



PARCA Certified PACS System Manager
(CPSM)
Requirements

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Certified PACS System Manager (CPSM) requirements

This document contains the detailed requirements for the certification of a CPSM or Certified PACS System Manager. The requirements for the Systems manager builds on the skills acquired as CPIA and CPSA, which certifications are both requisites prior to achieving this certification. The focus is on detailed technical understanding of the imaging chain, advanced standards understanding and strong network and security knowledge.

1. Image quality, grayscale pipeline

- 1.1 Pixel representation: Pixel data is stored with a certain pixel range (number of bits) in a specific manner in the DICOM images representing grayscale or color. – Know how to identify the pixel attributes (Allocated, Stored, High bit), the representation (monochrome, color) as well as signed/unsigned identification. Know different color schemes (by plane, by pixel, RGB, YBR, etc.), and MONOCHROME1/2 difference.
- 1.2 Pixel pipeline in detail: The image pixels stored in a DICOM object follow a pipeline of operations to transform to a vendor independent domain, aka “P-values”. – Know the importance of having vendor independent grayscale pixel values and the meaning of P-values.
- 1.3 Modality LUT: The modality LUT or rescale/intercept takes care of the modality specific representation (e.g. a LUT for CR) or implements scaling for CT images. - Know the structure of the LUT and where to find the rescale/intercept and LUT’s in the image header.
- 1.4 MASK: An optional Mask is applied for Digital Subtraction Angiography or cardiology applications. – Know the function of the mask operation.
- 1.5 VOI LUT: A Value Of Interest LUT or Window Width/Center can be applied to the image to show the area of interest. Multiple WW/Ctr values could be present (e.g. soft tissue-bone for CT chest). VOI LUT and Modality LUT can be interchanged by modalities. – Know importance of WW/Ctr., where to find it in the image header, and configuration capability of Modality/VOI LUT.
- 1.6 Presentation LUT: Mostly for printers, but potentially also for workstations, an application specific LUT can be applied to the images. – Know function of presentation LUT, how it is supported in printers as a SOP Class and in workstations as part of the Presentation State.
- 1.7 GSDF: To achieve a consistent presentation of the images among different displays and hardcopy, a standard mapping from digital values to density or luminance is defined. Devices require calibration to comply with this mapping. – Know meaning of JND, importance of calibration, and popular commercial calibration methods.

2. Image quality, presentation pipeline

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- 2.1 Shutters: Shutters are applied typically at a QA station to eliminate collimation or as a circle to potentially eliminate a white surrounding. – Know function of shutter.
- 2.2 Image annotations: Saving image annotations in a standard manner allows these to be saved and exchanged among different vendor-platforms. – Know function of image annotations and importance for communicating between radiologists and physicians.
- 2.3 Spatial transformation: Especially for left/right or Landscape/Portrait examinations whereby the modality does not recognize the proper orientation, the technologist will orient the image appropriately. In addition, a zoom factor such as for CT-spine exams can be applied for a series of images. – Know function and typical applications of spatial transformation.
- 2.4 Display Area Annotation: Sometimes, text might be added as comments, not necessarily related to one specific image area. – Know function of display area annotation.
- 2.5 Hanging protocols: Images are presented on a workstation in a certain manner, depending on the application (ICU, OR), modality type (CT, MR, X-ray) and user preferences (PA left or right?). – Know what hanging protocols are and the importance of them being properly applied.

3. Image quality, troubleshooting

- 3.1 IHE consistent presentation state test images: Issues with the pixel pipeline can be identified by using a set of test images that are generated for the IHE Consistent Presentation of images. – Know how to use the IHE test images to identify potential issues with implementing the pipeline correctly at a workstation. Know how to use the accompanying test procedures.
- 3.2 AAPM TC 18 monitor tests: To evaluate the monitor performance, one can use the recommendations by AAPM TC 18. - Know how to use the AAPM TC18-QC test pattern.
- 3.3 AAPM TC 18 anatomical test images: To characterize the whole imaging display chain from a clinical perspective, one can use the AAPM anatomical test images. – Know which different AAPM anatomical images there are available and to use them for characterizing the display imaging chain.

4. Advanced topics, DICOM Standard

- 4.1 New DICOM objects (CT/MR): New acquisition techniques (Multislice CT) and data types (raw data, spectroscopy), forced the definition of new DICOM objects. These are specified for CT, MR, and soon for XA and RF. – Know the value of supporting the new DICOM objects and their characteristics, especially the multiframe approach, impact on pixel pipeline, definition of functional groups and dimensions.
- 4.2 GWL: General Purpose Worklist is used by a workflow manager to provide workstations with work lists in a standard manner so that multiple users can access

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this information and update the status by “locking” it while reading it. – Know importance and function of General Purpose work list.

