

## Implementation of the 2016 ACR Digital Mammography Quality Control Manual: Technologist's Section

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BOULDER COMMUNITY HEALTH

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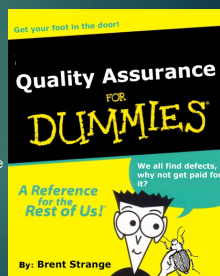
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### QC Test Drivers

- ▶ Based on a variety of sources
  - ▶ MQSA
  - ▶ SFM
  - ▶ ACRIN DMIST
  - ▶ Manufacturer's QC programs
  - ▶ MITA
  - ▶ Subcommittee clinical experience
- ▶ Apply to all manufacturers
- ▶ Be clinically relevant
- ▶ Be user friendly




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### Phantom Design Goals

- ▶ More challenging targets
- ▶ More sensitive to changes
- ▶ Fewer digital processing artifacts
- ▶ Full field
- ▶ Same attenuation as current phantom
- ▶ Same Pass/Fail targets as current phantom

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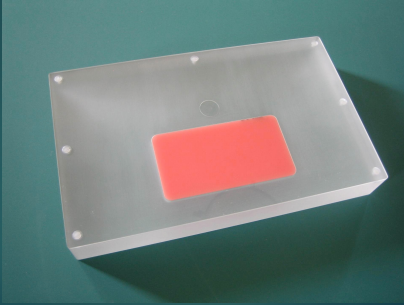
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## New Phantom



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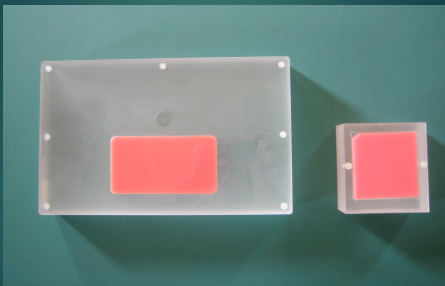
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## Cousins



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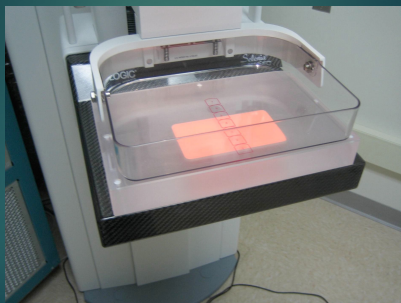
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## New Phantom in Clinical Environment



