



Specialized Topics in Areas of Radiologic Sciences
P.O. Box 2931 Toledo, Ohio 43606 419-471-1973
E-mail: info@xrayhomestudies.com
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Unit 45

Digital Radiography and PACS

by

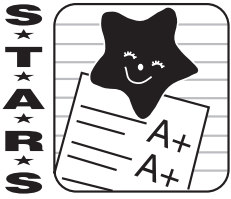
Christi E. Carter, MSRS, RT ®

&

Beth L. Veale, M.Ed., RT ® (QM)

Second Edition

**Prepared by: Carolyn J. Frigmanski, M.A., B.S.R.T. ®
Founder, S.T.A.R.S.**



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In the spring of 2013, The Ohio Department of Health (ODH) approved ALL of them for GXMO license renewal. Please check with your state licensing agency if you are not a licensed GXMO in Ohio to be sure your state accepts these ce credits for your state license renewal requirement.

This product consists of a text on a desired topic and multiple question, short answer post test(s) pages. The number of Ohio Department of Health approved continuing education (ce) credits is listed on our order form. This home study product was originally developed for radiographers across the country who were registered with the American Registry of Radiologic Technologists (ARRT) and approved by the American Society of Radiologic Technologists (ASRT). Please disregard any reference to the ASRT/ARRT within this product, if any.

You must complete the reading and questions with a **75% or higher score** on the post test(s) to get your approved CE credit!

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Thank you for selecting **S.T.A.R.S.** to meet your continuing education needs!

Sincerely,

Carolyn J. Frigmanski, M.A.,B.S.R.T. ®, Founder

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The Ohio Dept. of Health (ODH) requires a **minimum of 12 continuing education credits (ceus) to be completed every 2 years (your biennium) BEFORE your license expires.** You may do more than 12 ceus, but not less than 12 ceus, if you so choose. Ceus in excess of 12 cannot be carried over to the next biennium.

You will receive a hard copy renewal notice by mail from the ODH 60 days **BEFORE** your license expires. **It is your responsibility to amend your personal information to the ODH whenever you change your name, address or place of employment as soon as possible by using the ODH website or contacting the ODH by telephone at 614 752-4319 for assistance. Failure to receive an ODH notice is not an acceptable reason for failing to renew on time.** You can add completion of clinical modules to your GXMO license on the ODH web site.

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You can renew immediately when you receive your notice or you have 30 days to complete the renewal process and payment to the ODH after your license expires. Online renewal requires your credit card for payment. If you chose hard copy renewal, you may submit a check or money order.

You and/or your employer can view and/or print your renewed license on line upon completion of the process. Problems that exist with renewal should be addressed to the ODH by calling for assistance.

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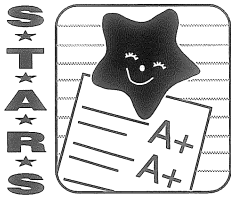
GXMOs must notify the ODH in writing within 30 days of any changes in the physician providing direct supervision. If your scope of practice changes (e.g. chiropractic to podiatric), a competency form must be completed and submitted to the ODH.

You may also want to check the ODH web site periodically for changes that may have occurred during your biennium and to share this information with your co-workers and/or administrative staff members.

The ODH website is: <http://www.odh.ohio.gov/odhPrograms/rp/rlic/ristatus.aspx>

Email is: BRadiation@odh.ohio.gov

Thank you very much.



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Complete ALL hard copy unit post tests for the products you purchased in legible printing BEFORE your license expires. Mail is processed the same day it is received.

You may want to copy them BEFORE you mail them to the S.T.A.R.S. office to minimize mail delivery complications. They will NOT be returned to you unless you get a 75% or less. If you do NOT get a 75% or better after evaluation, the post tests will be sent back to you with the questions needing a new answer selection. After completing the questions, send them ALL back to the S.T.A.R.S. office for re-evaluation.

Be sure to use the CORRECT postage by having it weighed at the post office if it consists of more than 5 pages. Envelopes with INSUFFICIENT POSTAGE will be sent back to the participant and delay your post test evaluation and certificate creation.

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I do NOT accept scanned pages because I do NOT want you putting your private, personal information on the internet. I do NOT open attachments due to the threat of virus contamination that may jeopardize my web site and computerized databases.

Do NOT send your study media i.e. CD, DVD, booklets and/or books back to me.

