Cleveland Clinic

Implementation of a Large-Scale DR QC Program

March 10, 2015

Katie Hulme, MS, CRE, DABR

CCF System

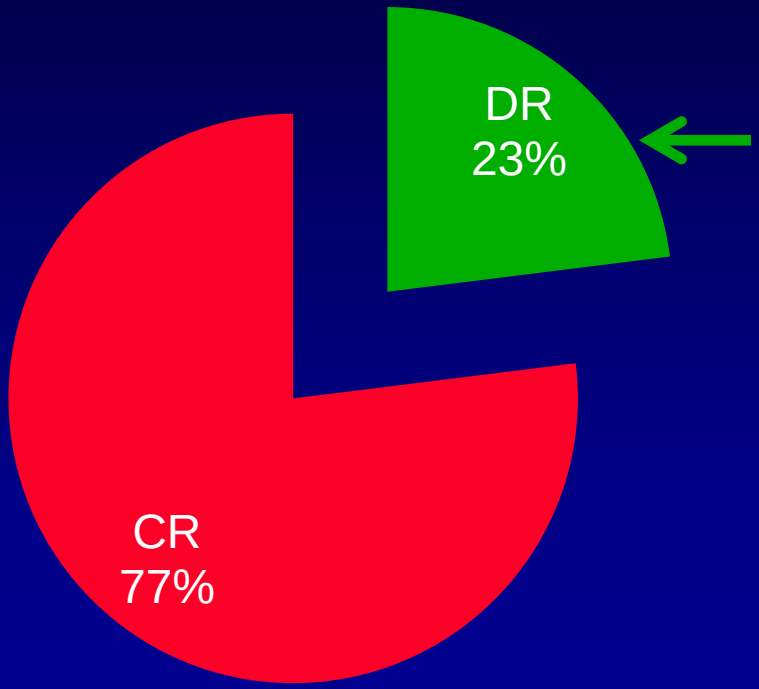
1 main campus

9 affiliate hospitals

49 outpatient health centers

Breakdown of Equipment

142 Radiographic Rooms

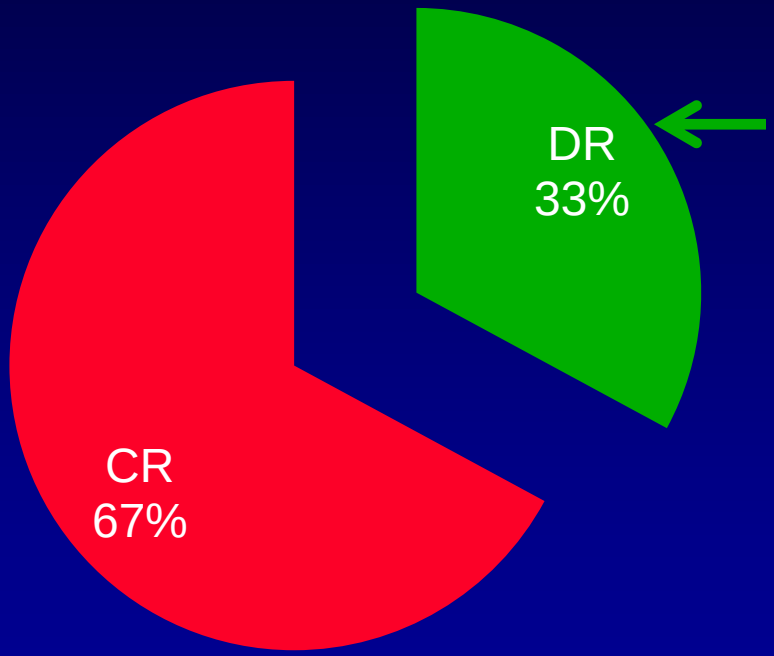


35 digital

- Shimadzu RadSpeed (w/ Canon CXDI NE)
- Shimadzu RadSpeed (w/ Konica Aero DR)
- Philips Digital Diagnost
- GE Discovery XR656
- GE Proteus (with wireless upgrade)
- Siemens Axiom Aristos
- Siemens Multix M

Breakdown of Equipment

76 Mobile Units

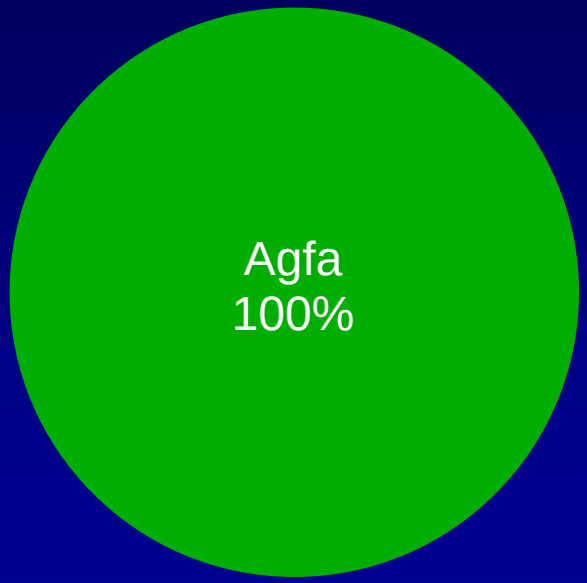


25 digital

- Agfa DX-D 100
- Shimadzu Evolution (with Konica Aero DR)
- Shimadzu MobileDart (with Canon CXDI NE)
- DRX-1 Retrofit (Carestream)

Breakdown of Equipment

96 CR Readers



All Agfa Readers

- ADC Compact Plus
- CR-25
- CR-75
- DX-S
- DX-G
- DX-M

Generator
Tube
CR Plates (Cleaning and Erasure)
Patient Entrance Skin Exposure

Digital Detectors
CR Readers

Digital Quality Control

Performance Testing
(*Physicist*)

TG-150

Ongoing QC
(*Technologist*)

TG-151

Performance Testing
Back in 2010…

1. Evaluation of Technologist QC Program
2. **Visual Inspection of Room and Equipment**
3. Acquisition Workstation Monitor Check
4. **HVL, kVp Accuracy, and Output Measurements**
5. **Exposure Reproducibility and Linearity**
6. **Timer Accuracy**
7. **Manual Tabletop Collimation**
8. **X-Ray to Light Field Congruence**
9. **Positive Beam Limitation**
10. Exposure Index Verification
11. **Automatic Exposure Control**
12. Detector Evaluation
13. **Patient Incident Air Kerma**
14. Kerma Area Product Accuracy

Technologist QC
Back in 2010…

1. IP Inspection
2. **IP Erasure**
3. **IP Cleaning**
4. DR Detector Calibrations / Automated Self-Tests
5. Reject Analysis

Talk Overview

- CCF Experiences with:
  - CR Plates and Readers
  - Dose tracking
    - Patient Incident Air Kerma
    - Exposure Index Verification
    - AEC Calibration and Verification
    - Ongoing Exposure Analysis
  - Things to ask your FSE at acceptance!!

CR Plates and Readers
CCF Experience

Overview: CR QC

QC for Imaging Plates (IP's)

+

QC for CR Readers

Overview: CR QC

- **Tests and Tolerance:**
  - **Use Vendor Specs**
- **In the absence of recommendations:**
  - **Use TG-10!**

IP Performance Testing

- Exposure Index
  - Detector sensitivity can vary with phosphor batch
- Artifacts
- Detector uniformity
  - Qualitative vs. Quantitative

