1. **ASRT Animation**

2. **Welcome**
Welcome to Essentials of Digital Imaging: Module 5 – Picture Archiving and Communications Systems.

3. **License Agreement**

4. **Objectives**
After completing this module, you will be able to:
- Define HIS and HL7.
- Define RIS.
- Identify the components of a PACS.
- Discuss the purpose of a PACS.
- Describe the function of the PACS components.
- List the data included in a PACS display.

5. **Hospital Information System (HIS)**
A health information system, or HIS, is a paper or electronic system that manages the administrative, financial, and clinical information necessary to operate a hospital or health care system. It also might be referred to as a clinical information system, although that part concentrates on patient- and clinically-related data. It can be an all-encompassing system or have department-specific subsystems.

6. **Health Level 7 (HL7)**
Health Level 7, or HL7, is another important standard that facilitates communication in medical imaging. HL7 established the software standards for exchanging electronic information in health care. Whereas DICOM is mainly concerned with images and their associated data, HL7 focuses on the standards for transmitting text-based information throughout a medical center. Together, DICOM and HL7 make it possible to create, view, store and access images, reports, and patient records on different types of equipment from a variety of manufacturers.

7. ** Radiology Information System (RIS)**
A radiology information system, or RIS, is a data system for patient-related functions in the radiology department. Examples of RIS functionality include scheduling appointments, collecting and displaying orders for radiologic examinations, creating modality worklists, storing and displaying patient data, tracking patients, providing patient and order data to PACS, distributing and storing radiology reports, providing billing services and maintaining a database to track and project trends.

8. **Picture Archiving and Communications System (PACS)**
PACS, which stands for picture archiving and communications system, is a computer-based storage, retrieval and viewing system for digital imaging examinations. Once a digital image is stored in a PACS, it can be retrieved and viewed on a computer monitor, and the PACS software enables the viewer to manipulate images. Basic image manipulations include magnifying and minimizing an image, altering image brightness and contrast and annotating the image using text, symbols, lines and arrows.

PACS archives images, patient information and reports. An individual who has system privileges can access the information stored in PACS. This access also means that this individual can view images from any computer connected to PACS. Additionally, images can be viewed from any computer with access to the internet using web-based PACS.

The evolution of PACS continues to have a profound effect on healthcare, one that closely parallels the ability of consumer electronics to capture and share digital images. The radiology department uses a sophisticated PACS to transmit images throughout the medical facility or to referring physicians.
9. PACS Workflow
The PACS workflow is similar for computed radiography, digital radiography, computed tomography, magnetic resonance imaging, nuclear medicine, and sonography. The images are captured digitally at the various modality workstations. From the modality workstation, the technologist can inspect the image for accuracy before sending it to PACS. In the absence of a PACS, the digital images are laser printed to create hard copy, analog images.

The radiologist views the image and dictates a diagnostic interpretation that is transcribed into an electronic report. The image and the report are then electronically archived and can be viewed by other medical personnel instantaneously. Additionally, patient information can be associated with the image, either through the hospital information system or the radiology information system.

10. Advantages of PACS
The major advantage of PACS is its ability to move images throughout the medical facility, as well as to archive them. Multiple users can access the digitally captured images from the PACS. PACS also can be queried by the RIS in order to retrieve prior exams from a long-term archive. This step makes previous patient examinations available within the current archive. The process is called “prefetching.”

11. Terminology and System Components
Some basic, yet very specific, image requirements are integrated into PACS. They include compatibility with the Digital Imaging and Communications in Medicine, or DICOM standards, a digital format or digital conversion, access to PACS via a network, registration of the sending device to PACS, and satisfying network protocols.

Many computer programs don’t communicate well with each other, which also was the case for various imaging equipment systems with proprietary infrastructures. Images and their associated data could only be captured, manipulated, viewed, and printed on systems and equipment from a specific manufacturer. It wasn’t possible to acquire an image using a system from 1 manufacturer, store it on equipment from a different company, and then print the image on equipment from a third vendor.