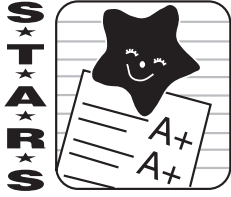
United States Postal Service (USPS):

If you are using USPS for priority or express mailing, please keep your receipt with the tracking number in case of a problem with the delivery. Please mark the section for NO SIGNATURE REQUIRED for express mail and send it to my home address: Carolyn J. Frigmanski, MA, BSRT (R) 3134 Aldringham Road Toledo, Ohio 43606. The USPS does NOT deliver to my P.O. Box address. Please call to let me know I should be expecting it at 419 471-1973.

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If you are using these delivery services, please keep your receipts with the tracking number in case of a problem with the delivery. Please mark the section for NO SIGNATURE REQUIRED for express mail and send it to my home address: Carolyn J. Frigmanski, MA, BSRT(R) 3134 Aldringham Road Toledo, Ohio 43606. Please call to let me know I should be expecting it at 419 471-1973.

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Unit 45: **Digital Radiography and PACS** Second Edition by Christi E. Carter, MSRS, RT ® and Beth L. Veale, M.Ed., RT ®(QM)

Please complete the answer sheet at the conclusion of this post test & return it to the **S.T.A.R.S.** office.

Chapter 1

- Digital imaging was first used in medical applications with the advent of
 - magnetic resonance imaging
 - computed tomography
 - ultrasound
 - nuclear medicine
- The term used to describe moving images via telephone lines to and from various locations is
 - remote radiography
 - kinetic imaging
 - teleradiology
 - via communication
- Computed radiography was first introduced commercially in the United States in 1983 by
 - Eastman Kodak
 - Siemens Corporation
 - General Electric
 - Fuji Medical Systems of Japan
- The digital radiography system utilizing devices to absorb x-rays and convert them into light is
 - indirect capture
 - digital analysis
 - analog conversion
 - direct conversion
- The imaging modality in which the latent image formation results when x-rays strike a phosphor, get deposited in the phosphor and released when stimulated by light from a reader is called
 - conventional film/screen radiography
 - photostimulable phosphor system (PSP)
 - digital radiography (DR)
 - electron capture radiography
- When utilizing PSP and DR, radiographic contrast is *primarily* controlled by the function of
 - filtration
 - grid ratio
 - imaging processing look-up table
 - look-up tables (LUT)
- The abbreviation used to identify standards to allow imaging modalities to communicate is
 - PACS
 - DICOM
 - RIS
 - HIS
- Many PACS reading stations also have image processing capabilities.
 - True
 - False

9. Grid use is more critical in digital imaging because the system is more sensitive to
- a. scatter
 - b. light
 - c. kVp
 - d. mA changes

Chapter 2

10. The smallest element in a digital image is called a
- a. bit
 - b. matrix
 - c. byte
 - d. pixel
11. The smaller the pixel is, the greater the detail.
- a. True
 - b. False
12. The square arrangement of numbers in columns and rows in a digital image is called the
- a. matrix
 - b. megabyte
 - c. field of view (FOV)
 - d. pixel bit depth
13. The perfect deviation index (DI) has a value of
- a. +1
 - b. -1
 - c. 0.0
 - d. 0.1
14. The brightness of the image on the monitor can be manipulated by adjusting the
- a. kVp
 - b. window level
 - c. window width
 - d. DI
15. The brightness in a monochromatic monitor can be affected by
- a. contrast
 - b. photon energy
 - c. overhead light
 - d. crystal type
16. Higher spatial resolution in a digital image can be accomplished by using
- a. bigger pixels
 - b. a larger matrix
 - c. a bigger FOV
 - d. smaller pixels
17. Modulation transfer function (MTF) is perfect when the MTF is _____%.
- a. 50
 - b. 75
 - c. 100
 - d. 1,000
18. Noise that occurs during image acquisition is known as
- a. mottle
 - b. radiographic
 - c. anatomic
 - d. fog
19. Latitude is dependent on the
- a. image detector
 - b. noise factor
 - c. MTF %
 - d. deviation index
20. The highest detective quantum efficiency (DQE) exists with
- a. amorphous silicon
 - b. non-metal oxide
 - c. cesium iodide
 - d. amorphous selenium

