#)

Photo Upload	Order Date and Time	Department
	8/27/2010 11:20 AM	Sfo-3w** >Hospital



Web based DICOM study viewer.



All present DICOM viewers Lack Color Management

aRGB

sRGB

Philips iSite Enterprise

User: Flynn, Michael J

PHILIPS

Patient Directory View Exams, 1 Patient(s) selected

Flynn, Michael Sex: M, BirthDate: 4/1/1969, MRN: 2009SIIM Referring: Michael, Ordering Provider, .

Patient History Timeline

OT None OT None

0401 0401

Most Recent: 4/1/2009 Least Recent: 4/1/2009

4/1/2009 11:35:56 Acc# 2009SIIMaRGB	4/1/2009 11:35:58 Acc# 2009SIIMaRGB	4/1/2009 11:36:00 Acc# 2009SIIMaRGB	4/1/2009 11:36:02 Acc# 2009SIIMaRGB
Dermatology demonstration photographs (a) Arm Series #1	Dermatology demonstration photographs (a) Face Series #2	Dermatology demonstration photographs (a) Hand Series #3	Dermatology demonstration photographs (a) Thumb Series #4
4/1/2009 11:34:45 Acc# 2009SIIMsRGB	4/1/2009 11:34:47 Acc# 2009SIIMsRGB	4/1/2009 11:34:50 Acc# 2009SIIMsRGB	4/1/2009 11:34:51 Acc# 2009SIIMsRGB
Dermatology demonstration photographs (s) Arm Series #1	Dermatology demonstration photographs (s) Face Series #2	Dermatology demonstration photographs (s) Hand Series #3	Dermatology demonstration photographs (s) Secondary Capture Sequence Series #4



DICOM Photo viewers - Issues

- Excellent organization of images and studies.
- Mature viewing functions.
 - Mouse controlled Pan & zoom.
 - Robust interpolation algorithms
 - Hanging protocols to compare current with prior.
 - However,
 - NO COLOR MANAGEMENT SUPPORT

- While IHE profiles would define the functions needed, adoption within the industry is likely to take some time.
- ICC software toolkits for common OSs would reduce the investment required for color management support.



Questions?