IP Performance Testing

TECHNOLOGIST during routine plate cleaning

- Physical inspection for defects

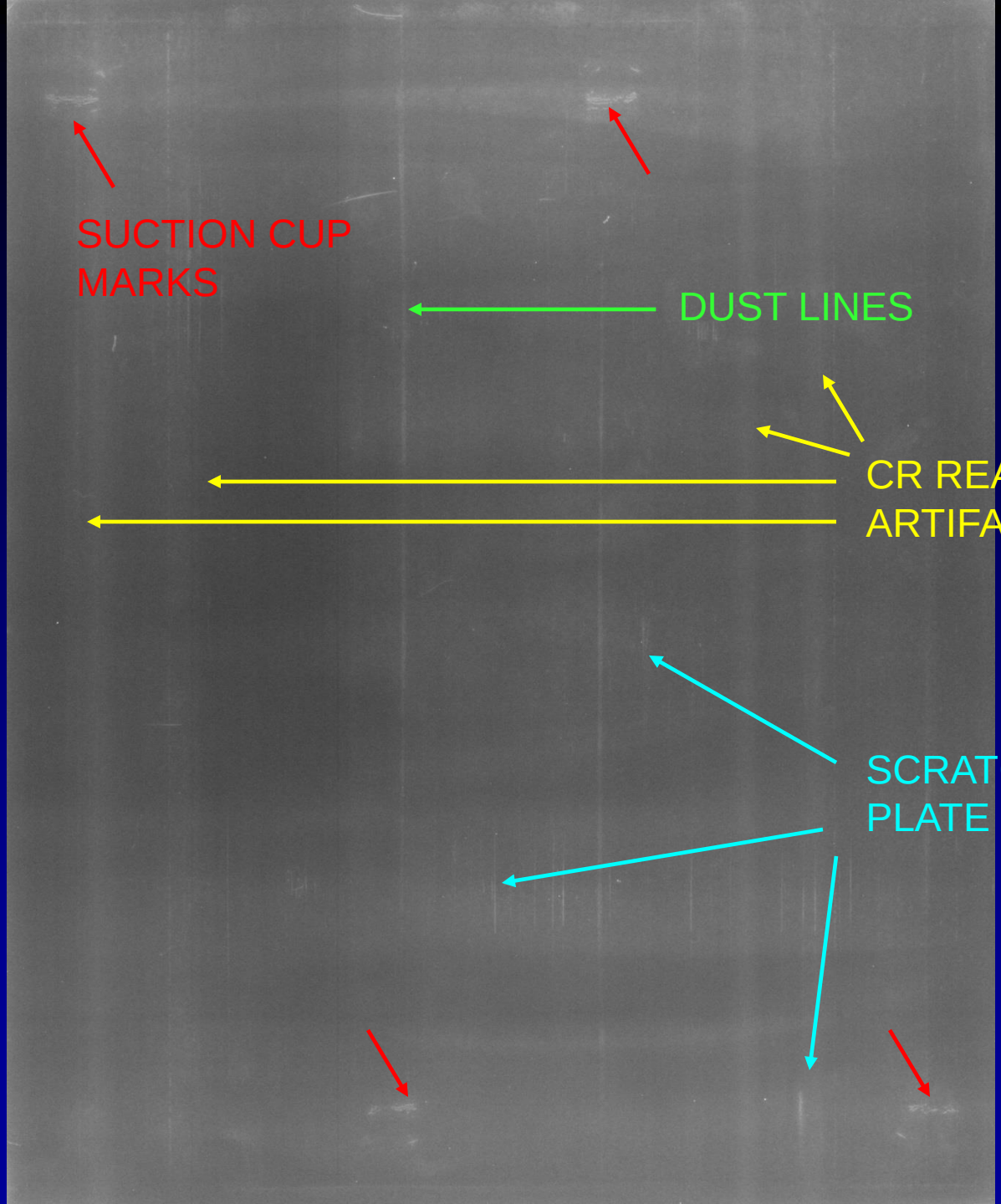
INSPECTION =

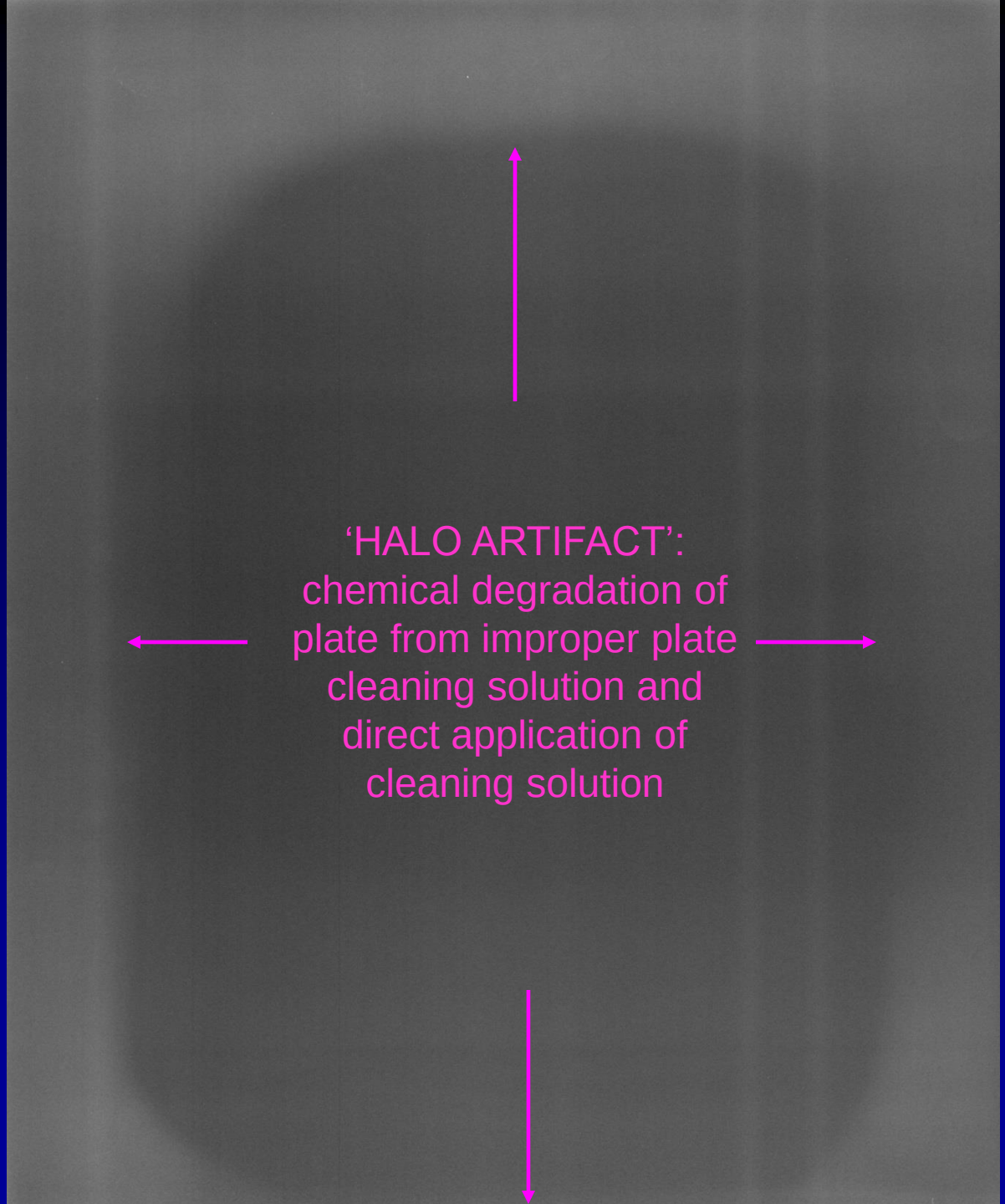
Inventory of all IP's

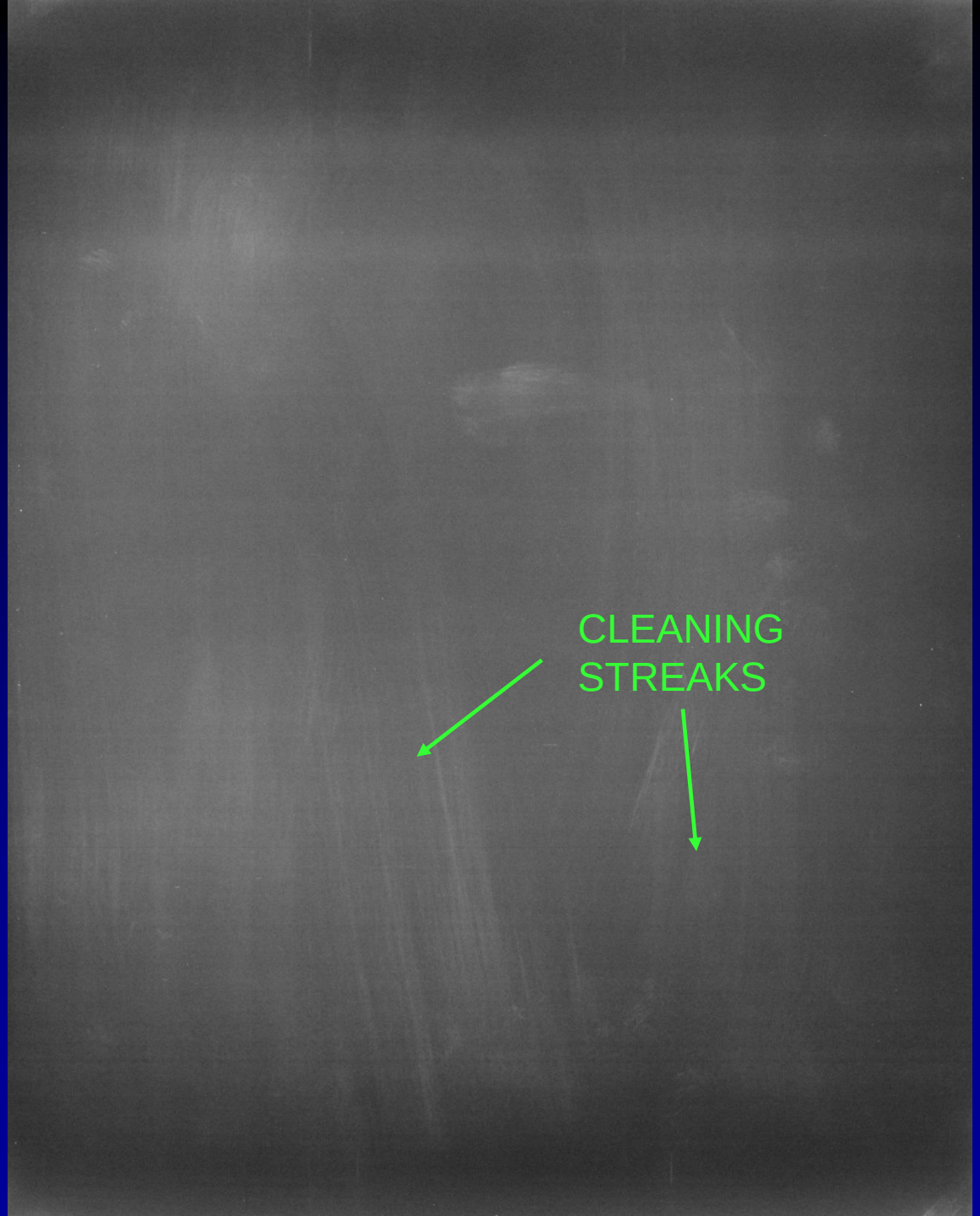
+

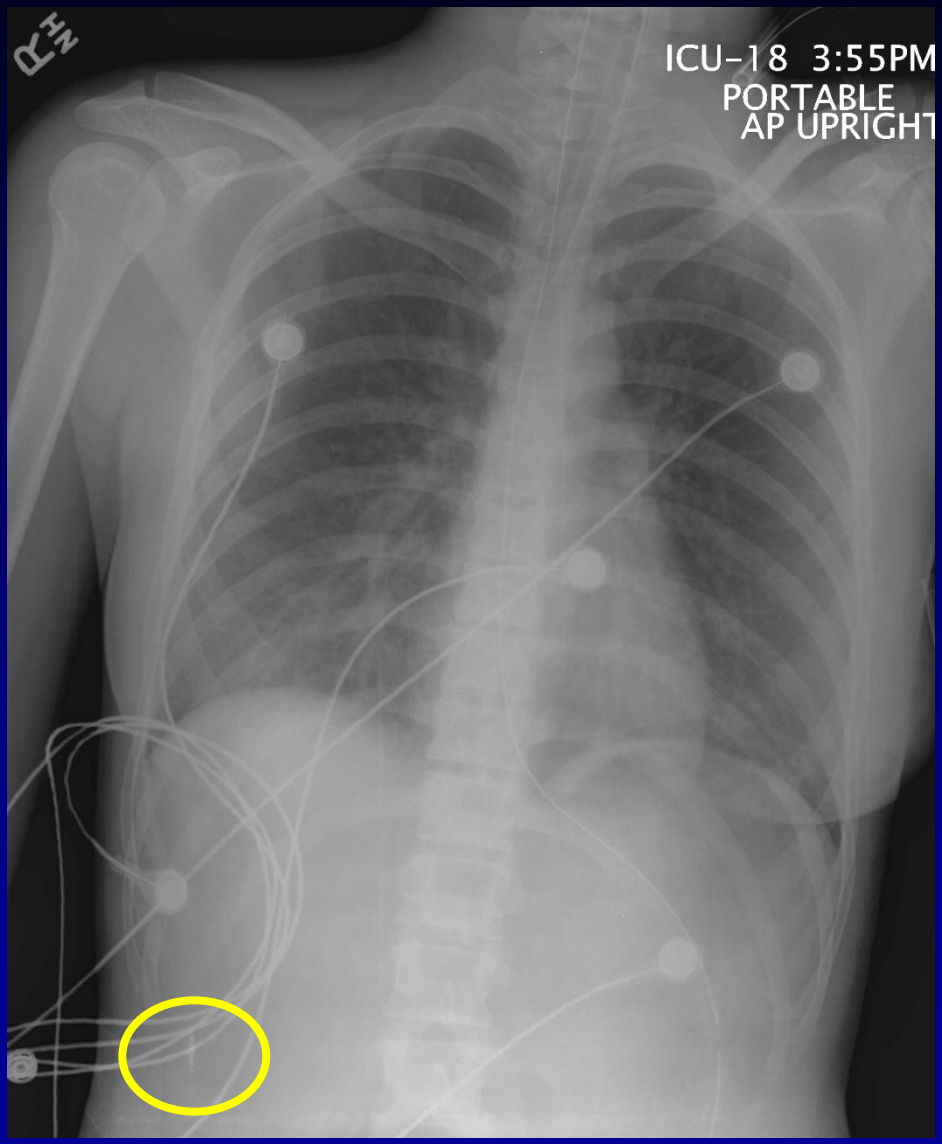
- Uniform exposure of each IP
- Evaluate flat-field image for artifacts
- Remove damaged plates from service

PHYSICIST during annual performance evaluation


SUCTION CUP MARKS
DUST LINES
CR READER ARTIFACTS
SCRATCHES ON PLATE


‘HALO ARTIFACT’:
chemical degradation of
plate from improper plate
cleaning solution and
direct application of
cleaning solution


CLEANING
STREAKS


ICU-18 3:55PM
PORTABLE
AP UPRIGHT


Acquired on Agfa CR system

Cleaning Mistakes:

- Using incorrect cleaning solution
- Not wearing gloves
  - Lotion w/ UV protection will block signal!!
- Applying uneven pressure across plate
  - i.e. rough back and forth motion instead of smooth circular motion
- Not allowing screens sufficient time to dry before putting them back into cassettes

Exposure Index Verification and Uniformity

Exam Tag	Delay	Filtration	SID	kVp	mAs	µGy (IP)*
FFPI	0 min	21 mm Al	150.0	75.0	10	20.3

* Value for double exposure w/ reported technique

						Artifacts (mark 1 if present, 2 if significant, 3 if unacceptable)								
Plate Label	Plate ID	Size	IS/ OOS	EI	P/F	Halo	Cleaning Streaks	Suction Cup Marks	Smudge / Watermarks	Scratches or Cracks	Other	Comments	Total Score	*
	QC1	14" x 17"	IS	2150	P							QC plate	0	E
	1	14" x 17"	IS	2091	P	2						FLFS	2	OK
	3	14" x 17"	IS	2255	P			1				FLFS	1	G
	5	14" x 17"	IS	2148	P							FLFS	0	E
	7	14" x 17"	IS	2046	P								0	E
	8	14" x 17"	IS	2177	P								0	E
	24	14" x 17"	IS	2076	P			2		1			3	RFS
	26	14" x 17"	IS	2336	P				1				1	G

* E = Excellent condition (score of 0), G = Good (1), OK = Adequate (2), RFS = Remove from service (score ≥3)