Chapter 3

21. Images that are too bright or too dark may be due to improper centering. a. True b. False
22. A graphic representation of the optical densities in a collimated area is called the
a. matrix b. histogram c. FOV d. image sample
23. The shape of the histogram is _____ specific.
a. exposure b. matrix c. anatomy d. density
24. The individual who described a way to convert analog signals to digital signals was
a. Einstein b. Roentgen c. Nyquist d. Gates
25. Incorrect technical factors can be “fixed” with
a. rescaling b. dose creep c. aliasing d. filtering
26. There is a look-up table (LUT) for every anatomic part. a. True b. False
27. Window width controls the ratio of black and white or the
a. density b. exposure index c. brightness d. contrast
28. Veil glare can be minimized by utilizing a processing function called
a. image orientation b. shuttering c. stitching d. annotation
29. Retrieval of images from PACS (picture archiving and communication system) is the function of
a. demographic input c. an archive query
b. digital history d. digital memory

Chapter 4

30. During the reading process, the phosphor releases stored
a. x-rays b. electrons c. laser energy d. light
31. The phosphor used in PSP imaging plates is in the family of crystals called
a. barium fluorohalide c. rare earth
b. lithium fluoride d. amorphous
32. The _____ layer of the imaging plate reduces static electricity.
a. protective b. backing c. conductive d. support

33. The laser in the PSP reader emits _____ light.
- a. blue b. red c. green d. ultraviolet
34. A device/system that represents changing values as continuously variable physical quantities is
- a. digital b. synchronous c. fluctuating d. analog
35. The spatial resolution in computed radiography systems has a lp/mm. range of
- a. 1-3 b. 2-4 c. 2.55 – 5 d. 5-7
36. To erase the image on a CR imaging plate, _____ energy must be applied.
- a. laser b. light c. ultraviolet d. microwave
37. It is not recommended to select kVp below _____ on most digital projection systems.
- a. 45 b. 55 c. 65 d. 75
38. When insufficient light is produced, the grainy image is referred to as
- a. quantum mottle b. laser noise c. fog d. insensitivity
39. A moire pattern can be created when the scanner laser is parallel to the
- a. imaging plate b. grid lines c. body part d. sensors
40. Improper calculation of the exposure indicator can result from insufficient
- a. mA b. kVp c. distance d. collimation

Chapter 5

41. Phosphors that produce light when absorbing x-rays are classified as
- a. receptors c. photoconductors
b. scintillators d. convertors
42. The crystal used in direct conversion flat-panel detectors is amorphous
- a. silicon b. cesium iodide c. gadolinium d. selenium
43. Needles that allow a greater detection of x-rays are composed of
- a. gadolinium oxysulphide c. thallium doped cesium iodide
b. amorphous selenium d. barium fluorohalide
44. Flat-panel detectors use about _____ kilometers or _____ miles of electrical bias.
- a. 1.0/1.5 b. 2.0/1.5 c. 2.5/1.6 d. 3.0/2.5

45. Manufacturers use a standard of less than approximately ____% to ____% defective pixels.

- a. 0.0/1.0 b. 0.0/0.1 c. 0.1/0.2 d. 1.0/2.0

46. Image lag is an artifact described as similar to a (an) _____ image.

- a. double exposed c. underexposed
b. overexposed d. fogged

Chapter 6

47. The layer in charge-coupled devices (CCDs) that contains electronic gates is called

- a. silicon dioxide b. carbon c. silicon substrate d. polysilicon

48. Overfill in the detector elements can create a “_____” effect.

- a. excess b. bucket c. blooming d. readout

49. Most CCD chips range from _____ to _____ cm. in size.

- a. ½/1 b. 2/4 c. 3/5 d. 4/6

50. Dark current noise is also referred to as _____ noise.

- a. detective b. amplification c. statistical d. quantum

51. The *strongest* advantage of CCDs is their

- a. modular design c. reduced detective quantum efficiency (DQE)
b. inexpensive cost d. abundance as an element

52. The most popular semiconductor in complementary metal oxide (CMOS) systems is

- a. silicon b. arsenic c. selenium d. cesium iodide

Chapter 7

53. The _____ is an example of an input device for a computer.

- a. monitor b. speakers c. printer d. mouse

54. A single unit of data is called a _____.

- a. byte b. binary c. bit d. quantum

55. The brain of the computer is the component called the

- a. memory b. microprocessor c. motherboard d. ports

56. Random access memory (RAM) is short term storage for open programs. a. True b. False

57. The most common wired connection used between devices today is called a (an)
- a. USB b. parallel port c. IDE port d. serial port
58. The main repository for programs and documents on a personal computer is called the
- a. bus b. network card c. motherboard d. hard drive
59. A digital versatile disk (DVD) holds up to _____ times more than a compact disk CD.
- a. three b. four c. six d. seven
60. The number of pixels on a display is known as its
- a. dot pitch b. matrix c. resolution d. dot triad
61. The operating system used for digital x-ray consoles is called
- a. real-time c. single-user, single task
b. multiuser d. single user, multitask
62. The Food and Drug Administration cleared mobile devices to view DICOM images in
- a. 2000 b. 2006 c. 2011 d. 2012

