ABR Prep
Part 1 & Diagnostic Part 2

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Path to ABR Certification

- **Part 1** (Computerized, general and clinical parts)
  - Basis: Knowledge level of 2nd year graduate student
  - Eligibility: Must be enrolled in and in good standing with or graduated from a CAMPEP accredited program (typically taken in 2nd or 3rd year of graduate school)
  - Note: you have 10 years after passing part 1 to finish process
- **Part 2** (Computerized, specialty specific)
  - Basis: Knowledge level after completing CAMPEP residency
  - Eligibility: Must have passed Part 1. Must have completed CAMPEP residency by 8/31 of year in which Part 2 will be taken. If completed residency in year prior, must be currently employed.
- **Part 3** (Oral, clinical practice)
  - Basis: Same material as Part 2 with emphasis on practicing clinical medical physics, clinical judgment and communication
  - Eligibility: Must pass Part 1 and Part 2

ABR Exam Part 1

Basis	Knowledge level of 2nd year graduate student
Eligibility	Must be enrolled in and in good standing with or graduated from a CAMPEP accredited program (typically taken in 2nd or 3rd year of graduate school)
Application Date	Accepted between September 2 – December 1, 2019
Cost	$505 (2019)
Exam Date	Early August

Content Guide

Part 1: General Content Guide

- **Atomic / Nuclear Physics, Sources of Radiation, Interaction of Radiation with Matter**
  - Basic atomic and nuclear physics
  - Radioactivity
  - Sources of radioactive material
  - Radioactive material uses and safety
  - Radiation generating equipment: photons, electrons and heavy particles
  - Interactions of photon and particle radiation with matter
  - Dosimetry concepts and units
  - Spatial distribution/transmission of radiation (photons, protons and electrons
- **Radiation Instrumentation and Measurement**
  - Gas-filled detectors
  - Scintillation detectors
  - Solid state detectors
  - Neutron detectors
  - Emerging and miscellaneous detectors
  - Measurement procedures
  - Quality control and quality assurance
  - Applications in imaging, nuclear medicine, therapy and safety
- **Diagnostic Medical Physics**
  - Radiography, Fluoroscopy and Mammography
  - Computed Tomography
  - Ultrasound
  - Magnetic Resonance
  - Modality comparison, image features and artifacts
  - Endogenous and exogenous contrast
  - Modality facility considerations, safety
  - Methods of quality control and quality assurance
- **Nuclear Medical Physics**
  - Scintillation cameras
  - Image acquisition and reconstruction
  - Common radionuclides
  - SNR, subject/image contrast
  - Spatial resolution
  - Mechanical aspects: accuracy, precision
  - Single Photon Emission Computed Tomography (SPECT)
  - Positron Emission Tomography (PET)
  - Modality comparison, image features and artifacts
  - Image processing and analysis
  - Applications, dose, facilities and safety
  - Hybrid imaging (SPECT/CT, PET/CT, PET/MR)
  - Methods of quality control and quality assurance
  - Counting principles
  - Physical, biological, and effective half-life
- **Therapeutic Medical Physics**
  - Clinical linear accelerator principles, collimation and mechanical aspects
  - Clinical kV and MV photon beam characteristics
  - Clinical megavoltage electron beam characteristics
  - Clinical proton beam characteristics
  - Comparison of clinical photon, electron and proton beams
  - Dose functions: PDD, TAR, TPR, TMR, SMR
  - Principles of radiation treatment planning
  - Basic dose (monitor unit) calculation
  - Brachytherapy
  - Radiation safety and protection, patients and personnel
  - Methods of quality control and quality assurance
- **Radiation Protection, Safety,** Professionalism and Ethics
  - Principles of radiation safety
  - Radiation risk and epidemiological data
  - Radiation protection regulations: NRC and Agreement States
  - Radiation areas
  - Regulatory exposure limits
  - Radiation protection program
  - Radioactive source management and security
  - Transportation of radioactive materials
  - Shielding design for diagnostic, nuclear medicine and therapeutic installatior
  - Signage for diagnostic, nuclear medicine and therapeutic installations
  - Nonionizing radiation safety
  - Mechanical and electrical safety
  - Principles of quality assurance and quality control
  - Management of radiation accidents and large-scale radiological events
  - Professionalism and ethics
- **Mathematics – Statistics, Image Processing – Analysis, Informatics**
  - Mathematics relevant to medical physics
  - Statistics and biostatistics
  - Medical image analysis and processing
  - Observer performance and ROC analysis
  - Informatics

Part 1: Clinical Content Guide

- **Anatomy**
  - Breast
  - Cardiovascular
  - Digestive System
  - Musculoskeletal
  - Neurological System
  - Reproductive/Endocrine
  - Thoracic Cavity
  - Urinary System
  - Lymphatic System
- **Radiation Biology**
  - Physics and chemistry of radiation interactions with matter
  - Molecular and cellular radiobiology
  - Tumor radiotherapy
  - Normal tissue response to radiotherapy
  - Time dose fractionation
  - Radiobiological basis of radiation protection
  - Radiation accidents and environmental radiation exposure
  - Diagnosis and medical management of radiation syndromes
  - Deterministic effects
  - Stochastic Effects
  - Radiation carcinogenesis
  - Heritable radiation effects
  - Effects on the developing embryo
- **Human Physiology**
  - Nervous system
  - Musculoskeletal system consists of the
  - Cardiovascular system
  - Respiratory system
  - Digestive system
  - Integumentary system
  - Urinary system
  - Reproductive system
  - Immune system
  - Endocrine system
- **General Medical / Radiology / Radiation Therapy Terminology**
  - Medical Root Words
  - Diagnostic Radiology terminology
  - Radiation Therapy terminology
- **Clinical Procedure Applications**
  - Diagnostic Radiology
  - Radiation Therapy
- **Pathology**
  - Neoplastic Diseases
  - Benign Disease
  - Infectious Diseases
  - Congenital and hereditary diseases
  - Inflammatory
  - Trauma
  - Cardiovascular Diseases
  - Neurological

ABR Exam Part 1

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Content Guide

General Content Guide

- **Atomic/Nuclear Physics, Sources of Radiation, Interactions of Radiation with Matter**
- **Radiation Instrumentation and Measurement**
- **Diagnostic Medical Physics**
- **Nuclear Medical Physics**
- **Therapeutic Medical Physics**
- **Radiation Protection and Safety**
- **Professionalism and Ethics**
- **Mathematics – Statistics, Image Processing – Analysis, Informatics**