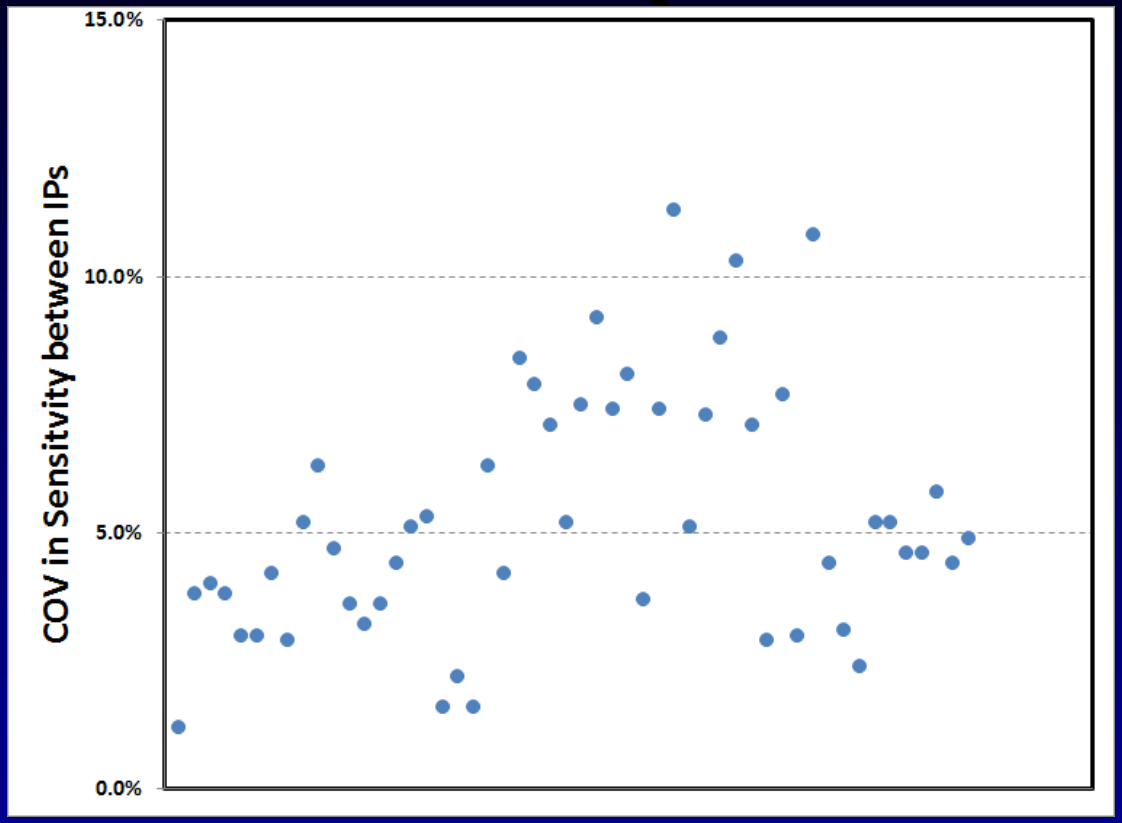
Expected EI:	2028			
Plate Average:	2103			**Tolerance Criteria:**
Tolerance Criteria (Single Plate) EI:	Min: 1682.7		Max: 2524	±20% of plate average
SD in Sensitivity:	109.0	**COV:**	5.2%	COV<±10% across all plates

Characteristics	Quantity of Interest	Acceptable Tolerance
Dark noise	Average signal and its standard deviation within 80% of the image area	$E < 0.012$ mR $\sigma_E / E < 1\%$
Uniformity	Signal standard deviation within 80% of the image area, and the standard deviation of the average screen signal among screens	$\sigma_E < 5\%$
Exposure calibration	The exposure indicator response expressed in terms of exposure to 1 mR entrance exposure	$E_{measured} = 1 \pm 10\%$
Linearity and autoranging	The slope of the system response (expressed in terms of logarithm of exposure) vs. logarithm of actual exposure	Slope $= 1 \pm 10\%$ Correlation coefficient > 0.95
Laser beam function	Jitter dimension in pixels	Occasional jitters $< \pm 1$ pixel
Limiting resolution	Maximum discernible spatial frequencies of a high-contrast line-pair along scan, sub-scan, and 45° axes	$R_{scan} / f_{Nyquist} > 0.9$ $R_{sub\text{-}scan} / f_{Nyquist} > 0.9$ $R45° / (1.41\, f_{Nyquist}) > 0.9$
Noise and low-contrast resolution	A linear fit of system noise (expressed in terms of logarithm of corresponding σ_E / E to logarithm of actual exposure	Correlation coefficient > 0.95
Spatial accuracy	The difference between the measured (d_m) and actual distances (d_0) in orthogonal directions	$(d_m - d_0)/ d_0 < 2\%$
Erasure thoroughness	Average signal and its standard deviation within 80% of the reread/unexposed image	$E < 0.012$ mR $\sigma_E / E < 1\%$
Aliasing/grid response	No quantitative tolerance levels	
IP throughput	Measured throughput in screens per hours (T_m) and the specified throughput (T_0)	$(T_0 - T_m) / T_0 < 10\%$

[Adapted from Table XIV in reference 56 with permission from AAPM.]

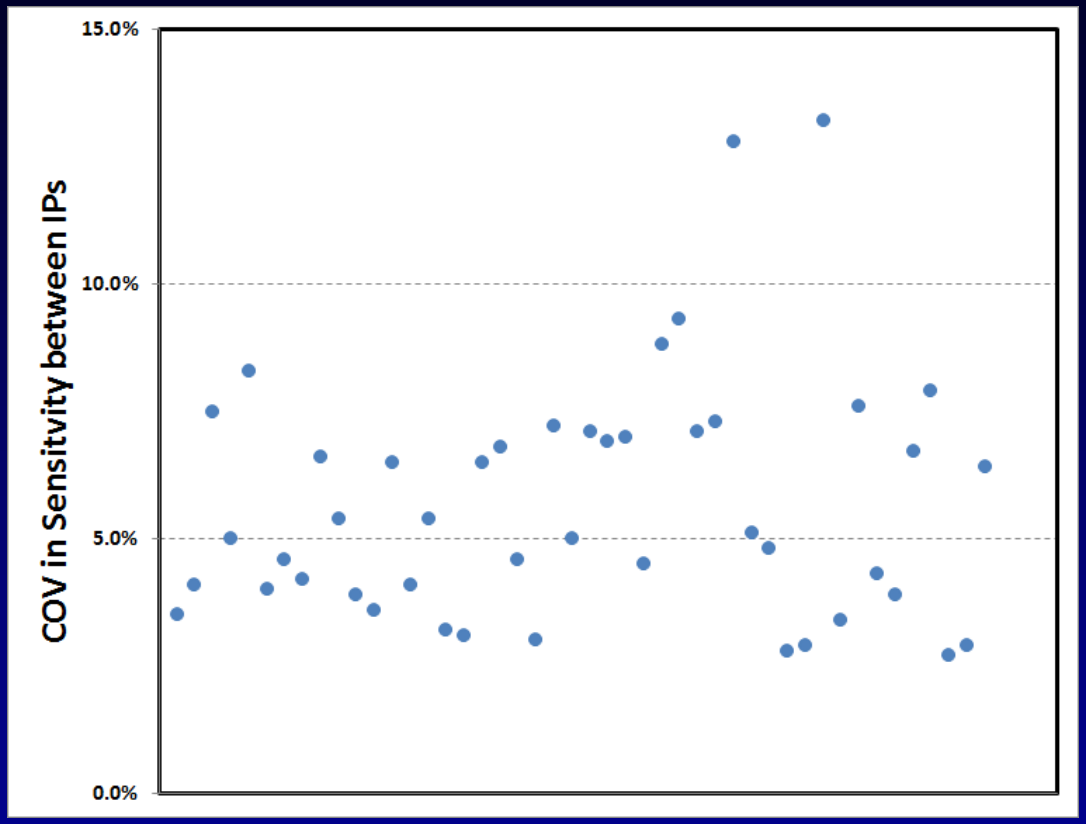
TG-10

Intial Results (2010-2011)



- 1089 plates
  - 193 removed from service due to damage (~18%)
- Average SD of 5.1% in sensitivity between screens at a single facility

2014 Results

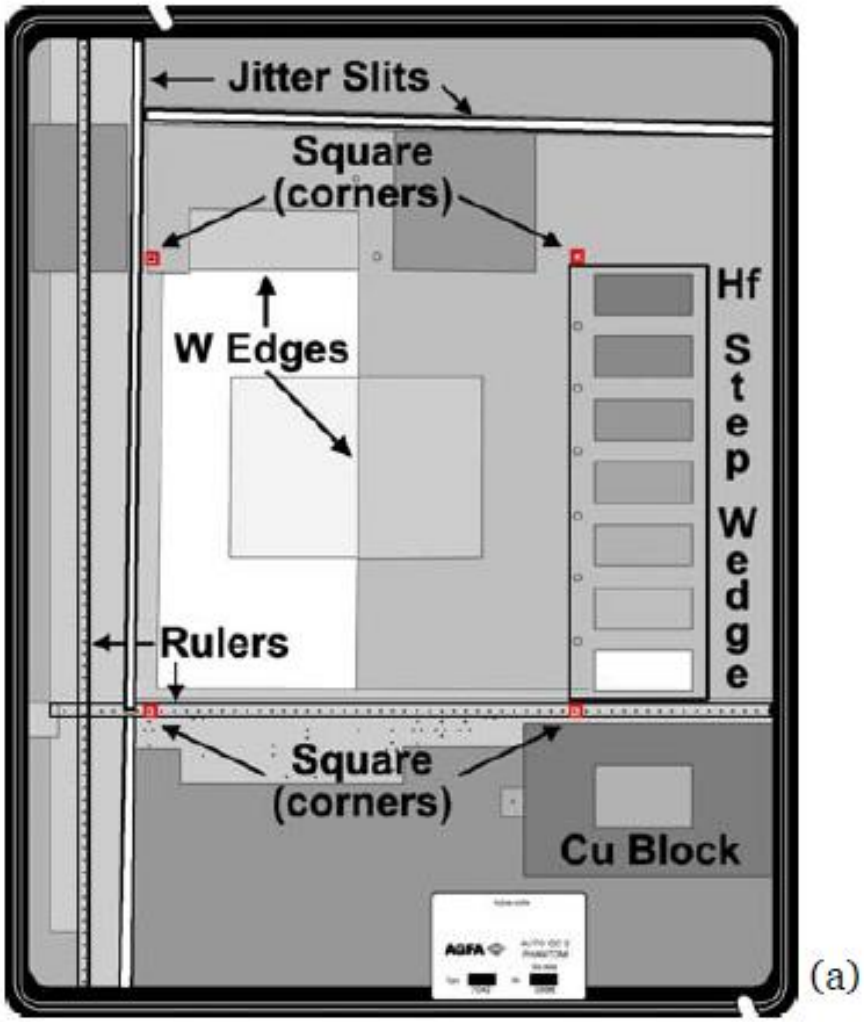


- 940 plates
  - 30 removed from service due to damage (~3%)
- Average SD of 5.5% in sensitivity between screens at a single facility