- 4.3 Hanging Protocols: Hanging protocols are critical to make sure that images are presented in relationship to each other based on modality, application, and user preferences. In order to exchange these preferences in a standard manner, a new protocol is defined in DICOM. – Know the function, capabilities and DICOM implementation of hanging protocols.
- 4.4 PDF encapsulation: It is (soon) possible to encapsulate PDF documents in a DICOM “wrapper” as a means to capture information that is not (yet) standardized in an other manner. – Know if the application and use of DICOM PDF encapsulated documents.
- 4.5 Configuration Management: DICOM requires fixed IP addresses and AE titles. The DICOM configuration management allows a system to use dynamic addressing and also extends to security and other parameters. – Know the importance of the DICOM configuration management and the parameters that can be managed/exchanged.
- 4.6 WADO: To retrieve DICOM objects over the Internet, a new standard is defined (Web Access to DICOM Objects), allowing a representation of the DICOM image in a web-friendly format to be exchanged with different images sizes, and encoding (JPEG). – Know of the advantages of using WADO vs a proprietary web access protocol and representation and the major parameters to be exchanged.

5. Structured Reporting (SR)

- 5.1 Different SR SOP Classes: There are three basic SR SOP Classes, each with increasing complexity, i.e. Comprehensive, Enhanced, Basic Text. Templates can be exchanged as part of these reports or a SR can be constrained to have only specific templates. – Know difference between basic SR’s.
- 5.2 SR building blocks: SR is created as a structure of relationships between certain content items. – Know difference between these building blocks as well and be able to list at least five of each.
- 5.3 Templates: Templates are used to constrain the SR content. – Know importance of templates and be able to reproduce the template for the Key Object (Image) Note.
- 5.4 Special applications: SR is used for special applications such as Cardiology and Ultrasound. – Know of some SR examples used for Cardiology and Ultrasound
- 5.5 SR used for computer-based reporting: Computer based reporting (a computer generating a report in the form of findings and/or measurements) is done by SR as well, in particular the computer aided diagnosis. – Know of at least one application for CAD where SR is used to capture the findings.
- 5.6 Use of SR in IHE Radiology: The IHE Radiology Technical Framework provides a Simple Image Numeric Report (SINR) integration profile by which DICOM SR information can be sent in HL7 Version 2.x report messages. – Know the basic data flows of the SINR Profile.

6. Advanced standards, general

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- 6.1 Information model: The relationship between the scheduled imaging procedures, performed procedures and results (i.e. images and other objects) is defined both by DICOM and IHE. The relationship between the scheduled procedures and performed procedures is n:m, i.e. there could be multiple scheduled grouped in a single performed or one scheduled and multiple performed and there is also the unscheduled case. How to identify these properly, and the use of the Accession Number and UID's is critical for proper RIS-modality PACS integration. – Know the identifiers used for each information model entity, their relationships and potential issues that could arise by not supporting the complete information model.
- 6.2 CDA: The Clinical Document Architecture (CDA) is a “persistent” object that is defined by HL7 to include a patient medical record. It also includes image references as well as other clinical information and will become most likely an important component of the Electronic Health Record. - Know function of CDA and relationship to DICOM.
- 6.3 CCOW: The Clinical Context Object Working Group has defined a standard under the HL7 umbrella to exchange patient, provider, and encounter context information so that multiple applications running on a single computer can communicate with each other in a standard manner. CCOW patient context is also used by the IHE Enterprise User Authentication profile. – Know the function, applications and protocol used for CCOW.
- 6.4 Audit trails: Audit trails are required by HIPAA for certain transactions to log the access of PHI. As part of the IHE Basic Security profile, the syslog standard is used to record and exchange this information so it can be logged at a central location in a standard manner. – Know the defined standard by IHE for audit trails, and recognize the importance of doing this in a central location in a standard manner.
- 6.5 HL7 3.0: The HL7 2.x standard has certain limitations, among those a lack of an information model and robust messaging method using a standard encoding. A new version of the HL7 standard is defined which is starting to be implemented in early applications and also provides the basis for new extensions such as the CDA, using XML encoding. – Know the major components of the HL7 standard, i.e. the RIM, HMD, RMIMs, CMETs and ITS.

7. Security

- 7.1 HIPAA requirements for PACS: A PACS systems deals with patient information and is therefore subject to the US federal HIPAA regulations. – Know HIPAA terminology: PHI, BA, CE, impact of minimally necessary information availability, and TPO rule.
- 7.2 Administrative safeguards: These safeguards cover the processes and procedures that have to be in place to meet the HIPAA requirements. This includes a risk management process, with as important part the risk analysis. In addition, it covers assigned security responsibility, workforce security, information access management,

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security awareness and training, incident procedures and contingency plans. – Know the details of the major sections of the HIPAA administrative safeguards.