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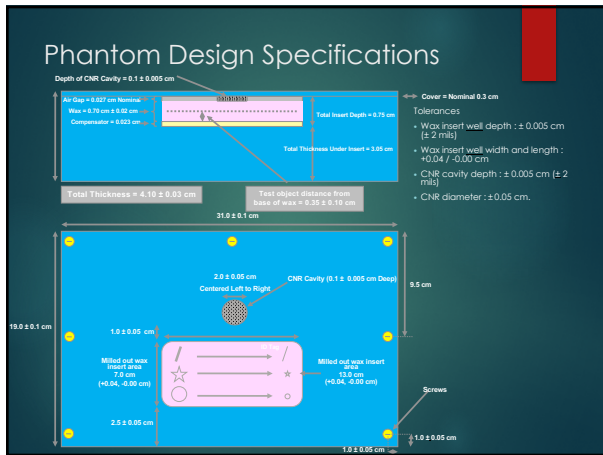
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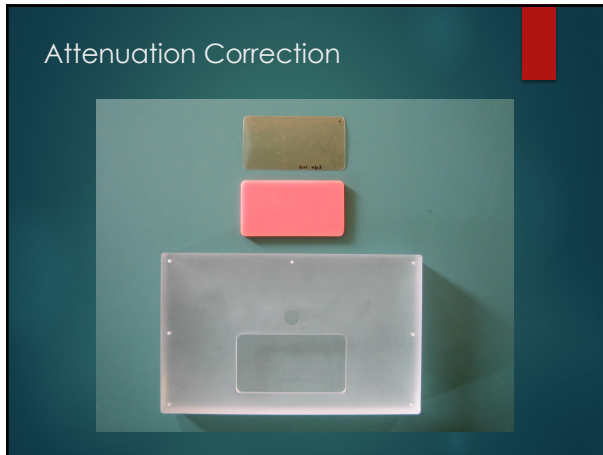
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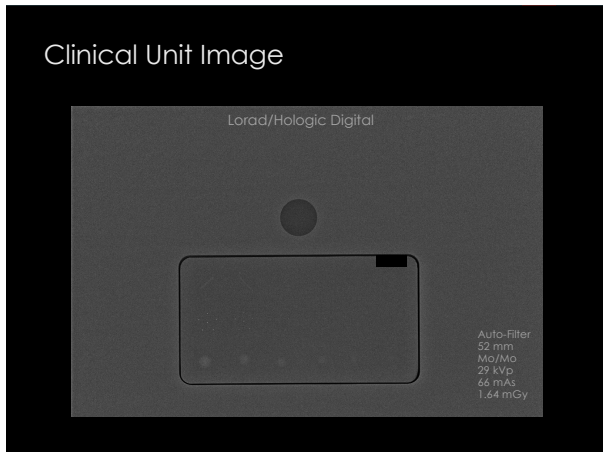
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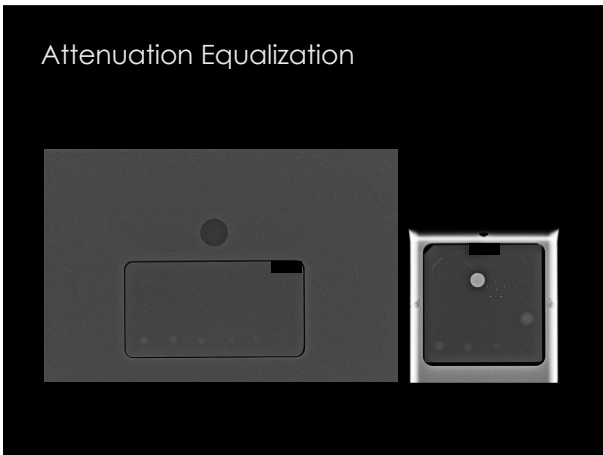
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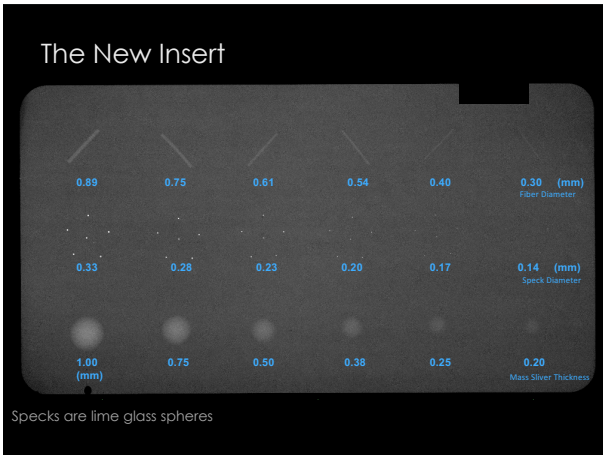
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### Visual Test Object Comparison

Fibers (mm)		Specks (mm)		Masses (mm)	
ACR 156	FFDM	ACR 156	FFDM	ACR 156	FFDM
1.56					
1.12		0.54		2.00	
0.89	0.89	0.40		1.00	1.00
0.75	0.75	0.32	0.33	0.75	0.75
	0.61		0.28	0.50	0.50
0.54	0.54	0.24	0.23		0.38
0.40	0.40		0.20	0.25	0.25
	0.30	0.16	0.17		0.20
			0.14		

Fail Passed

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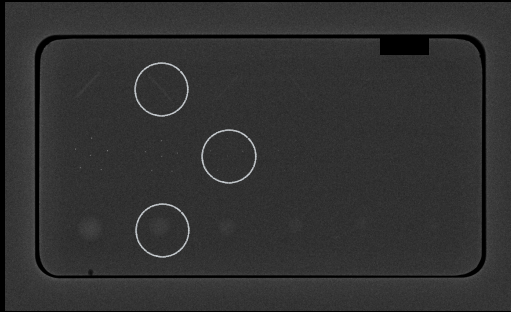
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### Phantom Scoring



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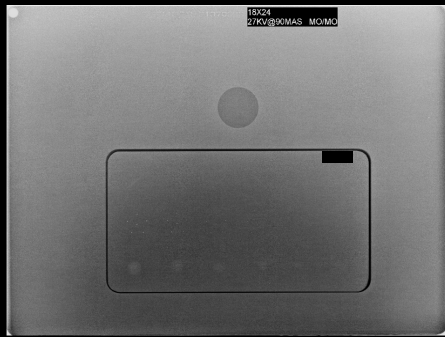
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### CR Imaging