12. DICOM Standards
The American College of Radiology, commonly referred to as ACR, and the National Electrical Manufacturers Association, or NEMA, were active in creating processes and standards for PACS. In 1982 these groups formed a joint committee to create a standard process for transmitting medical images and their associated information. In 1985 the committee set the first standards for PACS, and in 1992 the term “DICOM” was first used to describe the standards for sharing medical information.

In 1993 the committee published version 3.0 of the DICOM Standard. This document offered numerous enhancements to standardize medical imaging communication for digital imaging technology. Today, medical equipment purchases include a DICOM conformance statement that outlines the manufacturer’s level of compliance with DICOM standards. DICOM is continually evolving and now applies to aspects of medical imaging such as studies, reports and other data groupings.

13. Knowledge Check

14. Knowledge Check

15. DICOM Commands
The DICOM conformance statement is a very specific document that describes how the equipment handles image data. A product identified as DICOM compliant may only be compliant for certain tasks. DICOM Query/Retrieve is a command that initiates a search of PACS based upon specific patient or study criteria. DICOM Get Worklist imports patient information and study requirements from a HIS or RIS, depending on the system configuration. DICOM Send conveys image data to the network from a DICOM-compliant system. DICOM Print sends image data to a DICOM-compliant device capable of printing a hard copy.
16. DICOM Header
The DICOM header is part of the information built into a digital image in a DICOM format. This series of information lines is attached to the image, but functions in the background. The lines contain identifying data and directions that ensure proper functionality as the image is captured, reviewed, altered, edited, transferred, stored and printed. The DICOM header provides information about data sources and where to locate the sources associated with an image.

Devices associated with PACS can be classified in 3 ways. A service class user, or SCU, device provides information that can only be viewed by a limited number of users. Examples of this type of device are a modality workstation or acquisition equipment. A service class provider, or SCP, device acts as a server to deliver information to wider groups of users. An example of a SCP is PACS. The device also can be classified as both an SCU and SCP.

17. DICOM Header Data
The data included in the DICOM header is generated directly by the acquisition equipment or indirectly by the HIS or RIS and PACS. The header, which is not visible when viewing the images, stores essential identifying information about the image. The information includes technical factors such as the kVp and tube current, exam characteristics like the DAP reading, SID, image format, receptor size, bit data, and exposure indicator, and patient information such as the position and body part used during the examination. The header also contains demographic data, including the type of study, acquisition date and time, patient identifiers, and patient gender. Another area of data describes the image processing and display parameters.

18. PACS Features
Another feature of the PACS is the ability to generate a list of patient names and exams. The list is available before the examination, when a technologist chooses the correct patient name and exam type to attach to the digital image and also after the examination, at the PACS workstation, where the user can review the images. The list can be queried using specific criteria that allows the user to find a completed examination or examination in progress. Technologists can retrieve images from a patient’s previous studies to use as a comparison or to help locate the exact area that needs to be imaged.

19. Unique Identifiers
Unique identifiers allow computer systems to distinguish one patient’s data from other data, thereby reducing the chance of mismatching a patient and his or her records. The accession, or order, number is associated with each imaging examination performed in the radiology department. It is issued by the RIS. The unique number appears in the DICOM header for every image acquired during a specific examination on each patient. The number sets the exam apart from all others and accurately identifies a patient’s images for associated reports.

The medical record number used by health care institutions is also a unique identification number. Currently, medical record numbers are specific to an institution or health system; however, there is increasing interest in providing a unique identification number for each person that can be used at any institution or health care system.

20. Data Match
To function properly, a PACS requires digital image data and the associated patient identifiers. The HIS or RIS generates the patient identifiers, and when an examination is ordered, the patient identifiers are sent to the acquisition equipment, the PACS and a work list server. Image acquisition equipment can provide both image data and patient identifier data. However, a PACS must verify the match between these items before storing the image file.