- 7.3 Physical Safeguards: The physical safeguards deal with the physical access to the information, including facility access controls, workstation use and security as well as device and media controls. – Know the details of the major sections of the physical safeguards.
- 7.4 Technical safeguards: These deal with the technical aspects, including the access control, audit controls, preserving the integrity of the information, authentication and transmission security. . – Know the details of the major sections of the technical safeguards.
- 7.5 Standard implementation for security: Authentication, authorization, confidentiality, integrity are means that can be implemented with standards. Anonymization or attribute level security is an important tool for de-identification the images. IHE also has defined a special security profile. – Know the function and give examples of the four security mechanisms, how to implement de-identification, and the components of the IHE secure profile.
- 7.6 Remote servicing: Remote service is a potential liability from a security perspective. There are guidelines available making recommendations for using gateways, secure protocols, and audit trails to secure these connections. – Know about the published recommendations for remote service.
- 7.7 Implementation zones: From a device perspective, there is always a trade-off between the implementation of policies/procedures and appropriate technical means that complement the procedures. The specific implementation and trade-off depends on the location, i.e. the different zone it is used. – Be able to identify for the PACS equipment in each zone the specific security implementation, based on a spreadsheet.

8. Networking fundamentals

- 8.1 LAN design: Local area networks are the backbone for the PACS systems. The building blocks for these networks are hubs, bridges, routers and gateways. Physically, the network uses patch panels and wiring closets. – Know the function of each of the network components, the relationship with the seven-layer OSI model, and the configurability of these devices.
- 8.2 Ethernet, TCP/IP: Most network connections use the TCP/IP for layer 4 and Ethernet for layer 2 communication. – Know details of each protocol, i.e. addressing protocol type, characteristics and difference between TCP/IP and ftp.
- 8.3 WAN network design: Wide Area connections use a variety of technologies, such as ISDN, DSL, with different line capacity, T1, T2, etc. - Be able to distinguish between the different network technologies and pro's and con's of each of these.
- 8.4 Packet switching, circuit switching: Most commonly used public networks use either packet or circuit switching technology. – Know the characteristics of each of these protocols and how they could impact the performance.

- 8.5 The Internet: Internet is often used to reach physicians at their home and/or offices. – Know the architecture of the Internet, the function of RFC's and structure of Internet governance as well as details about http, url, domains.
- 8.6 High availability is critical. - Know how to determine and calculate high availability
- 8.7 Throughput, bandwidth, level of service parameters: Network access is determined by several critical parameters used for planning and forecasting the required network topology. – Know meaning and how to characterize these parameters, in particular the level of service.

9. Security mechanisms

- 9.1 Network monitoring tools: In order to determine whether a network is performing, identify bottlenecks and/or issues, one could use different network monitoring and management tools such as sniffers, software for statistics, etc. – Know which tools are available and be able to use these.
- 9.2 Firewalls: Firewalls are critical to protect the integrity of a network. – Know function of different types of firewalls (application level etc.) and how and where to use them in a healthcare environment.
- 9.3 DMZ: The DMZ is used to screen off mission-critical components for an enterprise, such as the servers. – Know the function of the DMZ, what to put in there and how to protect/screen the information in the DMZ from the outside world.
- 9.4 Using encryption: Secure protocols, using encryption might be used when data transfer is exposed and/or communicated via a non-secure channel such as the internet. – Know how these protocols work, meaning and impact of encryption key length and when to use SSL and IPsec as well as https.
- 9.5 IDS: Intrusion Detection Systems are increasingly deployed to monitor the network for any suspicious behavior. – Know the function of the IDS and when and where to use these in your enterprise.
- 9.6 Patch management: When to apply a new OS patch is a trade-off between the expected benefit (i.e. additional protection from a security hole and therefore potential attack), and the additional work and potential impact on normal functioning. – Know how to trade off the implementation of patches and how to work with vendors and your IT department to validate these.

10. Security implementation

- 10.1 Network monitoring tools: Network monitoring tools are critical in order to troubleshoot and monitor the network. – Know how to set up and use these tools.
- 10.2 Firewalls and DMZ: Firewalls and DMZ are used to protect the integrity of mission critical data. – Know how to configure and set-up firewall rules and learn how to place certain resources within DMZ's.
- 10.3 Proxy servers: A proxy server screens of the internals of the network architecture from the outside world. – Know how to set up proxy servers

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- 10.4 Secure VPN connections are used for WAN connectivity, especially via the Internet.
Know the installation and configuration of SSL connections
- 10.5 IPsec: IPsec can also be used for connecting devices to an enterprise in a secure manner. – Know how to connect and install secure tunnels using IPsec.