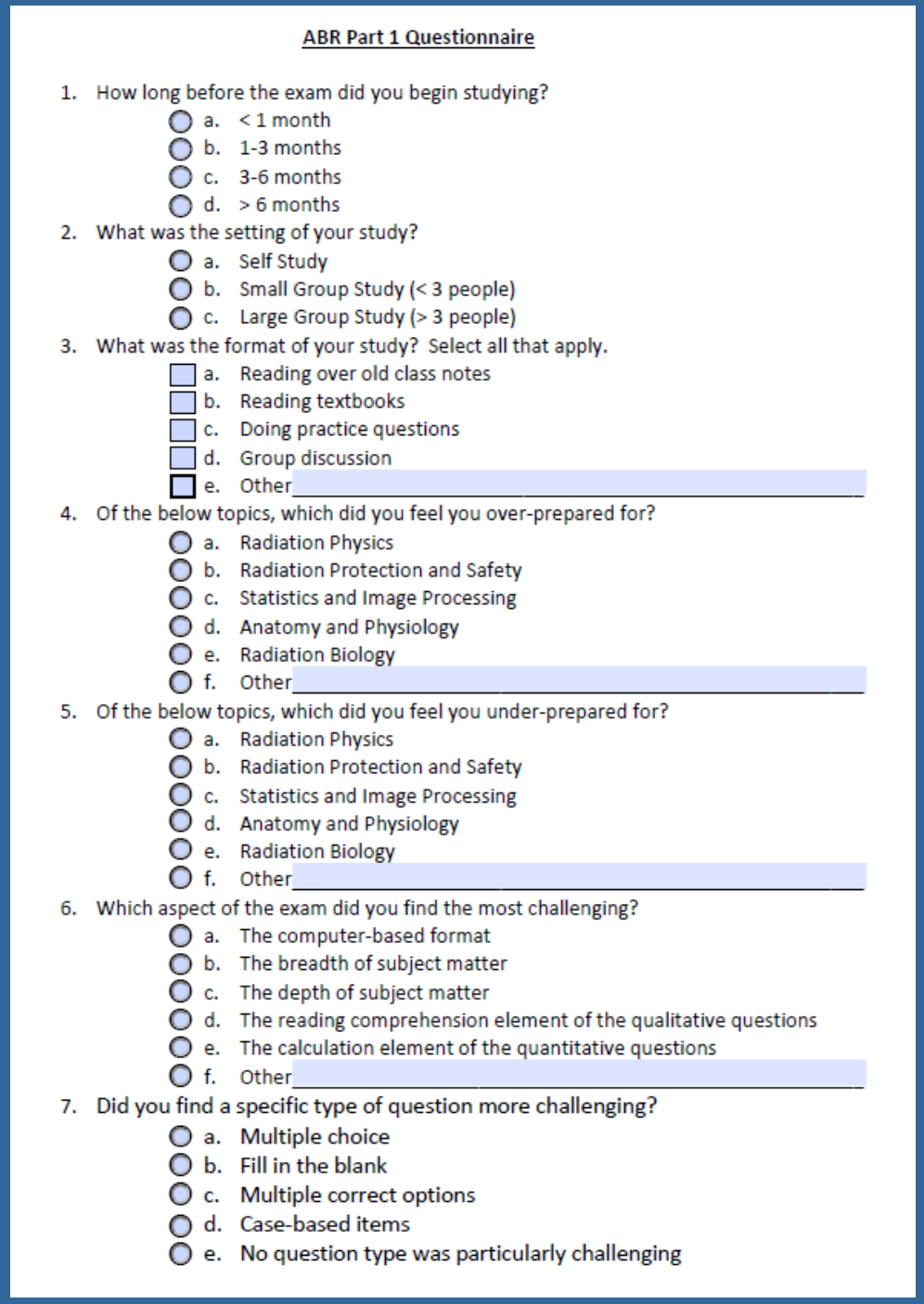
Clinical Content Guide

- **Anatomy**
- **Radiation Biology**
- **Human Physiology**
- **General Medical / Radiology /Radiation Therapy Terminology**
- **Clinical Procedure Applications**
- **Pathology**

Part 1 Questionnaire

(Because we took Part 1 over a decade ago)

- 2 institutions:
  - UT Health San Antonio
  - MD Anderson Cancer Center
- 14 responses:
  - 5 Imaging / 9 therapy
  - All Passed Part 1