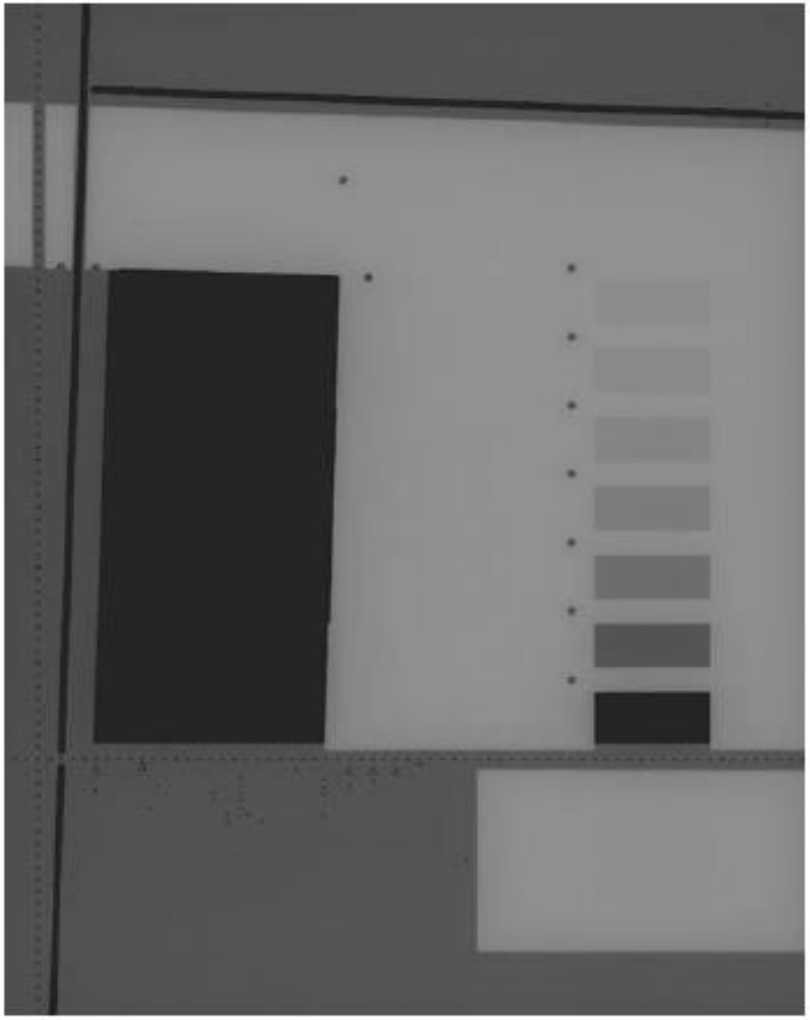
Performance Testing (TG-10)

CR Reader – FLYING SPOT
Dark Noise and Uniformity
Exposure Indicator Calibration Accuracy
Linearity and Auto-ranging Response
Laser Beam Function
Limiting Resolution and Resolution Uniformity
Noise and Low-Contrast Resolution
Spatial Distance Accuracy
Erasure Thoroughness
Aliasing / Grid Response
IP Throughput

AUTOQC² Phantom



(a)



(b)

Agfa's Auto QC2 TM: Second-generation Quality Control for Computed Radiography Systems, White Paper (10/30/2006)

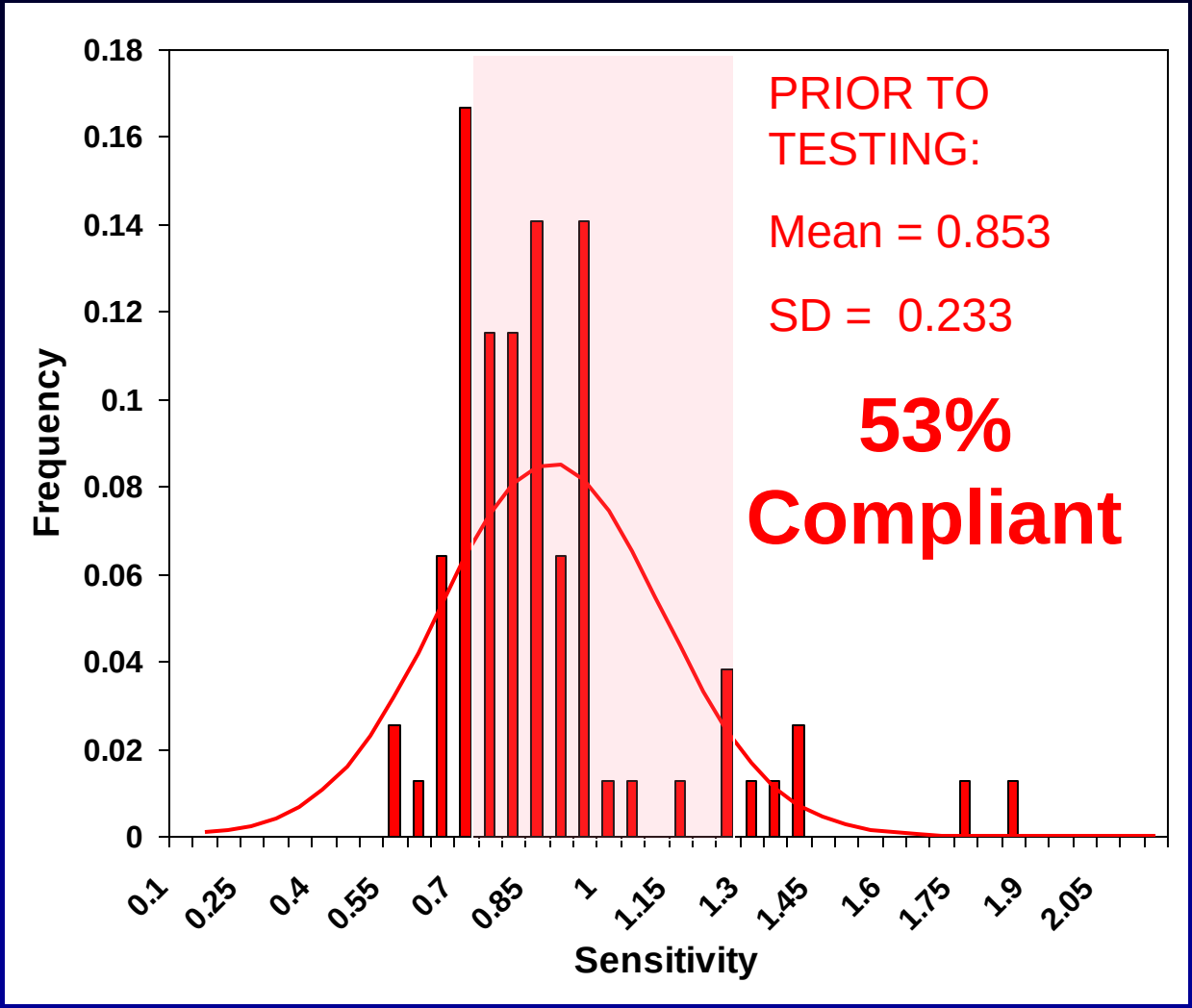
Exposure Indicator Accuracy

- How well matched should my readers be?
  - ±25% should be achievable
  - TG-10 recommends readers be matched within ±10%
  - Can adjust the high-voltage settings on some units
  - In other cases have to replace the PMT