On the modality workstation, the technologist chooses the correct patient identifiers to be associated with the examination; these identifiers are embedded in the DICOM headers attached to each image. The technologist checks the accuracy of the information before performing the examination. When the exam is complete, the technologist then sends the images to PACS, and then PACS checks the match before storing the image file.
21. **PACS Verification**
When the images arrive in the PACS, the database software verifies the accuracy of the examination before archiving. The work list server records patient identifiers and the image gateway transmits the digital image with the DICOM header information. The image gateway is the main conduit for images sent from all acquisition equipment connected to the PACS. Usually there is more than 1 image gateway connection as a backup, in the event an image gateway fails, for the acquisition equipment. The PACS server checks the information from those 2 sources, and if there is a match, it sends the images to the specified archive destinations.

22. **PACS Workstations**
PACS viewing stations are characterized according to the available privileges and monitor resolution. The stations can be referred to as a clinical workstation, which is actually somewhat of a misnomer. This seems to imply that the clinical workstation user is viewing nondiagnostic images, which is not true. The stations also can be called a diagnostic workstation. The difference in the naming of the stations has more to do with their intended functions. For example, only diagnostic workstations are used by radiologists for exam interpretation, and their features, such as monitor resolution, typically reflect this purpose.

The type and number of PACS workstations are specific to the institution and equipment manufacturer. Also, an institution may choose to purchase the PACS software from a vendor but provide its own hardware for accessing the PACS.

23. **Clinical Workstations**
A clinical workstation has a monitor with a display resolution of less than 2,000 x 2,000, which equals a matrix size of less than 2,048 x 2,560 pixels. The number, type, and functions of the tools for these workstations are associated with a user’s software privilege level, with radiologists having the highest level. Clinical workstations usually are placed near patient care areas with greater concentrations in higher traffic areas, such as the intensive care unit or emergency department.

24. **Diagnostic Workstations**
The number, type, and orientation of monitors at diagnostic workstations differ from clinical workstations. Diagnostic workstations may have from 2 to 4 monitors with display resolutions of 2,000 x 2,000 and higher. The number, type, and functions of the tools for these workstations are associated with the user’s privilege level and the radiologist’s role in interpreting images and producing reports. Most monitors are positioned in a portrait rather than landscape orientation. Diagnostic workstations usually are located in radiology reading rooms, with more workstations in higher traffic areas.

25. **Knowledge Check**

26. **Knowledge Check**

27. **PACS Archive**
Typical PACS archiving devices include servers with multiple, redundant and large-capacity hard drives, tape or disc jukeboxes and, possibly, Web-based servers. These devices are part of the PACS hardware and controlled by PACS application and database server software. It is critical that each image is properly tracked because all images are a part of each patient's folder in the electronic medical record.

28. **PACS Storage**
A PACS provides both online, or near-term, storage and archive, or long-term, storage. This is similar to the analog image practice of storing some images in a file room close to the radiology department and others off site in long-term storage.

Preset rules determine when an image is placed in near-term storage and when it is transferred to a long-term archive. Part of this decision process is based on an image's activity, rather than its acquisition date. All PACS have image storage redundancy, which means that at least 2 copies of images are archived.
PACS also has image security to eliminate accidental erasure of records. As software and archiving systems evolve, newer approaches appear for storage and security.

29. PACS Storage Capability
The storage capabilities of a PACS archive present perhaps the biggest design challenge. Medical digital images are quite large compared with photos taken on a personal digital camera. A single diagnostic medical image may reach 4 to 5 megabytes, so a 5-projection lumbar spine examination may require up to 25 MB of storage space. This may not seem like a lot of storage space today, but when PACS was first developed in the 1980s, the storage size of a single study must have seemed like an insurmountable obstacle.

30. PACS Storage Needs
Imagine the digital file storage capabilities required by a department that produces 400 images a day. If each file is 4 megabytes, then 1.6 gigabytes of storage is needed for 1 day, 11.2 gigabytes for 1 week and so on. Although MR and CT image sizes are smaller, those modalities create many more images for a single exam. CT scans range in size from 15 to 25 megabytes, and MR exams range from 10 to 15 megabytes.