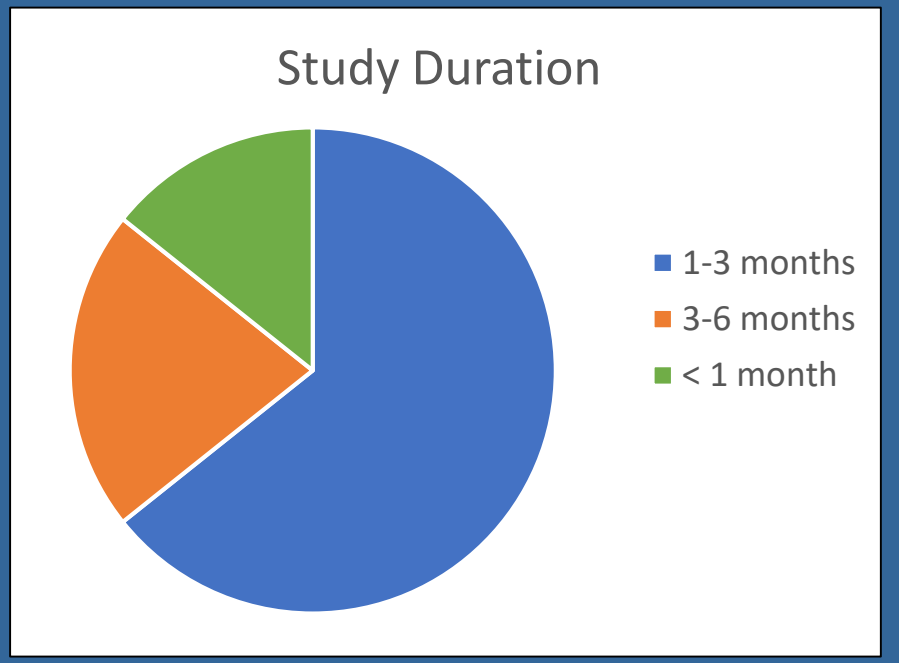


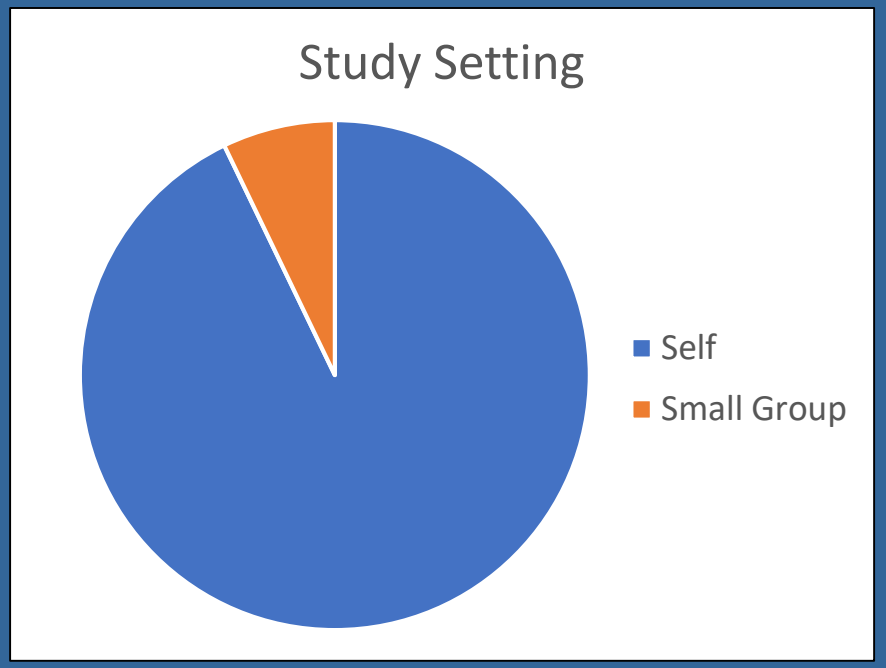
ABR Part 1 Questionnaire

1. How long before the exam did you begin studying?
   - a. < 1 month
   - b. 1-3 months
   - c. 3-6 months
   - d. > 6 months
2. What was the setting of your study?
   - a. Self Study
   - b. Small Group Study (< 3 people)
   - c. Large Group Study (> 3 people)
3. What was the format of your study? Select all that apply.
   - a. Reading over old class notes
   - b. Reading textbooks
   - c. Doing practice questions
   - d. Group discussion
   - e. Other _____
4. Of the below topics, which did you feel you over-prepared for?
   - a. Radiation Physics
   - b. Radiation Protection and Safety
   - c. Statistics and Image Processing
   - d. Anatomy and Physiology
   - e. Radiation Biology
   - f. Other _____
5. Of the below topics, which did you feel you under-prepared for?
   - a. Radiation Physics
   - b. Radiation Protection and Safety
   - c. Statistics and Image Processing
   - d. Anatomy and Physiology
   - e. Radiation Biology
   - f. Other _____
6. Which aspect of the exam did you find the most challenging?
   - a. The computer-based format
   - b. The breadth of subject matter
   - c. The depth of subject matter
   - d. The reading comprehension element of the qualitative questions
   - e. The calculation element of the quantitative questions
   - f. Other _____
7. Did you find a specific type of question more challenging?
   - a. Multiple choice
   - b. Fill in the blank
   - c. Multiple correct options
   - d. Case-based items
   - e. No question type was particularly challenging

Questionnaire Results

Subject	Most Common Response
Study Duration	1-3 Months (64%)
Study Setting	Self Study (93%)
Study Format (choose all that apply)	Practice Questions (100%), Reading Textbooks (79%) or Class Notes (79%)





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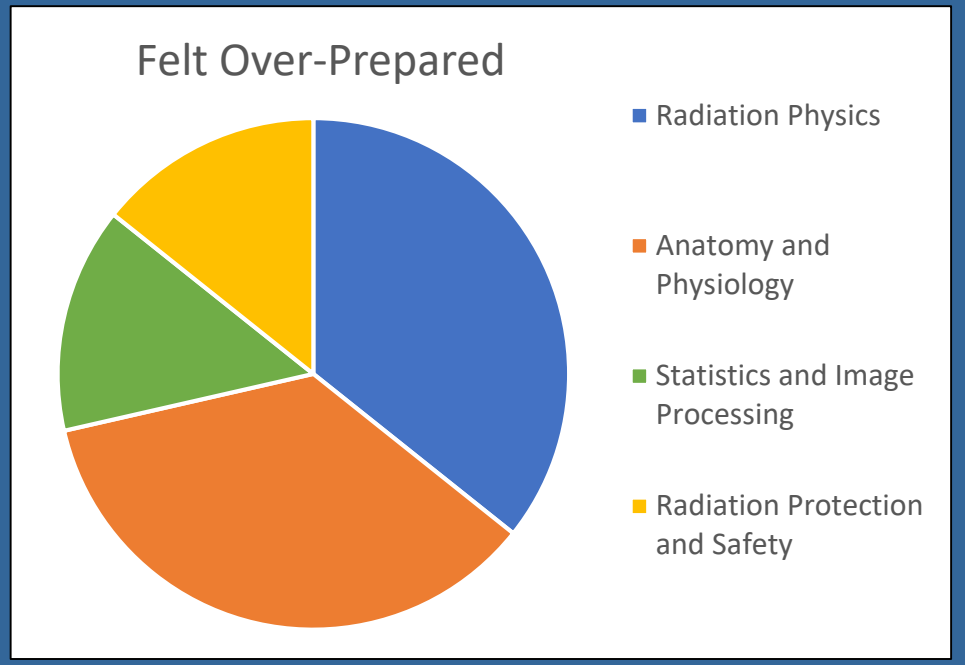
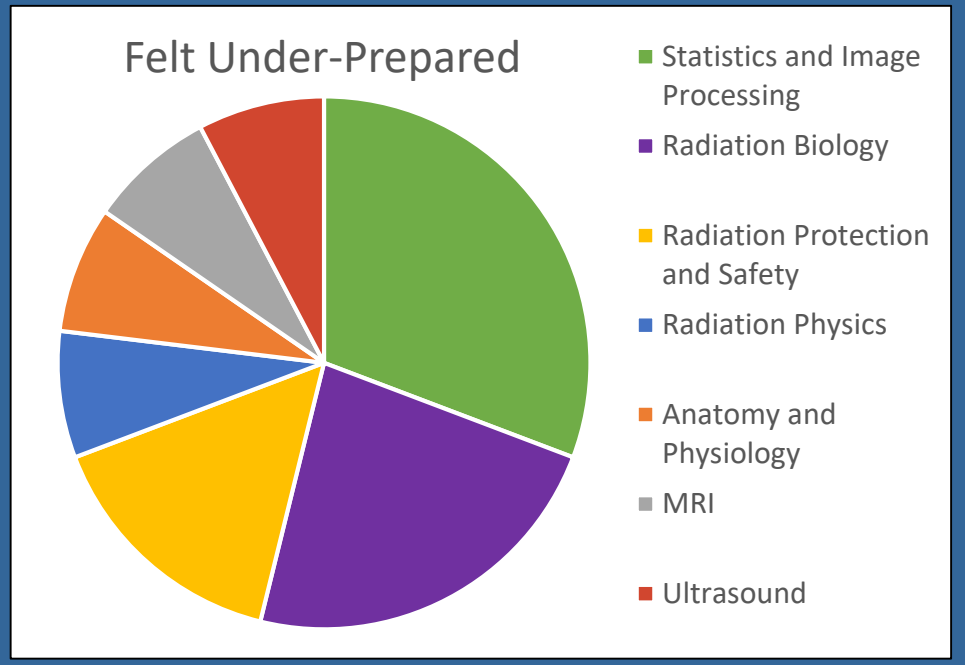
Study Format (choose all that apply)	Practice Questions (100%), Reading Textbooks (79%) or Class Notes (79%)
Perceived Area of Ease	Radiation Physics (36%), Anatomy and Physiology (36%)
Perceived Area of Difficulty	Statistics and Image Processing (30%), Radiation Biology (21%), Radiation Protection (14%)