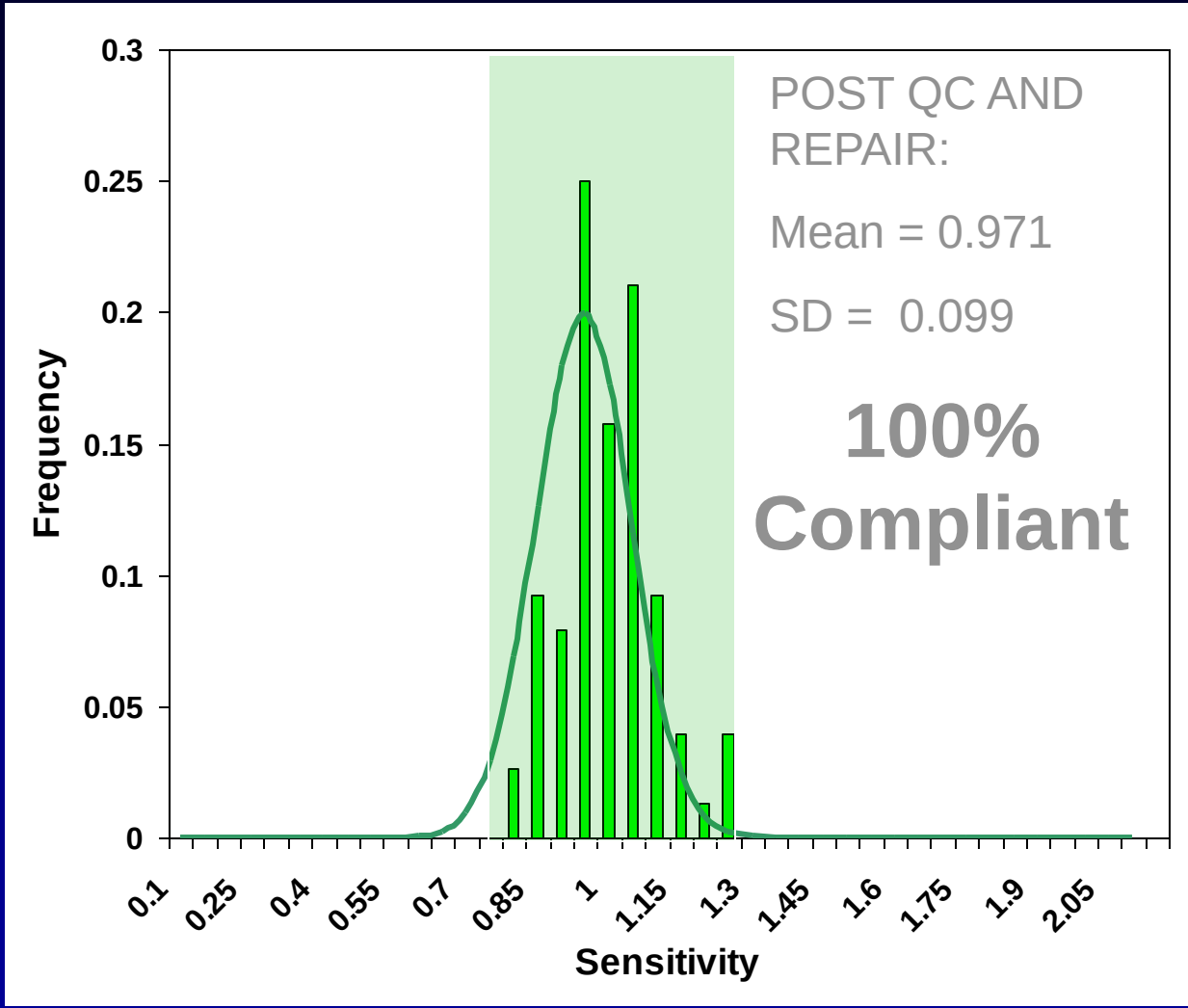
Clinical Experience….

- 80 readers (Agfa)
- 38 units required PMT replacement (~50%)

Prior to testing:



Post QC and Repair:



2014 results

- 82 readers
  - 3 failures
    - 1 sensitivity failure
    - 1 uniformity failure
    - 1 SNR failure (minor)

Periodic QC (TG-10, TG-151)

TECHNOLOGIST QC	Recommended Frequency TG-10	CCF
Printer QC (density test)	Daily	Daily
Cassette Erasure	Monthly (or as needed)	Every other day
Plate Cleaning	Quarterly (pending environment)	Monthly / Quarterly
QC of Clinical Images (Artifact Identification)		
QC Phantom (resolution, contrast/noise, laser jitter, EI accuracy)	Monthly	n/a
SMPTE Pattern for PSP QC Workstation	Monthly	n/a
Reject Analysis	Quarterly*	Monthly
Dose Monitoring	Quarterly*	n/a

Mandated by ODH

*TG-151 recommends *monthly*

Next Steps

- Program for QC of Clinical Images
- QC for acquisition workstations

Dose Tracking (Annual)
CCF Experience

Dose Tracking – Annual (Physicist)

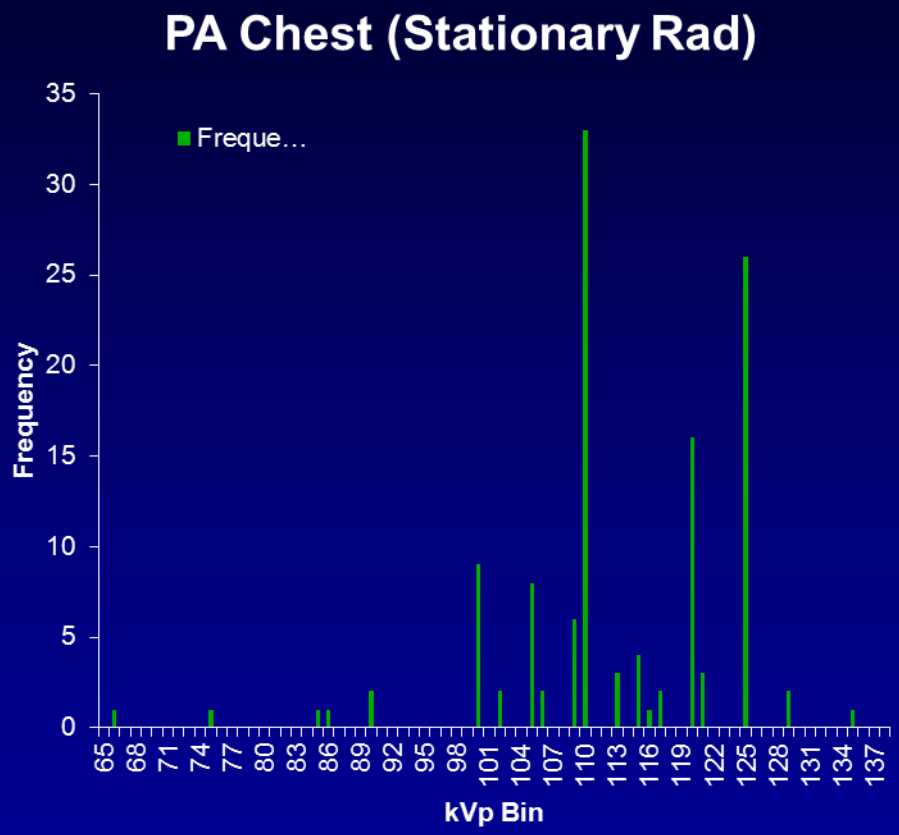
- Tube Output, HVL
- Incident Air Kerma ($K_{a,i}$) Measurements
  - 'typical' doses
  - references for limits / reference levels:
    - NCRP 172
    - NEXT Surveys
    - State regulations
- AEC evaluation
  - EI is useful for this as well!
  - TEIs will be correlated w/ cutoff dose
- Accuracy of metric used for ongoing QC
  - DAP, EI, etc.