Storing image data in more than one place is almost a requirement to safeguard digital images. Because we can theoretically make numerous electronic copies from raw digital image data without losing image quality, it makes sense to store copies of the original images in multiple locations so they can’t be lost or destroyed.

It’s not unusual for a film-screen image to be lost or not returned to an institution after it’s been borrowed. Fires, floods and other natural disasters have destroyed entire film libraries. The storage redundancies possible with electronic imaging can help prevent losing an entire archive because of a natural disaster or a corrupted device. Some medical centers agree to serve as a backup by hosting another facility’s server on site. Other institutions store image data at some distance from their site to avoid losing information in the event of a massive catastrophe.

31. PACS Archiving Equipment
The type of archiving equipment a facility requires depends on the size of an imaging department, the number and types of exams performed, and the department workflow. Storage capabilities vary by manufacturer and the type of equipment, and can be grouped into several categories: an image acquisition modality workstation, clinical workstation, diagnostic workstation, redundant array of independent disks, or RAID, and jukebox.

32. Modality Workstation Storage
The image acquisition modality workstation is the equipment that acquires a patient’s images. For instance, the CT scanner, the MR scanner, or the flat-panel image receptor are workstations. The number of patients who have been imaged on a specific piece of equipment and departmental protocols determine how long patient information can remain on the hard drive of a modality workstation. Because the hard drive size on the equipment is limited, images must be moved continually and deleted to make room for new patient studies.

33. Quality Assurance Workstation Storage
Technologists might also refer to the quality assurance, or QA, workstation as the clinical workstation. This is where technologists prepare and match images with patient data before sending them to the radiologist. In some cases, the image acquisition modality workstation and the QA workstation serve the same purpose. In other departments, the QA workstation serves as a hub for modality workstations so that technologists can manipulate images and prepare examinations away from the modality controls. This frees up the acquisition equipment for the next patient exam. Because several modality workstations may send images to QA workstations, the QA workstation must have a larger storage capacity and can store images up to 5 days.

34. Diagnostic Workstations
The diagnostic workstation is used by radiologists to interpret clinical images. The storage capacity of these workstations must be large because they simultaneously receive data from multiple image acquisition devices. In addition to the images sent by the modality workstations, archived patient images are sent to the diagnostic workstation for comparison. Diagnostic workstations must accommodate the increased storage demands of radiology reports, or interpretations. The reports are attached to image data, which nominally increases file sizes.

The diagnostic workstation must store up to 1 week’s worth of patient images to meet the demand for comparing studies, consulting with referring physicians, and handling the image traffic from acquisition equipment.

35. RAID Storage
Redundant array of independent disks, or RAID, is a general term that relates to computer storage devices that are not specific to the PACS. “Near term” also is used to describe RAID capabilities. Like its name suggests, a RAID connects hard drives used for computer storage. The redundancy occurs in the way data are stored on those hard drives. The multiple devices in a RAID serve as a backup if a drive fails so that images can be retrieved. PACS uses a RAID as the main storage because it can be accessed quickly and has a fast response time. Images usually are transmitted from a RAID to a diagnostic workstation in less than 2 minutes, which is much faster than locating an image in a film library and hanging it on a view box.

Although a RAID’s storage capacity is quite large, it’s still limited as to what it can store on its drives. Response time slows considerably as more information is stored. For this reason, most institutions limit RAID storage of patient images to an average of 6 to 12 months.

36. Jukebox Storage
The jukebox is the largest storage device used by the PACS and is considered long-term storage. The media holding patient image data rest in slots until needed. When a specific image is requested, a retrieving arm grabs the media device containing the patient data and places it in a drive that reads and transmits the data.

Jukeboxes used for long-term storage employ digital-optical media, or digital tapes, to store data. The extra time involved in locating and retrieving image data means that accessing an image from a jukebox can take 2 to 5 minutes. Access times are considerably longer during times of heavy usage, such as the early morning.