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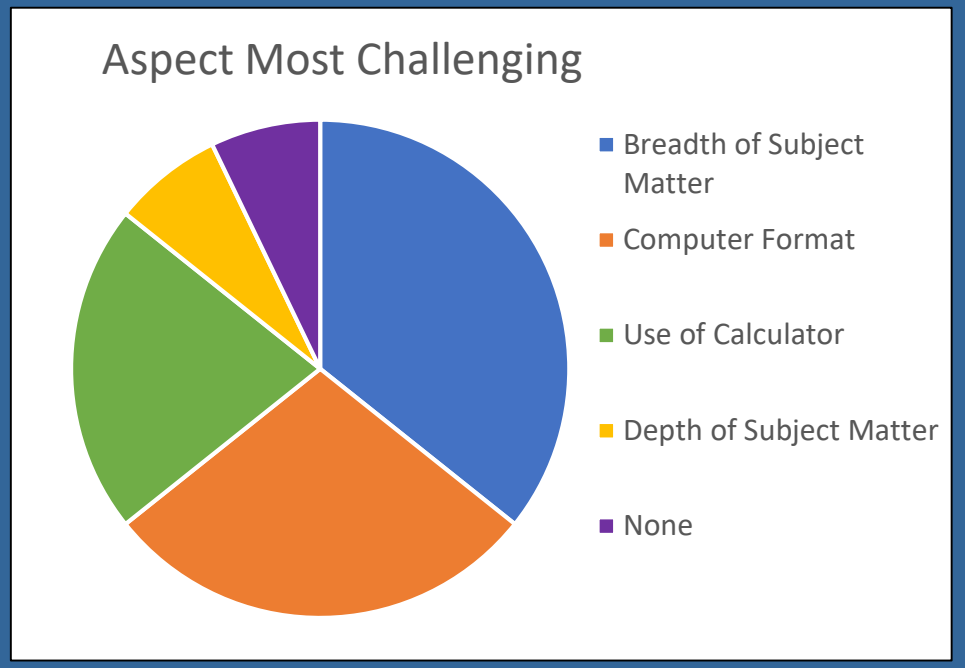
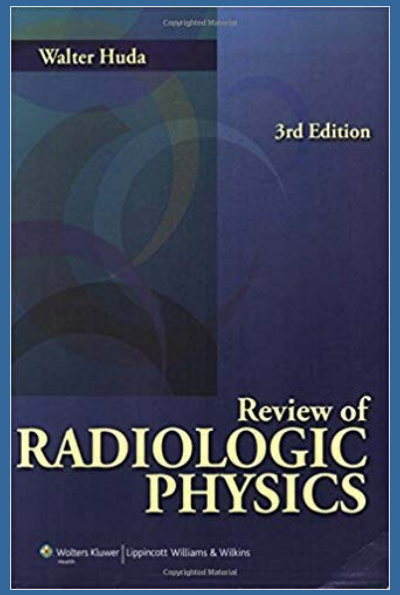
Perceived Area of Difficulty	Statistics and Image Processing (30%), Radiation Biology (21%), Radiation Protection (14%)
Aspect Most Challenging	Breadth of Subject Matter (36%), Computer Format (30%)

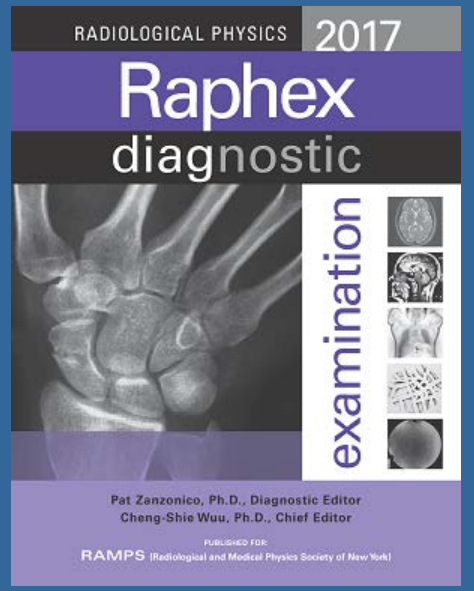


Open Ended Questions

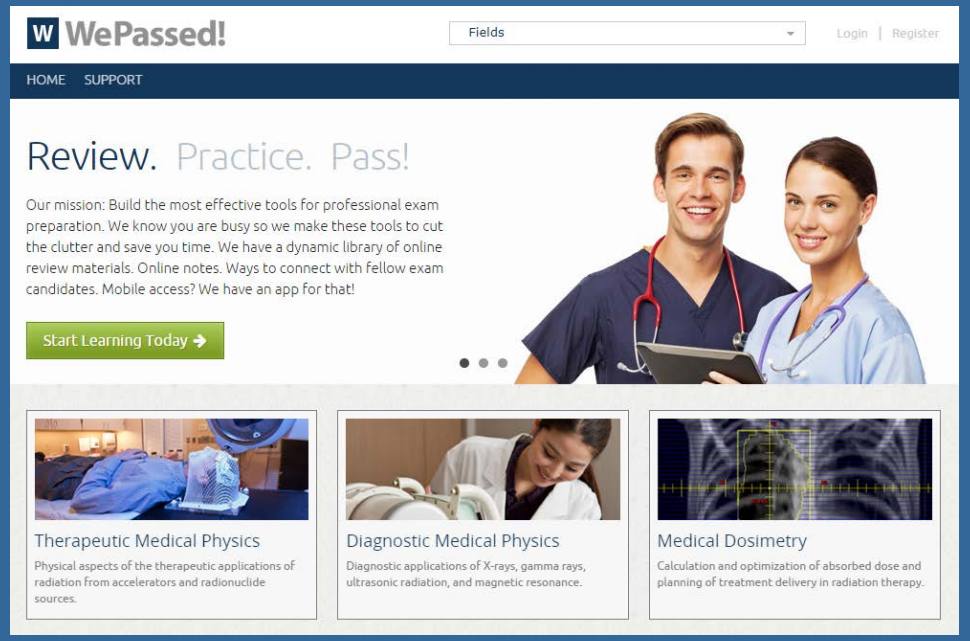
- Other general topics worth studying:
  - Disease states
  - Medical root words
  - Screen calculator use