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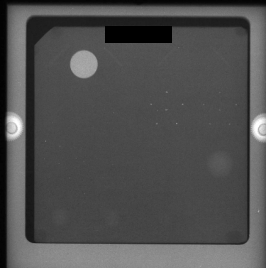
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### Screen-Film Imaging



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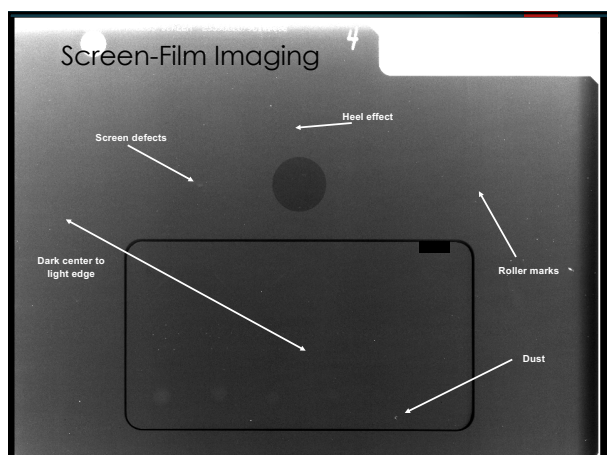
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## AEC Technique Comparison

	Lorad – Mo		Lorad - W		Fuji CR 18 x 24 cm	
Mode	Auto-Filter		Auto-Filter		AA	
Phantom	FFDM	156	FFDM	156	FFDM	156
Compression Thickness (cm)	5.2	5.2	5.2	5.2	4.0	4.0
Target/Filter	Mo/Mo	Mo/Mo	W/Rh	W/Rh	Mo/Mo	Mo/Mo
kVp	29	29	28	28	27	27
mAs	66.4	65.4	92.5	97.6	90	89
Machine Reported Dose (mGy)	1.64	1.61	1.03	1.08	**	**

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## Manual Technique Signal Comparison

	Lorad/Hologic – Mo/Mo	
Mode	Manual	
Phantom	FFDM	SFM
Target/Filter	Mo/Mo	Mo/Mo
kVp	29	29
mAs	65	65
Signal in Wax	542.0	546.5
St. Dev. In Wax	9.7	9.7

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## Versatility!

50% of the required RT and MP tests incorporate the new phantom




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## What Is New? Technologist Section

- ▶ Monitor QC for the interpretation workstations
- ▶ Management forms
  - ▶ ACR Technique and Procedure Summaries
  - ▶ Corrective Action Log
  - ▶ Facility Offsite Display Locations
  - ▶ QC Summary Checklists
    - ▶ Digital Mammography Unit QC Summary Checklist
    - ▶ Facility Display Device QC Summary Checklist
- ▶ Facility Equipment Inventory
- ▶ Improved QC Forms
- ▶ Instructions for Mobile Units
- ▶ Reduced calculations

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## RT Tests

Test	Minimum Frequency	Corrective Action Timeframe
<b>Technologist Tests</b>		
1. ACR DM Phantom Image Quality	Weekly	Before clinical use
2. Computed Radiography (CR) Cassette Erasure (if applicable)	Weekly	Before clinical use
3. Compression Thickness Indicator	Monthly	Within 30 days
4. Visual Checklist	Monthly	Critical items: before clinical use; less critical items: within 30 days
5. Acquisition Workstation (AW) Monitor QC	Monthly	Within 30 days; before clinical use for severe defects
6. Radiologist Workstation (RW) Monitor QC	Monthly	Within 30 days; before clinical use for severe defects
7. Film Printer QC (if applicable)	Monthly	Before clinical use
8. Viewbox Cleanliness (if applicable)	Monthly	Before clinical use
9. Facility QC Review	Quarterly	Not applicable
10. Compression Force	Semiannual	Before clinical use
11. Manufacturer Detector Calibration (if applicable)	Mfr. Recommendation	Before clinical use
Optional - Repeat Analysis	As Needed	Within 30 days after analysis
Optional - System QC for Radiologist	As Needed	Within 30 days; before clinical use for severe artifacts
Optional - Radiologist Image Quality Feedback	As Needed	Not applicable