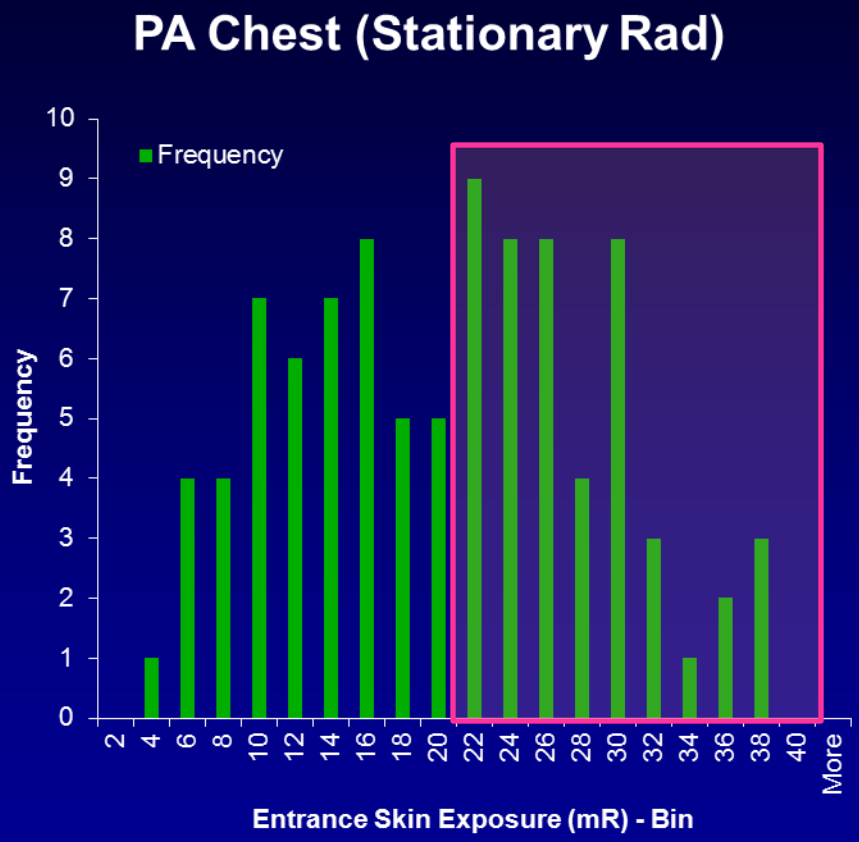
CCF Patient Incident Air Kerma (IAK)

- **GOAL:**
  - **to reduce average patient doses for common radiographic exams to below 3rd quartile NEXT* data for ALL sites**

**NEXT = National Evaluation of X-Ray Trends(CRCPD Pub. No. E. 03-2)*

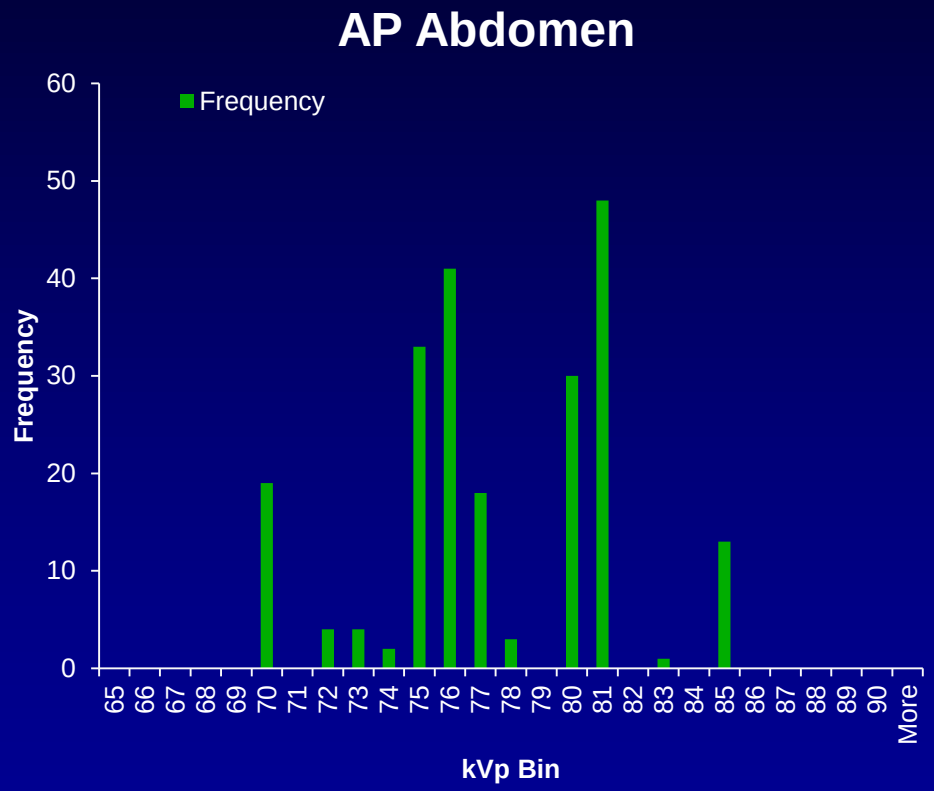
Where we were (2010)…

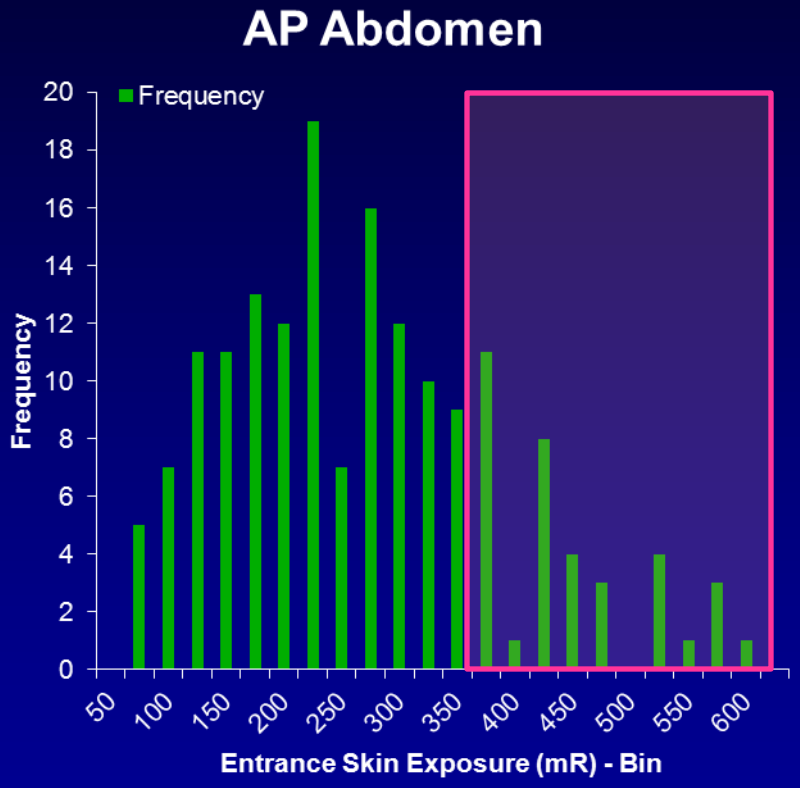




EXCEEDING NEXT 3rd QUARTILE

Where we were (2010)…





EXCEEDING NEXT 3rd QUARTILE

CCF Patient Incident Air Kerma (IAK)

- **HOW:**
  - **kVp standardization for select exams**
    - Enables comparison of IAKs between sites with *same* system
  - **Development and documentation of image-based methodology for in-house AEC evaluation and calibration**
  - **Instituted new CCF limit for IAK**
    - Identify outliers during annual testing

**NEXT = National Evaluation of X-Ray Trends(CRCPD Pub. No. E. 03-2)*

CCF IAK Limits

	ODH Limit		CCF ESE Standard		ESE Range quoted by ODH		CRCPD, Pub No. E-03-2, Table 4				TX Limit (mR)
							NEXT Data		NEXT Data		
	(mGy)	(mR)	(mGy)	(mR)	Min (mR)	Max (mR)	Q3 (mGy)	Q3 (mR)	Av (mGy)	Av (mR)	
AP Abdomen	5.26	600	3.40	388	300	490	3.469	396	2.374	271	450
AP Lumbar	6.13	700	4.20	479			4.179	477	2.996	342	550
AP Thoracic	3.50	400	2.27	325							325
AP Cervical	1.75	200	1.75	200					1.183	135	120
LAT Skull	1.75	200	1.75	200					1.270	145	150
DP Foot	0.88	100	0.31	35	8	35					50
PA-AP Chest w/ Gr	0.35	40	0.26	30	10	15	0.158	18	0.114	13	30
PA-AP Chest woo Gr	0.26	30	0.18	20			0.123	14	0.079	9	20
PA-AP Chest w/ Gr	0.35	40	0.26	30	10	15	0.158	18	0.114	13	30

NEXT = National Evaluation of X-Ray Trends
CRCPD = Conference of Radiation Control Program Directors

CCF IAK Limits

	Grid Y/N	SID (cm)	AEC cell(s)	Dens	kVp	mAs	Patient Size (cm)	Measured Air Kerma: Measured @ SCD (mGy)	Incident Air Kerma $K_{a,i}$: $K_{a,i}$ @ SSD (mGy)	ODH Limit (mGy)	CCF Limit (mGy)
AP Abdomen	Y	102	LRC	0	80		23			5.26	3.40
AP Lumbar	Y	102	C	0	80		23			6.13	4.20
AP Thoracic	Y	102	C	0	75		23			3.50	2.27
AP Cervical	Y	102	C	0	74		13			1.75	1.75
LAT Skull	Y	102	C	0	76		15			1.75	1.75
DP Foot	Y	102	C	0	60		8			0.88	0.31
PA-AP Chest*	Y	102					23			0.35	0.26
PA-AP Chest*	N	102					23			0.26	0.18
PA-AP Chest	Y	182	LR	0	120		23			0.35	0.26