- Other recommended resources:
  - Raphex practice questions (Medical Physics Publishing)
  - Huda, Review of Radiologic Physics
  - Quizlet (digital flashcard app)
  - WePassed





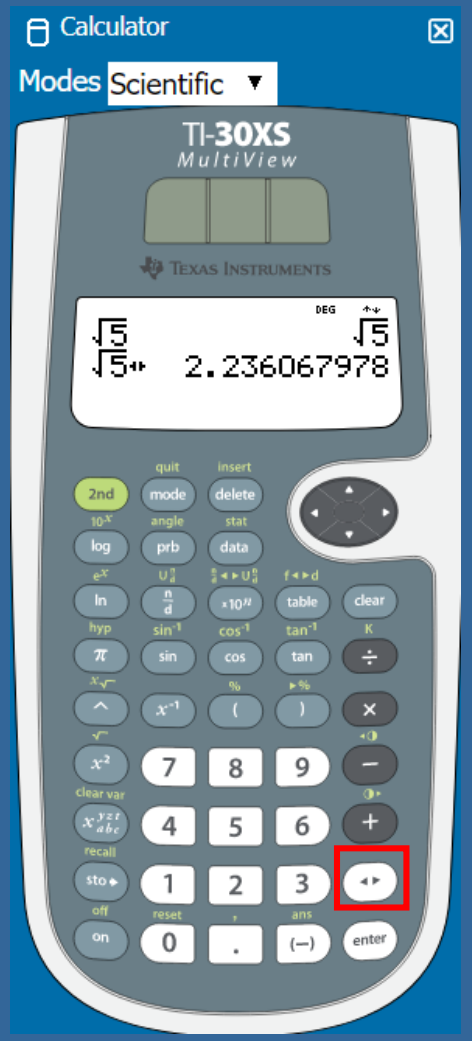
medicalphysics.org



wepassed.com

Note on Computerized Testing (Parts 1 & 2)

- Familiarize yourself with the format:
  - Interface https://wsr.pearsonvue.com/demo/
  - Review new question types https://www.theabr.org/medical-physics/initial-certification/part-1-exam/content-guide
  - Virtual Calculator https://wsr.pearsonvue.com/athena/athena.asp
- Be prepared for a long day
  - Dress comfortably and for varying temperatures
  - You will be asked to remove watches and jewelry and place in locker
  - You may take breaks as necessary but the time does not stop
  - Noise canceling over-ear headphones will be available on request
  - List of items permitted in test room is VERY limited
    - Unwrapped throat lozenges
    - Some medications (no asthma inhalers)
    - If you have questions, contact Pearson Vue https://home.pearsonvue.com/abr



ABR Exam Diagnostic Part 2

Basis	Knowledge level after completing CAMPEP residency
Eligibility	Passed Part 1. Completed CAMPEP residency by 8/31 of year in which Part 2 will be taken. If completed residency in year prior, must be currently employed.
Application Date	Accepted between December 1 and January 31st 2019
Cost	$650 (2019)
Exam Date	Early August

Content Guide

1. **Radiography, Mammography, Fluoroscopy, and Interventional Imaging**
   - X-ray imaging physics
   - Radiography
   - Mammography
   - Fluoroscopy and Interventional Radiology
   - Clinical Medical Physics Practice (radiography, mammography, fluoroscopy)
2. **Computed Tomography**
   - CT Design and Fundamentals of Operation
   - CT Clinical protocols and procedures
   - CT Image Quality
   - CT Radiation Dose and Patient Safety
   - CT Clinical Medical Physics Practice
3. **MRI and Ultrasound**
   - Magnetic Resonance Imaging and Spectroscopy Basic Physics
   - MR Imaging procedures and Safety considerations
   - Ultrasound basic physics, interactions, production and beam properties
   - Ultrasound data acquisition, image characteristics and safety
   - MRI and US Clinical Medical Physics Practice
4. **Informatics, image display, and image fundamentals**
   - Information Systems Design and Fundamentals of Operation
   - Image Display and Workstation
   - Modality Image Characteristics
   - Imaging Fundamentals
   - Professionalism and Ethics – Clinical Medical Physics Practice
5. **Radiation Biology, Dosimetry, Protection, and Safety**
   - Radiation Biology
   - Dosimetry Fundamentals
   - Radiation Protection
   - Radiation Safety
   - Room Shielding Design

Breadth and Depth of Part 2 Exam?

- Core knowledge
- Correct application and use of equations
- Identification
- Recall of standards and limits
- Depth of material similar to Bushberg detail level

- A list of constants will be provided https://www.theabr.org/medical-physics/initial-certification/constants-physical-values

Best advice for Part 2 studying I received: Study for Part 2 like you are studying for Part 3

- Rationale:
  - The ABR says the material is the same (kill two birds with one stone)
    - “Part 3 oral exam includes the same material as the Part 2 computer-based exam, but with a strong emphasis on practicing clinical medical physics, clinical judgment, and communication” – ABR.org

Best advice for Part 2 studying I received: Study for Part 2 like you are studying for Part 3

- Rationale:
  - The ABR says the material is the same (kill two birds with one stone)
    - “Part 3 oral exam includes the same material as the Part 2 computer-based exam, but with a strong emphasis on practicing clinical medical physics, clinical judgment, and communication” – ABR.org
  - Part 3 tests your understanding and ability to communicate this information, you have to learn it before you can understand and communicate it effectively
  - Studying for Part 2 and 3 as one will have fringe benefits in your clinical training
  - Early identification of potential gaps in knowledge