37. Prefetch Feature
The prefetch feature of PACS becomes especially important at the jukebox level. Prefetching automatically retrieves patient images from the jukebox based on predefined protocols.

PACS software can be programmed to search a HIS or RIS for the patients scheduled to undergo radiographic procedures the following day. The software compares those names to an exam list stored in the jukebox and predetermined protocols for prefetching. For example, a protocol might specify that the 2 most recent chest radiographs should be retrieved for patients scheduled for chest exams that day. Another protocol might state that the jukebox should retrieve only the last spine exam for patients scheduled for another spine exam.

The program can retrieve images during the night when demands on the jukebox are minimal so that radiologists can access the images from the diagnostic workstation first thing in the morning. Another form of prefetching occurs in real time. If the patient isn’t scheduled for an exam, there is an emergency situation, or the PACS software protocols are set up to do so, comparison images can be retrieved from the jukebox and sent to the diagnostic workstation quickly. This prefetch model is designed to deliver comparison images to a diagnostic workstation by the time the new images appear.

38. PACS Administrator
Undoubtedly, the most important piece of any PACS is the administrator. This term refers to the person who is responsible for ensuring that a PACS operates at its maximum functionality and efficiency. The PACS may be maintained and monitored by a team or by all personnel who use the system.

39. PACS Network
Another way to understand a PACS is as a computer network. At the most basic level, a PACS consists of imaging equipment that delivers a digital signal to a computer. The computer then processes the information and displays it on a monitor before storing the data. This setup could be called a mini-PACS because all the components of a larger PACS are present, but the scale is much smaller.

A stand-alone CT scanner is an example of a mini-PACS. The CT scanner’s digital output is sent to a computer console for processing before it’s transmitted to an image display monitor to be interpreted. Then a server stores the image to be retrieved later.

The inherent benefits of storing and retrieving digital images from modalities such as CT, MR imaging and sonography were the driving forces behind developing digital imaging capabilities for diagnostic radiography. Of course, the benefits of a PACS multiply when all digital modalities are networked and can communicate throughout a medical center.

A typical PACS platform receives images from all digital imaging modalities, including sonography, CT, MR, nuclear medicine, vascular-interventional, mobile fluoroscopy, diagnostic radiology, and fluoroscopy, mammography, and film digitizers. In addition, a PACS can store DICOM-compliant images and digital images in other formats, such as JPGs. For example, a patient’s image record in a PACS could include colonoscopy images.

40. Computer Networks
A PACS doesn’t just function in the imaging department. It interacts with other computers throughout the medical facility and the world, via a computer network or the Internet. A computer network connects 3 or more computers that share resources and information. The design of an institution’s computer network to some extent determines the flow of images and patient data throughout the medical center.

41. Departmental Access to PACS
A large-scale PACS network connects the multiple modalities that medical centers use every day. To be truly useful, a PACS must interact with departments other than the radiology department. This access can occur in 3 ways: PACS workstations can be installed throughout the facility, PACS software can be installed on existing computers throughout the medical center, and patient images can be integrated into the electronic health record, or EHR.

42. PACS Access Option #1
PACS workstations installed throughout a medical center allows images to be viewed by referring physicians and other allied health personnel. In this scenario, the individual needs an access code for the workstation and must know how to use the PACS software. This knowledge includes query and retrieval functions, how to manipulate a work list, along with how to open and close a study. In addition, the individual must be trained to manipulate the viewer controls that magnify, minimize or adjust brightness and contrast. Only 1 person at a time can interact with a workstation.

43. PACS Access Option #2
A second way to offer PACS to the rest of a medical center involves installing PACS viewing software on existing computers throughout the facility. PCs can be located in physicians’ offices, at nursing stations, or even in examination rooms. This option provides some of the same opportunities and issues as the PACS workstation, but limits the functions of a PACS viewer. This limited nature means that, in theory, it’s easier for everyone to operate. Accessing a PACS from additional computers can lead to more people using the system, which is a consideration if a PACS infrastructure can’t handle the increased image requests.