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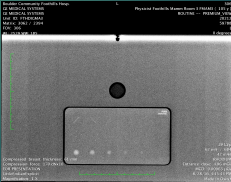
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## 1. Phantom Image Quality

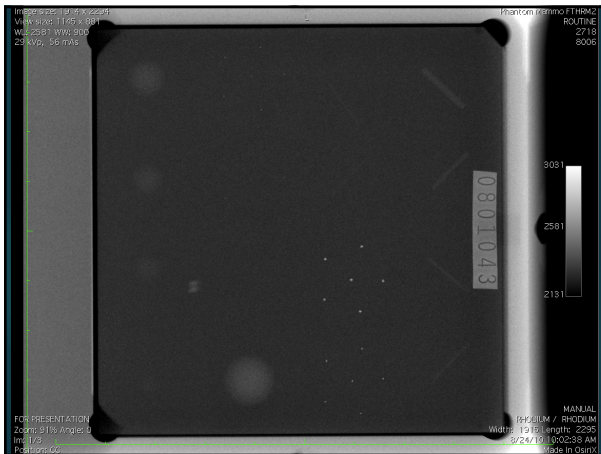
- ▶ For CR, erase plate first
- ▶ Create patient
  - use whatever ID system you want
- ▶ Align phantom
  - insert on top toward chest wall
- ▶ Compress to 5 daN (12 lb)
- ▶ Use CLINICAL technique
  - AEC cell under insert, if applicable
  - 4.2 cm compressed, 50%/50% breast
- ▶ Acquire image
- ▶ Record resulting technical factors
- ▶ Evaluate image
  - Count test objects
  - Artifacts
  - Use full resolution (1/1 pixel ratio)
  - Note no artifact deduction
  - Can fail image just for objectionable artifacts
  - **Must see 2 fibers, 3 speck groups, 2 masses**
  - **Artifacts must not interfere with interpretation**
- ▶ Corrective actions required prior to clinical use



## Phantom Scoring

Test Object	Full Point	Half Point
Fibers (6)	<ul style="list-style-type: none"> <li>• Full length visible (<math>\geq 8</math> mm long)</li> <li>• Correct location</li> <li>• Correct orientation</li> <li>• 1 break allowed (must be <math>\leq</math> width of fiber)</li> </ul>	<ul style="list-style-type: none"> <li>• At least half of length visible (<math>\geq 5</math> and <math>&lt; 8</math> mm long)</li> <li>• Correct location</li> <li>• Correct orientation</li> <li>• 1 break allowed (must be <math>\leq</math> width of fiber)</li> </ul>
Speck Groups (6)	<ul style="list-style-type: none"> <li>• 4 - 6 specks visible</li> <li>• Correct locations</li> </ul>	<ul style="list-style-type: none"> <li>• 2 - 3 specks visible</li> <li>• Correct locations</li> </ul>
Masses (6)	<ul style="list-style-type: none"> <li>• Density difference visible</li> <li>• Border is continuous and generally circular (<math>\geq 3/4</math> border visible)</li> <li>• Correct location</li> </ul>	<ul style="list-style-type: none"> <li>• Density difference visible</li> <li>• Border is not continuous or generally circular (<math>\geq 1/2</math> and <math>&lt; 3/4</math> border visible)</li> <li>• Correct location</li> </ul>

Artifacts are handled as Pass/Fail



## 2. CR Cassette Erasure (if applicable)

- ▶ Perform erasure procedure for all cassettes
- ▶ Document completion of the task



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## 3. Compression Thickness Indicator

- ▶ Use any easily available object that's about 4-6 cm thick
  - Two tape rolls work well
  - Note actual dimension
- ▶ Use smallest, non-flex paddle available
- ▶ Compress to about 5 daN (12 lb)
  - Record value and be consistent
- ▶ Record indicated thickness
- ▶ **Must be accurate to  $\pm 5$  mm**
- ▶ Corrective actions within 30 days