Part 2 Content Guide

1. **Radiography, Mammography, Fluoroscopy, and Interventional Imaging**
   - X-ray imaging physics
   - Radiography
   - Mammography
   - Fluoroscopy and Interventional Radiology
   - Clinical Medical Physics Practice (radiography, mammography, fluoroscopy)
2. **Computed Tomography**
   - CT Design and Fundamentals of Operation
   - CT Clinical protocols and procedures
   - CT Image Quality
   - CT Radiation Dose and Patient Safety
   - CT Clinical Medical Physics Practice
3. **MRI and Ultrasound**
   - Magnetic Resonance Imaging and Spectroscopy Basic Physics
   - MR Imaging procedures and Safety considerations
   - Ultrasound basic physics, interactions, production and beam properties
   - Ultrasound data acquisition, image characteristics and safety
   - MRI and US Clinical Medical Physics Practice
4. **Informatics, image display, and image fundamentals**
   - Information Systems Design and Fundamentals of Operation
   - Image Display and Workstation
   - Modality Image Characteristics
   - Imaging Fundamentals
   - Professionalism and Ethics – Clinical Medical Physics Practice
5. **Radiation Biology, Dosimetry, Protection, and Safety**
   - Radiation Biology
   - Dosimetry Fundamentals
   - Radiation Protection
   - Radiation Safety
   - Room Shielding Design

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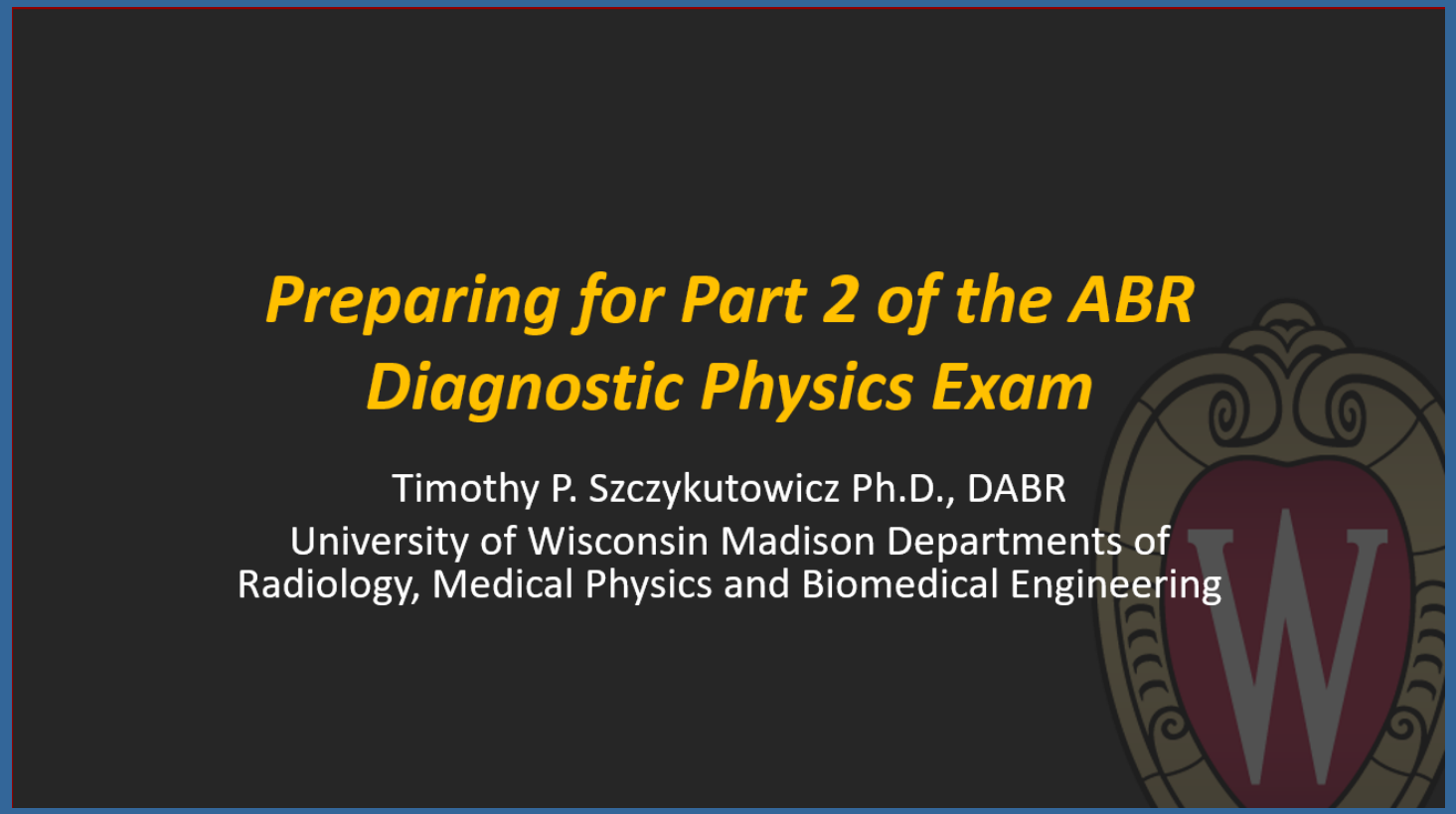
Part 3 Content Guide

DMP	Category Description
Radiography, mammography, fluoroscopy, and interventional imaging	• X-ray production, beam characteristics, interactions, and image-formation principles • Types and characteristics of image detectors • Clinical protocols for common imaging exams • Fluoroscopy and interventional procedures, including acquisition parameters and dose-reduction strategies • Image noise assessment and dose metrics for all projection imaging modalities • Common artifacts, quality assurance, quality control, mammography accreditation, and MQSA standards
Computed tomography	• CT system design and principles of operation; image-acquisition protocols, including helical acquisition and tube current modulation techniques • Cone beam geometry • Post-processing protocols, multi-planar and volumetric reconstruction • Quantitative CT • Image noise assessment, statistics, dose metrics (CTDI, DLP, SSDE), and effective dose estimation • Common CT artifacts, quality assurance, and CT accreditation program
MRI and ultrasound	• MR equipment, principles of magnetization, resonance, and excitation • MR pulse sequences, localization, acquisition, and processing • Ultrasound (US) principles, beam properties, acquisition methods, signal processing, and image display • Doppler US and color flow imaging principles and operation • Common artifacts for MRI and US, siting requirements for MRI, quality assurance, and accreditation for MRI and US
Informatics, image display, image fundamentals, professionalism and ethics	• Informatics infrastructure, standards, and patient security • PACS-modality connectivity, workflow, display, and archive functions • Image display requirements, characteristics, and calibration procedures • Image processing techniques and qualitative data extraction • Image fundamentals, sampling theory, and ROC analysis • Professionalism and ethics in clinical medical physics practice
Radiation biology, dosimetry, protection, and safety	• Radiation biology, radiation effects, and age/gender-specific risks • Radiation protection principles, guidelines, and regulations; radiation dosimetry, detectors, standards, and units • Radiation shielding design factors, barrier requirements, surveys, and reports • Patient safety and error-prevention issues, including dose reduction, sentinel events, and MR- and US-specific safety issues

OK, but WHAT do I study?

