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Standards for Image Exchange

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  - Other: Owner of PixelMed Publishing
It's good to share: medical image and report exchange between UK health service providers

The Royal College of Radiologists
2016
“There are notable differences when the results are examined at the level of UK country/region (see Figure 1). In London, 43% of respondents experienced difficulty almost every time or every time when accessing images and reports for MDTMs, compared to only 4% in Scotland. For follow-up image reporting work the proportion for London was 38% compared to 3% in Scotland, and for radiotherapy planning 19% compared to 0%.”

“Scotland has a national PACS”
Image Exchange Use Cases

- Transfer for specific event on demand
- Provide central single point of access
- Provide to patient

- Type of exchange – to view or import?
- Radiologists want imported images in regular PACS
- US MU – “View, Download or Transmit”
# Recommendations for Image Sharing

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>TIER 1 Exchange of Text-Based Reports</th>
<th>TIER 2 Exchange of Non-Radiology/Cardiology Images</th>
<th>TIER 3 Exchange of Radiology/Cardiology Images - Full Study</th>
<th>TIER 4 Exchange of Radiology/Cardiology Images - Key Images</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plain text +/- structured headings, scanned/ rendered document</td>
<td>&quot;Clinical Capture&quot; images with or without metadata</td>
<td>Complete set of images of diagnostic quality</td>
<td>IHE Key Image Note (KIN) and images referenced therein</td>
</tr>
<tr>
<td>ENCODING</td>
<td>PDF, HL7 2.x OBX segment content, CDA L1, or CDA L2 + CCDA DIR template</td>
<td>Without metadata: JPEG, PNG, DNG, PDF, H.264; with metadata: DICOM</td>
<td>DICOM (object appropriate to modality)</td>
<td></td>
</tr>
<tr>
<td>VOCABULARY</td>
<td>LOINC to describe study/procedure, LOINC for structured headings</td>
<td>LOINC to describe study/procedure (in DICOM header/XDS metadata)</td>
<td>LOINC to describe study/procedure</td>
<td>LOINC to describe study/procedure, DICOM DCID 7010 for titles</td>
</tr>
<tr>
<td>PUSH</td>
<td>HL7 V2 ORU/MDM MLLP over VPN/TLS, DIRECT SMTP or XDR preferred</td>
<td>DIRECT SMTP or XDR, DICOM DIMSE/ULP or STOW over VPN/TLS, IHE XDR-I</td>
<td>DICOM DIMSE/ULP or STOW over VPN/TLS, IHE XDR-I</td>
<td>DICOM DIMSE/ULP or STOW over VPN/TLS, IHE XDR-I</td>
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<tr>
<td>PULL</td>
<td>IHE XDS</td>
<td>IHE XDS-I, DICOM WADO-URI or WADO-RS over VPN/TLS</td>
<td>IHE XDS-I, DICOM WADO-URI or WADO-RS over VPN/TLS</td>
<td>IHE XDS-I, DICOM WADO-URI or WADO-RS over VPN/TLS</td>
</tr>
<tr>
<td>VIEW</td>
<td></td>
<td></td>
<td></td>
<td>IHE IID, else pull (WADO-URI+/XDS-I for rendered JPEGs when sufficient)</td>
</tr>
</tbody>
</table>
HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)

SITUATION:
THERE ARE 14 COMPETING STANDARDS.

14?! RIDICULOUS!
WE NEED TO DEVELOP
ONE UNIVERSAL STANDARD
THAT COVERS EVERYONE'S
USE CASES. YEAH!

SOON:

SITUATION:
THERE ARE 15 COMPETING STANDARDS.
How standards proliferate:

(See: A/C chargers, character encodings, instant messaging, etc.)

**Situation:**
There are 14 competing standards.

**That ridiculous.**
We need to develop one universal standard that covers everyone's use cases.  **Yeah!**

**Soon:**

**Situation:**
There are 15 competing standards.

https://xkcd.com/927/
STANDARDS MEETING

Each of you has been chosen to represent the interests of your respective companies.

AS YOU KNOW, THE BEST WAY TO CREATE STANDARDS IS TO MASH TOGETHER A BUNCH OF MUTUALLY EXCLUSIVE PREFERENCES.

I HOPE I'M NOT THE ONLY ONE WHO JOINED THIS GROUP JUST FOR THE LAUGHS.
STANDARDS MEETING

Each of you has been chosen to represent the interests of your respective companies.