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## 4. Visual Checklist

- ▶ Pretty much the same as it always is
- ▶ Make sure all bells and whistles are acting properly
- ▶ Be sure to rotate the C-arm the way you would for patient imaging
- ▶ When checking for cracks in paddles, face shields, and breast supports, only indicate issues that impact patient safety and image quality
- ▶ It may be necessary to add additional items to the checklist that are specific to your particular equipment or procedures
- ▶ Corrections required:
  - ▶ Prior to clinical use for critical tests
  - ▶ Within 30 days for non-critical tests



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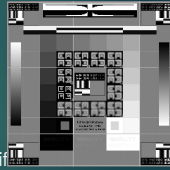
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## 5. Acquisition Workstation Monitor QC

- ▶ Need TG18-QC test pattern or equivalent
  - If this is not possible, this part of the test cannot be performed
- ▶ Inspect monitor for fingerprints, etc.
  - Clean as needed
- ▶ View test pattern
  - 5%, 95% boxes visible
  - Line-pairs distinguishable center and corners
- ▶ Corrective actions prior to clinical use
- ▶ Perform manufacturer automated QC if prescribed
  - Corrective actions within 30 days



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## 6. Radiologist Workstation Monitor QC

- ▶ Need TG18-QC test pattern or equivalent
  - If this is not possible, this part of the test cannot be performed
- ▶ Inspect monitor for fingerprints, etc.
  - Clean as needed
- ▶ View ACR DM Phantom image
  - Score and inspect for artifacts as in Test 1
- ▶ View test pattern
  - 5%, 95% boxes visible
  - Line-pairs distinguishable center and corners
- ▶ Corrective actions prior to clinical use
- ▶ Perform manufacturer automated QC if prescribed
  - Corrective actions within 30 days



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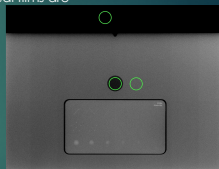
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## 7. Film Printer QC (if applicable)

- ▶ Required if images are printed for referring physicians and patients
- ▶ If printer used less than monthly, do before clinical films are printed
- ▶ Print ACR DM Phantom image
  - Do not adjust WW/WL
  - Print true size
  - Film size use for majority of clinical printing
- ▶ Score and inspect for artifacts as in Test 1
- ▶ Measure OD inside and outside of the cavity
- ▶ Calculate contrast =  $OD_{cavity} - OD_{background}$
- ▶ Measure  $D_{max}$
- ▶ Same phantom score requirements
  - Background OD must be  $\geq 1.6$ , should be 1.7-2.2 (2.0 optimal)
  - $D_{max}$  must be  $\geq 3.1$ , should be  $\geq 3.5$
- ▶ Corrective actions prior to clinical use



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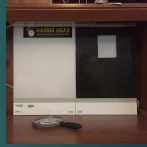
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## 8. Viewbox Cleanliness (if applicable)

- ▶ Required if prior or outside images are viewed on viewboxes
- ▶ Viewboxes must be clean and free of marks
- ▶ If viewboxes appear non-uniform, all lamps must be replaced
- ▶ Masks must be functioning
- ▶ Corrective actions prior to clinical use



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## 9. Facility QC Review

- ▶ Review of RT and MP QC efforts
- ▶ Must be done by
  - Lead interpreting physician
  - Facility manager
  - In person or by remote means
- ▶ Record MP test results on form
- ▶ Enter prior week of RT QC data
- ▶ Review most recent quarter of data with LIP and manager
- ▶ Review each QC test and results
- ▶ Note corrective action documentation present as needed
- ▶ Discuss reasons for failures
- ▶ Review MP results
- ▶ Document the review



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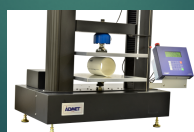
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## 10. Compression Force

- ▶ Few changes from the 1999 ACR Mammography QC Manual
- ▶ **Must check that adequate force ( $\geq 25$  lb) for length of average exposure**
- ▶ Corrective actions prior to clinical use



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## 11. Manufacturer Detector Calibration (if applicable)

- ▶ Required if a manufacturer specifies that a **calibration** must be performed
- ▶ Must follow manufacturer's procedure
- ▶ Must follow manufacturer's schedule
- ▶ Corrective actions prior to clinical use

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## Optional Tests

- ▶ Repeat analysis
- ▶ System QC for Radiologist
- ▶ Radiologist Image Quality Feedback

As  
Needed

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## Up Next:

- ▶ Eric Berns, PhD
  - ▶ Medical Physicist Section




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