- Credit where credit is due:



Preparing for the ABR Diagnostic and Nuclear Medicine Physics Exams, AAPM 2016

Radiographic, Mammographic, Fluoroscopy and Interventional

*Essential references highlighted in yellow, Book chapters highlighted in blue

Topic	References
X-ray Production	Bushberg Ch 1-3,6, Handbbook of Medical Physics Ch 1
Beam Characteristics	Bushberg Ch 1-3,6, Handbbook of Medical Physics Ch 1
Interactions	Bushberg Ch 1-3, Handbbook of Medical Physics Ch 1
Image Formation Process	Bushberg Ch 7
Types of Detectors	Bushberg Ch 7 (CMOS, CCD, Flat panel TFT (how they read out), indirect vs direct)
Clinical Protocols for commong exams	Clinical knowledge: common CT doses, views typical in mammo, workflow for MRI brain scans, scoliosis imaging NCRP 149: Guide to Mammography and Other Breast Imaging Procedures (basic understanding of clinical mammography) Rad-IR study Journal of Vascular Interventional Radiology 2003 (high dose exams, define high dose)
Fluoroscopy and Interventional	Bushberg Ch 9 AAPM TG 125: Fluoro ABC Control Logic AAPM/RSNA Physics Tutorial for Residents: Fluoroscopy optical coupling and the video system (focus on high level understanding)
Acquisition Parameters	AAPM TG 116 Report 116: An exposure indicator for Digital Radiography
Dose Reduction	Bushberg (for each modality, look into the effect of acquisition parameters on dose)
Image noise assessment	Bushberg Ch 4, Handbook of Medical Physics (chapters on linear systems analysis)
Dose metrics	Bushberg (for each modality, describe typical dose metrics used)
Artifacts	Computed Radiography Image Artifacts Revisited AJR: 196, January 2011 Digital radiography: CR vs DR? Sometimes recognizing the distinction in technologies makes a difference, Chuck Willis, Applied Radiology Jan 2008 Digital Mammographic Artifacts on Full-Field systems: what are they and how do I fix them? Radiographics 2008
QA/QC	**AAPM Report 93: Acceptance testing and quality control of photostimulable storage phosphor imaging systems from TG 10** **CFR 21 1020.32 (fluoroscopic equipment)**
Mammo accreditation/ MQSA	**ACR FFDM Mammo QC Manual** At least 2 manufacturer's QC Manuals Review of Breast Tomosynthesis Parts 1 and 2, Sechopoulos, Medical Physics, Jan 2013.

Study guide curtesy of Tim Szczykutowicz, adapted by Jessica Nute

Computed Tomography

*Essential references highlighted in yellow, Book chapters highlighted in blue

Topic	References
System design/ operation principle	Bushberg Ch 10,11
Image acquisition protocols	CT protocols (ACR national dose registry, AAPM CT protocol guides)
AEC/TCM/auto kV	McCollough. "CT dose reduction and dose management tools: overview of available options 1" Radiographics 26.2 (2006): 503-512 Yu, L "Automatic selection of tube potential for radiation dose reduction in CT: a general strategy" Med Phys 37.1 (2010) 234-243. Boone, J "Dose reduction in pediatric CT: A rational approach 1" Radiology 228.2 (2003): 352-360.
Cone beam	IAEA Report 5: Status of Computed Tomography Dosimetry for Wide Cone Beam Scanners ACR CT Accreditation FAQ (question on collimations greater than 100 mm)
Post Processing	Bushberg Ch 5, Jiang Hsieh "Computed Tomography"
Reformats (volume render/ multiplanar)	Bushberg Ch 5, Jiang Hsieh "Computed Tomography" Ch 4
Quantitative CT	Bushberg Ch 10, Willi Kalendar "Computed Tomography" Ch 1, Figure 9
Noise	Bushberg Ch 10
Dose metrics	Bushberg Ch 11
Effective dose	**AAPM Report 204: Size-Specific Dose Estimates (SSDE) in Pediatric and Adult Body CT Examinations** **AAPM Report 220: Use of Water Equivalent Diameter for Calculated Patient Size and Size-Specific Dose Estimates (SSDE) in CT**
Artifacts	CT Image Artifacts revisited AJR:196, Jan 2011
QA/QC	AAPM TG 66: QA for CT Simulators and the CT Simulation Process ACR 2017 CT QC manual and FAQ
Accreditation	**ACR 2017 CT QC manual and FAQ**

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MRI and Ultrasound

*Essential references highlighted in yellow, Book chapters highlighted in blue

Topic	References
MR equipment and operation	Bushberg Ch 12, Clinical observation
Magnetization, resonance, excitation	Bushberg Ch 12,13 (Signal Intensity vs Time for all major pulse sequences, ex Fig 12-24)
MR localization/ acquisition / processing	Bushberg Ch 12,13
	Google --> "pulse sequence design made easier"
MR Artifacts	Bushberg Ch 13
	ACR MR Phantom guidelines
	An image based approach to understanding the physics of MR artifacts Radiographics 2011
MR Accreditation	**ACR 2015 MRI Quality Manual, Large and Small Phantom Testing Guidance, MR Accreditation Program Testing Instructions, FAQ**
MR Shielding/sitting	AAPM Report 100: Acceptance Testing and QA procedures for MRI facilities
US Principles (beam forming, processing)	Bushberg Ch 14
	Google US probes and know what the different ones look like and why you use them (convex, endocavity, linear, pulsed array, etc)
US image display	Bushberg Ch 14
	Know what you are looking at on A/B/m mode, doppler image, doppler waveform all look like)
US Doppler/ Color Flow	**Optimizing Doppler and color flow US: Application to hepatic sonography Radiographics 2004**
US Accreditation	ACR Ultrasound Accreditation Program Requirments, Ultrasound Quality Control FAQ
US Artifacts	Bushberg Ch 14
	Feldman "US artifacts 1" Radiographics 29.4 (2009): 1179-1189
	Pozniak "Spectral and color doppler artifacts." Radiographics 12.1 (1992): 35-44.