Chapter 8

63. The network classification used in PACS workstations in the reading room is known as
- a. tiny area (TAN) c. wide area (WAN)
b. local area (LAN) d. controller area (CAN)
64. The network in which no computer has ultimate control over another is described as
- a. server-based b. peer-to-peer c. client-based d. local area
65. A computer that can work independently of the network and manage its own files is called
- a. server b. client-based c. thin client d. thick client
66. The component used to connect several pieces of equipment together for networking purposes is
- a. wireless b. coaxial cable c. interface card d. hub
67. The _____ topology has the devices connected to a central hub or switch.
- a. star b. bus c. ring d. mesh
68. A router reads portions of messages and directs them to their intended target. a True b. False

69. The first version of digital imaging and communications in medicine (DICOM) was completed in
- a. 1969 b. 1974 c. 1985 d. 1999
70. One part of the DICOM Standard 3-2011 includes application hosting. a. True b. False
71. The number 1.2.840.8573.45671.2000510111764589.8765.1 represents a
- a. billing record c. specific physician
b. medical facility d. unique identifier
72. The most recent information technology in the forefront of medicine today is the
- a. radiology information system (RIS) c. hospital information system (HIS)
b. HL-7 standards d. electronic medical record (EMR)

Chapter 9

73. The electronic version of the file room and reading room is known as the
- a. RIS b. PACS c. HIS d. DICOM
74. The most interactive part of a PACS system for the health care worker is the
- a. server b. display workstation c. archive d. network
75. The central part of the PACS that houses all the historic and current data is called the
- a. server b. image manager c. hard drive d. archive
76. The term *workflow* in radiology begins with
- a. order entry b. patient identification c. scheduling d. patient prep
77. The hardware and software infrastructure of a computer system is known as its
- a. program c. system architecture
b. operating system d. delivery system
78. With PACS, the time from performing the exam to completing the final radiologist's report is a
- a. couple of hours b. couple of days c. week d. 2 weeks
79. In a client/server-based system, images are sent to a designated reading station. a. True b. False

80. – 82. Match the display workstation in Column A with the description in Column B

Column A

Column B

- | | |
|---------------------------------|--|
| 80. radiologist reading station | a. has the highest quality hardware and monitor |
| 81. physician review station | b. has CD/DVD burners |
| 82. technologist QC station | c. has a 1 K monitor |
| | d. has integration of RIS functions with PACS software |
83. The addition of text or graphics onto the image is called
- | | | | |
|----------------|------------|---------------|------------|
| a. orientation | b. panning | c. annotation | d. editing |
|----------------|------------|---------------|------------|

Chapter 10

84. The archive contains the master database of everything in the PACS system. A. True b. False
85. The long-term storage medium that uses blue laser technology is called
- | | |
|--------------------------------|---------------------------------|
| a. ultra density optical (UDO) | c. digital versatile disk (DVD) |
| b. magneto-optical disk (MOD) | d. magnetic disk |
86. A laser film digitizer uses a _____ neon laser beam to convert analog film images.
- | | | | |
|-------------|-----------|-------------|-----------|
| a. hydrogen | b. oxygen | c. nitrogen | d. helium |
|-------------|-----------|-------------|-----------|
87. The gold standard for film digitization is considered to be
- | | | | |
|----------|--------|--------|--------|
| a. laser | b. CCD | c. wet | d. dry |
|----------|--------|--------|--------|
88. The outer layer of a DVD is constructed of
- | | | | |
|-------------|---------|-----------|-----------|
| a. aluminum | b. gold | c. copper | d. silver |
|-------------|---------|-----------|-----------|