44. PACS Access Option #3
A final way to provide access to PACS outside the imaging department is to integrate patient images into the electronic health record. When a medical facility already has electronic medical records, also known as electronic patient charts, the PACS can provide digital images to the EHR, and they become part of the patient’s chart. PACS training isn’t required to query the images, and the images can be opened with the click of a mouse.

45. PACS Advantages
To recap, a great benefit of a PACS is that several people can view the same images simultaneously and in multiple locations. Given this fact, plus the capabilities of software tools, PACS facilitates consultation among physicians. The results of an examination can be distributed more quickly, a patient’s treatment can begin sooner and caregivers can spend considerably less time retrieving images and reports.

A PACS requires fewer staff members in the film file room. In addition, other department personnel can dedicate more time to performing imaging examinations and interpreting imaging results, rather than handling queries on the status of exams.

46. Computer Networks
A local area network, or LAN, is a computer network limited to a relatively small geographical area. Typically, LAN devices share a server loaded with appropriate applications and data for the LAN user group. An example of a LAN is a computer network that serves a group of CT scanners, monitors, and a single storage device.

A wide area network, or WAN, is a computer network that covers a relatively large geographical area. Typically, WANs use transmission systems provided by common carriers, such as a telephone or cable company. These networks share a server that has the appropriate applications and data for that WAN user group. WAN technologies generally function at the physical, data link, and network layers.

47. LAN vs. WAN
To summarize, a LAN covers a smaller area but transfers data at much higher rates. WANs, on the other hand, cover much larger areas and generally function at slower rates than LANs, depending on the equipment.

A LAN is usually a privately-owned network with secured communication lines. It provides more security for data transfer within an organization because, in theory, it can’t be accessed by anyone outside that network. Examples of LANs are the hospitals, or facility’s, health information system and radiology information system.

A WAN may be operated by a commercial firm or public entity, and transfers data over private or leased communication lines. A WAN can be as simple as a teleradiology system connected to a radiologist’s home via telephone lines, or as complex as the entire Internet.

48. IP Address
Every computer on a network has a unique identifier or address. The Internet protocol, or IP, address is a number that uniquely identifies a computer connected to a network. The address is expressed in dotted quad format. This 32-bit, 4-byte number identifies the network in its first 1, 2 or 3 bytes, and the rest of the numbers identify the computer or host.

49. Network Interface Card
Network interface cards connect the computer network full time through a hard or wireless connection. The network interface card is an installed computer circuit board that requires software to operate the network connection, but can be built into the computer’s operating system.

50. Network Switch
A network switch connects multiple network segments; the speed of the connection depends on the capability of the hardware. Connections can be made at 10, 100 or 1,000 megabits per second, at half or full duplex. A switch is “smart” in that it knows exactly where a select piece of data must go. Therefore,
the switch helps conserve network resources by reducing the time needed to search all network computers for a single address.

51. Router
A router is a junction between 2 or more networks. This connection allows data packets among the networks to be transported and buffered. Routers can filter the information flow depending on the sender or intended recipient of the images or other data.

52. Network Bridge
Like a router, a network bridge provides a junction between 2 or more networks. The difference between a bridge and a router is that bridging occurs at the data link layer of a 7-layer protocol stack, but routing works at the network layer. Because of this distinction, a bridge uses the media access control to control data transfer, and a router uses an IP address.

53. Wireless Access
Wireless routers and Bluetooth technology in a hospital environment also provide point-of-care access to images for physicians with the appropriate PACS software loaded on a personal digital assistant, otherwise known as a PDA, a tablet, or a laptop computer.

54. Network Firewall
A firewall controls traffic between a single computer and a computer network in an environment with no security, or between a computer network in a trusted environment and a computer network in a less secure environment. Firewalls prevent security breaches and may be either software-based or hardware-based.