Study guide curtesy of Tim Szczykutowicz, adapted by Jessica Nute

Informatics, Image Display, and Image Informatics

*Essential references highlighted in yellow, Book chapters highlighted in blue

Topic	References
Informatics infrastructure	General guidelines for purchasing and accepting testing of PACs equipment Radiogrpahics 2004
Standards	Google --> know DICOM, HL7, know dose structured reporting (spend some time on www.dclunie.com)
Patient safety/security	Google --> know HIPPA, Know the Belmont report
PACs modality connectivity	Read a DICOM conformance statement with your IT staff and ask questions
Workflow/display/archive functions	Bushberg Ch 5
Image display requirements	ACR-AAPM-SIIM Technical standard for electronic practice of medical imaging
	AAPM TG 18 Assessment of display performance for medical imaging systems
	Technological and Phycophysical considerations for digital mammographic displays Radiographics 2005
Monitor calibration requriements	**Bushberg Ch 5 (DICOM GDSF)**
Image processing	http://www.optics.rochester.edu/workgroups/cml/opt307/spr05/chris/
ROC analysis	Bushberg Ch 5
Imaging fundamentals/ sampling theory	Bushberg Ch 4, Handbook of Medical Physics Ch 2

Study guide curtesy of Tim Szczykutowicz, adapted by Jessica Nute

Radiation, Dosimetry, Protection and Safety

*Essential references highlighted in yellow, Book chapters highlighted in blue

Topic	References
Radiation Biology	Bushberg Ch 20
Radiation Effects	Bushberg Ch 20
Age gender specific risks	Bushberg Ch 20
Radiation protection principles	Bushberg Ch 21
	Radiation management for interventions using fluoroscopic or computed tomography. Journal of inerventional radiology 2012
Guidelines and principles of radiation protection	NCRP Report 116: Limitations of Exposure to ionizing radiation
	ACR-AAPM Practice parameters for diagnostic reference levels and acievable doses in medical x-ray imaging
	Balter. "Fluoroscopically guided interventional procedures; a review of radiation effects on patients' skin and hair" Radiology 254.2 (2010): 326-341.
	NCRP 168: Radiation dose management for fluoroscopically guided interventional medical procedures 2010
Dosimetry	**Jones. "Calculating the peak skin dose resulting from fluoroscopically guided interventions. Part 1: Methods" JACMP 12.4 (2011)**
	Landauer "special dose calculations" worksheet, Look at a picture of the inside of a rad badge
	Fetal dose calculations by Mark Rzeszotarski AAPM review course
Detectors	Bushberg Ch 21
	Read tech specs on 1 vendor site for all chambers (solid state, ion chambers, etc.) for all applications (sheilding verification, CTDI, exposure , kV ,etc)
Standard/units	Covered by other materials
Shielding	**NCRP 147 Structural Shielding design for medical x-ray imaging facilities**
Patient safety / error prevention	Covered by other materials
Sentinel event	1,500 rads to a single field (defined by join commission bulletins)
MR safety	Bushberg Ch 13
	ACR Guidance Document on MR Safe Practices: 2013
	Wikipedia article on NSF
US safety	Bushberg Ch 14

Study guide curtesy of Tim Szczykutowicz, adapted by Jessica Nute

How to use this study guide

- Build a repository of information through the creation of study guides
  - Large amount of material – you will start forgetting the first references by the time you are reviewing the last references
  - Useful for review as part of your Part 3 studying
  - Useful in your career as a physicist as well as MOC

- Include equations, figures and tables
  - Equations will be very important in Part 2
  - Figures and pictures will be very important in Part 3
  - Tables are useful for quick reference and memorization

How to use this study guide

- For TG reports, consider looking for executive summaries for a high level view of the report
- For textbook chapters, make detailed outlines with pictures (most copies of Bushberg come with a digital version which makes lifting figures for your personal notes easy)
- For articles, try and write a 1 pg summary of the major takeaways of the paper

How to use this study guide

- Group Study
  - Reduces load on any one person
  - You learn through teaching your peers
  - Benefit of multiple people with complementary strengths
  - Practice for the oral format of Part 3

- Self Testing
  - Start doing practice questions once first-pass studying is done to identify gaps in knowledge
  - Suggested Resources: Group members coming up with questions in their area of expertise, Huda review questions, Quizlet and WePassed

Final Comments

- This list isn't necessarily comprehensive
  - Look at recent AAPM publications
  - Ask other board certified physicists for reading recommendations
- Start early! It's a marathon not a sprint
- Add actual clinical observation into your study plan (especially for Part 3)
- Identify and address your weak areas early on
- **Remember: The goal of this process shouldn't necessarily be to pass the exam but to become a competent and well-rounded physicist. Focus on that goal and you will excel.**

Happy Studying!

ABR Exam Diagnostic Part 3

Basis	Same material as Part 2 with emphasis on practicing clinical medical physics, clinical judgment and communication.
Eligibility	Passed Part 1 and Diagnostic Part 2.
Application Date	Invitation to participate sent out 5 months prior to exam
Cost	$765 (2019)
Exam Date	Late April to Early May

Content Guide

DMP	Category Description
Radiography, mammography, fluoroscopy, and interventional imaging	• X-ray production, beam characteristics, interactions, and image-formation principles • Types and characteristics of image detectors • Clinical protocols for common imaging exams • Fluoroscopy and interventional procedures, including acquisition parameters and dose-reduction strategies • Image noise assessment and dose metrics for all projection imaging modalities • Common artifacts, quality assurance, quality control, mammography accreditation, and MQSA standards
Computed tomography	• CT system design and principles of operation; image-acquisition protocols, including helical acquisition and tube current modulation techniques • Cone beam geometry • Post-processing protocols, multi-planar and volumetric reconstruction • Quantitative CT • Image noise assessment, statistics, dose metrics (CTDI, DLP, SSDE), and effective dose estimation • Common CT artifacts, quality assurance, and CT accreditation program
MRI and ultrasound	• MR equipment, principles of magnetization, resonance, and excitation • MR pulse sequences, localization, acquisition, and processing • Ultrasound (US) principles, beam properties, acquisition methods, signal processing, and image display • Doppler US and color flow imaging principles and operation • Common artifacts for MRI and US, siting requirements for MRI, quality assurance, and accreditation for MRI and US
Informatics, image display, image fundamentals, professionalism and ethics	• Informatics infrastructure, standards, and patient security • PACS-modality connectivity, workflow, display, and archive functions • Image display requirements, characteristics, and calibration procedures • Image processing techniques and qualitative data extraction • Image fundamentals, sampling theory, and ROC analysis • Professionalism and ethics in clinical medical physics practice
Radiation biology, dosimetry, protection, and safety	• Radiation biology, radiation effects, and age/gender-specific risks • Radiation protection principles, guidelines, and regulations; radiation dosimetry, detectors, standards, and units • Radiation shielding design factors, barrier requirements, surveys, and reports • Patient safety and error-prevention issues, including dose reduction, sentinel events, and MR- and US-specific safety issues