As you know, the best way to create standards is to mash together a bunch of mutually exclusive preferences.

I hope I'm not the only one who joined this group just for the laughs.
How did the industry standards meeting go?

Did you convince 83 companies to adopt standards that benefit only us while dooming the entire industry in the long run?

Or are you a complete failure?

Can I hear those choices again?
HOW DID THE INDUSTRY STANDARDS MEETING GO?

DID YOU CONVINCE COMPANIES TO ADOPT STANDARDS THAT BENEFIT ONLY US WHILE DOOMING THE ENTIRE INDUSTRY IN THE LONG RUN?

OR ARE YOU A COMPLETE FAILURE?

CAN I HEAR THOSE CHOICES AGAIN?
Types of Exchange Standards

- “Edge” standards - transactions
  - DICOM, DICOMweb, HL7 V2, FHIR, IHE ITI-41/RAD-68

- Architectural standards
  - IHE XD*(-I), MIMA, IRWF
  - assembled from transaction standards

- Others
  - IHE Invoke Image Display (command & control)
Patterns of Image Exchange

- Peer-to-peer (push)
  - DICOM C-STORE, DICOMweb STOW, XDR, XDR-I
- Mediated peer-to-peer (through trusted third party) (push)
  - SMTP (NHIN DIRECT), RSNA Image Share, commercial services
- Registry (pull)
  - XDS-I (XDS + manifest of images) with sources left at sending site
- Single repository (pull)
  - DICOM C-FIND/C-MOVE/C-GET, WADO-URI, DICOMweb WADO-RS
  - XDS-I with sources sent to central co-located registry/repository/source
- Federated sources (multiple) (pull)
  - DICOM C-FIND or DICOMweb QIDO client/server side federated queries
Import rather than just view
PACS

Receive what was pushed

Trusted Third Party

Receive what was pushed
Push Transaction Standards

- DICOM C-STORE
- DICOMweb STOW (IHE WIC)
- XDR-I
Pull Transaction Standards

- DICOM C-GET or C-MOVE+C-STORE
- WADO-URI +/- rendered
- DICOMweb WADO-RS +/- rendered
- XDS-I (XDS + image manifest)
- MHD-I (non-SOAP XDS, FHIR, WADO)
- FHIR ImagingStudy resource
Finding Stuff Standards

- DICOM C-FIND
- DICOMweb QIDO-RS
- XDS-I (XDS + image manifest)
- MHD-I (non-SOAP XDS, FHIR, WADO)
- FHIR ImagingStudy resource
Choosing Standards

- SOAP is dead (needs toolkit), therefore XDS and XDS-I are dead too
- REST is cool (not gratuitously hard; just uses URL & headers, no toolkit)
- Traditional DICOM (DIMSE) protocol non-trivially complex (needs toolkit), etc.

- Don’t need a registry – DICOMweb (QIDO-RS, WADO-RS, etc.)
- Need a registry – MHD (SOAP-free XDS; same architecture, different protocol), or maybe just DICOMweb (what value does MHD/XDS really add?)
- Registry useful (maybe) if multiple sources & no query federation

- Payload (as opposed to protocol) is still a DICOM file
- WADO-RS supports XML and JSON encoding of DICOM metadata and separate bulk data in “consumer” media types (e.g., image/jpeg)
All Protocols Support Security

- User identity
- Secure connection (confidentiality)
- Enough information for access control
- Enough information for audit trail
- Including traditional DICOM

Do not confuse what is commonly implemented with what is defined/possible
It’s the metadata, stupid
And it’s not just for your audience
How Much Metadata?

- Finding the right study, priors, etc.
  - minimal/modest
  - patient and accession number
  - modality, procedure, anatomy, ...

- Viewing the images
  - what to show first, in the right order
  - much more series-instance/frame detail
  - critical for functionality and performance
“I’m right there in the room, and no one even acknowledges me.”
WHAT RADIOLGISTS WANT
I LOVE

IT WHEN

MY WIFE

COMES FLYING WITH ME
NAÏVE OR INAPPROPRIATE USE OF STANDARDS OR CHOOSING THE WRONG STANDARD FOR THE JOB PRODUCES APPLICATIONS THAT SUCK
XDS STANDARDS SUCKS
DICOMweb

Any image,
Any where,
Any time