55. The Internet
The Internet offers a number of possibilities for transferring and viewing digital images. Obviously, concerns about patient confidentiality are an issue, and many hospital administrators are reluctant to risk transmitting patient information via the Internet. However, sophisticated encryption software has proven a viable way to move images in a PACS environment.

56. Image Data Output
The capabilities of the PACS network now stretch beyond the walls of the hospital, which creates many opportunities and several challenges. For example, patients commonly request a copy of an image to take to a primary care physician or to a specialist for a second opinion.

In the analog imaging environment, films are copied using a film duplication device. The patient may be charged a nominal fee for the service before leaving with the copied films. However, the film copy does not match the original quality, which could present a problem in the future. As an alternative, a patient or a patient’s physician may borrow the original films from a medical center’s film library. However, this practice can be a problem because the originals might be lost or never returned. PACS solves these problems by burning image data onto compact discs or using Web-based technologies.

57. Viewing Images on CD
The major challenge in burning patient images onto a CD is not in recording the images, but rather in viewing the images on the receiving end. A PACS archive interface allows users to access the archive, retrieve desired images and burn them onto a CD, but a physician might not have a viewer that’s capable of rendering the images he or she receives. To solve this problem, viewing software is loaded onto the CD that holds the image data. In this way, a physician can review the images, no matter what equipment is available at the receiving site.

58. E-Mail
Using e-mail to transfer images to a new physician is an alternative to burning a CD. However, it’s not practical to send images this way because of file sizes and patient confidentiality issues. Instead, a PACS can sometimes generate a unique uniform resource locator, often referred to as a URL, or Web address, that is sent to a physician along with a password. The password provides access to a Web server that
holds the patient images. In this way, a physician can click on a link in an e-mail attachment, enter the password and access a website that displays the patient’s images; all the viewing software is available on the website.

59. Hard Copies
If necessary, PACS images can still be printed onto film using a laser printer or a thermal processor. The images then are viewed on a view box.

PACS, and occasionally image acquisition systems, allow staff to download images to hard media and other storage devices. In many cases, these images are exported so that a patient can take the records to a physician. When the image data files are exported it is important to include all demographic and patient identification data.

All Health Insurance Portability and Accountability Act, or HIPAA, guidelines must be followed to access the data when images are used as part of medical research or education. The exported data and images must be anonymous, or stripped, of all identifying information. When choosing the export format, technologists must be sure to follow the proper protected health information guidelines outlined by institutional policies and HIPAA.”

60. Image Sharing
The lines connecting a PACS, HIS, and RIS continue to blur as these communication systems share information and more departments request images. It’s not unusual for PACS to include images not generally associated with radiology, such as endoscopic images from a gastroenterology study. Improving access to these images enhances patient care by expediting clinical decision making throughout a medical center.

61. Teleradiology
Teleradiology is another extension of the PACS. Teleradiology distributes digital images off site to be interpreted. In many cases, a hospital has a teleradiology system that links a PACS to the homes of its radiologists so that they can review images at home. This use generally occurs in the evenings or on weekends when the medical center is not staffed as heavily. Teleradiology image display and interpretation is used on an emergency or on-call basis in this case, not as a scheduled practice.

Teleradiology actually predates large PACS applications for radiologist home use. Stand-alone teleradiology systems used phone lines to transmit images before large PACS systems were introduced. And stand-alone teleradiology systems continue to operate apart from those systems today.

Teleradiology is becoming synonymous with off-site reading by radiologists not employed by the institution that produces the image. This practice, also known as “night hawking,” is gaining popularity as a means to cover underserved areas of the United States, or regions outside the United States experiencing acute radiologist shortages.

62. Knowledge Check

63. Knowledge Check

64. Conclusion
This concludes Essentials of Digital Imaging: Module 5 — Picture Archiving and Communications Systems. You should now be able to:

- Define HIS and HL7.
- Define RIS.
- Identify the components of a PACS.
- Discuss the purpose of a PACS.
- Describe the function of the PACS components.
- List the data included in a PACS display.
65. Resources