Chapter 11

89. The systematic observation and assessment of different aspects in a radiology department is
- | | |
|-------------------------|-----------------------------|
| a. total quality (TQ) | c. quality assurance (QA) |
| b. quality control (QC) | d. quality improvement (QI) |
90. The QC activity designed for newly installed or majorly repaired equipment is called
- | | |
|------------------------|-----------------------|
| a. routine maintenance | c. acceptance testing |
| b. vendor maintenance | d. error maintenance |
91. Continuous quality improvement (CQI) requires the involvement of
- | | | | |
|------------------|-----------------|---------------|------------------|
| a. radiographers | b. radiologists | c. physicists | d. all personnel |
|------------------|-----------------|---------------|------------------|

92. The software is often the weakest link in the digital imaging chain. a. True b. False

93. The SMPTE or AAPM TG18-QC test pattern is utilized for QC evaluation of the

- a. monitor b. burner c. film digitizer d. software

94. The TG18-LN test pattern is used to evaluate

- a. reflection b. geometry c. luminance d. contrast

95. Resolution testing of the monitor quality should be conducted

- a. daily b. weekly c. monthly/quarterly d. annually

96. Printer test patterns require a _____ to measure the steps.

- a. sensitometer b. magnifier c. step wedge d. densitometer

97. After acceptance, workstation processing speed patterns should be evaluated

- a. daily b. weekly c. monthly d. quarterly

98. Compression recall is used to reduce the size of the image files. a. True b. False

99. Recognition of nondiagnostic images is primarily carried out by the

- a. radiographer b. qc technologist c. radiologist d. physicist

100. People trained by vendor applications personnel on all aspects of the system are called

- a. super techs b. application techs c. qc techs d. super users

Chapter 12

101. The organization determining standards of practice to assure quality in imaging systems is The

- a. American Society of Radiologic Technologists c. American Medical Association
b. American College of Radiology d. Joint Commission

102. The first line of defense in preventing, recognizing and reporting quality control issues is the

- a. radiographer b. radiologist c. physicist d. super user

103– 109. Match the QC duties described in Column A to the recommended schedule in Column B

Column A

Column B

103. reject analysis

a. daily

104. erase imaging plates

b. weekly

105. clean and inspect receptors

c. monthly

106. equipment malfunction errors

107. inspect laser printer

108. clean display screen

109. artifact identification

110. The safest procedure to perform if you are unsure of the latest cassette erasure is to

- a. ask someone
- b. use it anyway

- c. erase it before use
- d. pull it out of circulation

111. Legal issues may result if technologists do *not* use

- a. personal ID markers
- b. correct cassette size

- c. appropriate kVp
- d. good positioning skills

112. To prevent contamination when cleaning imaging plates, technologists must use gloves made of

- a. latex
- b. lint-free cotton
- c. rubber
- d. silk

113. Licensed companies must be used to dispose damaged imaging plates because they contain

- a. silver
- b. gold
- c. lead
- d. barium

114. Preventative maintenance should be typically scheduled on a _____ basis.

- a. monthly
- b. quarterly
- c. semiannually
- d. annually

115. The individual responsible for acceptance criteria and quantitative relationships is the

- a. physicist
- b. radiographer
- c. radiologist
- d. qc tech



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Name _____

Address _____

City _____ State _____ Zip Code _____

Social Security Number _____ Date _____

Answer Sheet for: Unit 45 Digital Radiography and PACS by Christi E. Carter, MSRS, RT ® and Beth L. Veale, M.Ed., RT ® (QM)

Please place your lettered selection for each question in the respective box and return *ONLY this post test sheet to S.T.A.R.S.*

1.	13.	25.	37.	49.	61.
2.	14.	26.	38.	50.	62.
3.	15.	27.	39.	51.	63.
4.	16.	28.	40.	52.	64.
5.	17.	29.	41.	53.	65.
6.	18.	30.	42.	54.	66.
7.	19.	31.	43.	55.	67.
8.	20.	32.	44.	56.	68.
9.	21.	33.	45.	57.	69.
10.	22.	34.	46.	58.	70.
11.	23.	35.	47.	59.	71.
12.	24.	36.	48.	60.	72.

**Answer Sheet for: Unit 45 Digital Radiography and PACS by Christi E. Carter, MSRS,
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73.	85.	97.	109.
74.	86.	98.	110.
75.	87.	99.	111.
76.	88.	100.	112.
77.	89.	101.	113.
78.	90.	102.	114.
79.	91.	103.	115.
80.	92.	104.	
81.	93.	105.	
82.	94.	106.	
83.	95.	107.	
84.	96.	108.	