* Measure for portables ONLY

CCF IAK limit tripped→ re-calibrate AEC according to CCF methodology

CCF IAK limit tripped

↓

re-calibrate AEC according to CCF methodology

Cleveland Clinic

Quality Control Procedures

AEC Calibration and Reproducibility (Agfa)

Table 1: Target EI values for AEC calibration

Plate Type	Target EI (100% Sensitivity)	Tolerance
Agfa MD4.0 (Table)*	400	±30%
Agfa MD4.0 (Upright Bucky: Non-Chest)*	400	±30%
Agfa MD4.0 (Upright Bucky: Chest)	600	±30%
Agfa HD5.0 (Table)*	350	±30%
Agfa HD5.0 (Upright Bucky: Non-Chest)*	350	±30%
Agfa HD5.0 (Upright Bucky: Chest)	525	±30%

*Tested during acceptance and annual

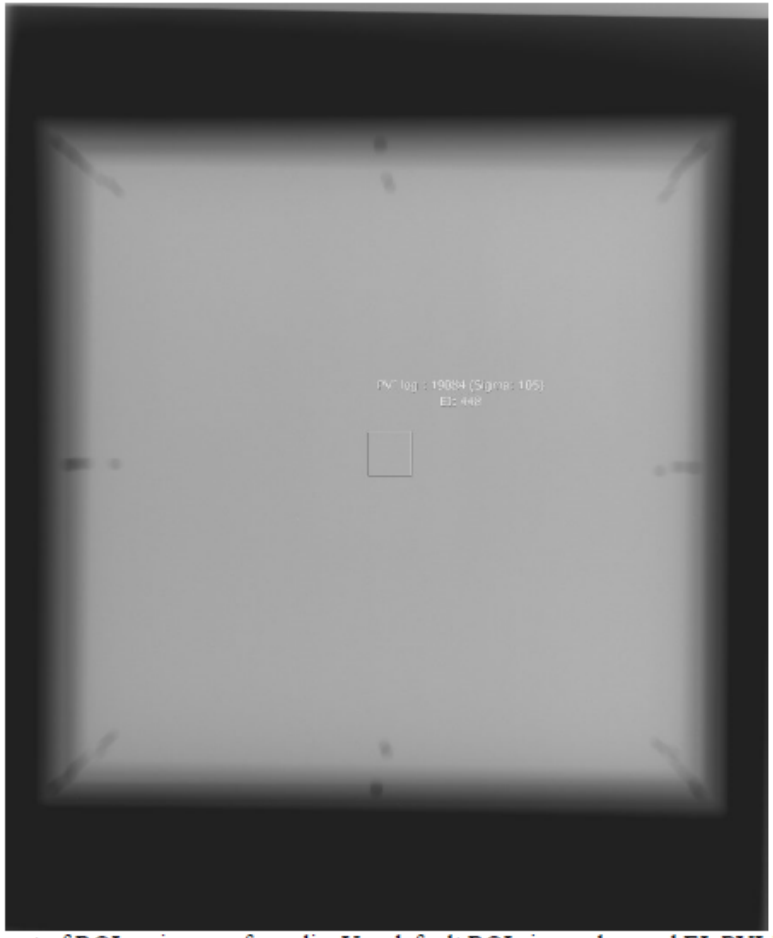
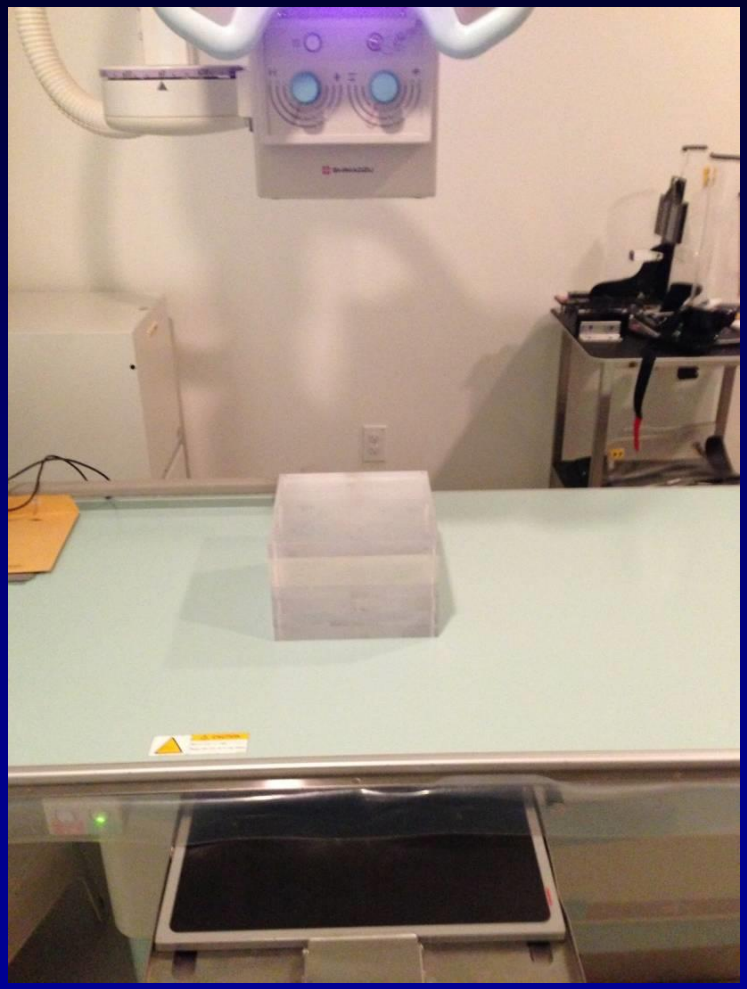
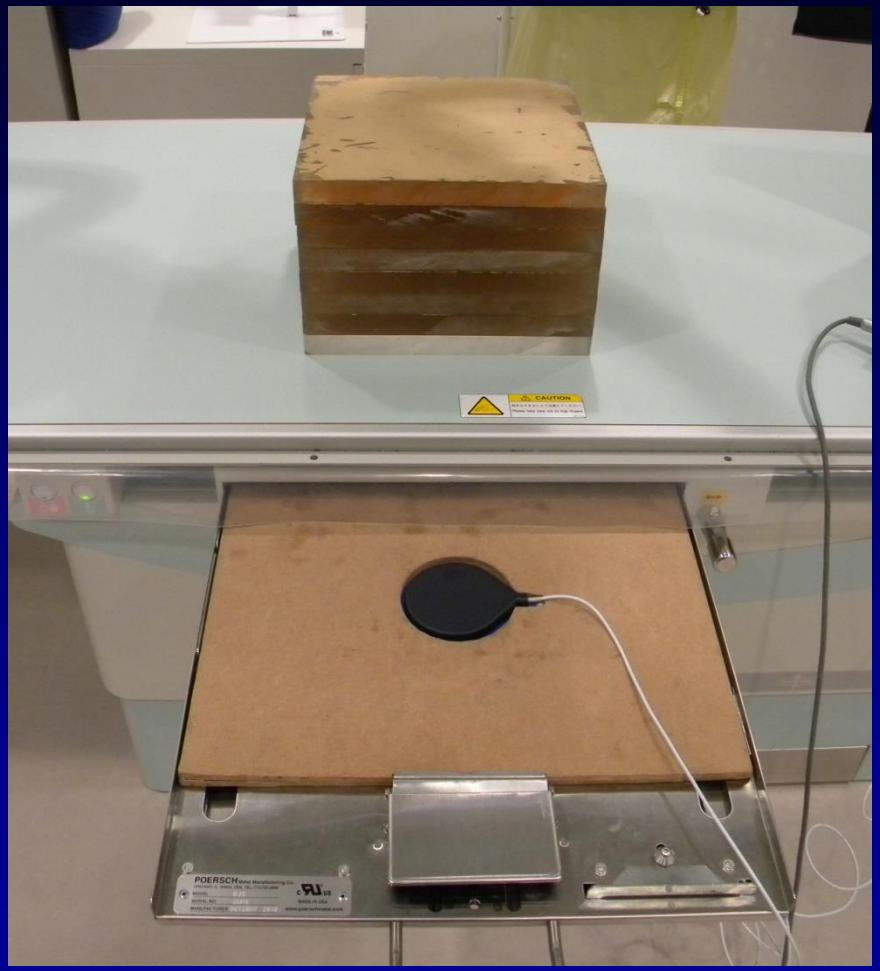


Figure 1: Placement of ROI on image of acrylic. Use default ROI size and record EI, PVI-log, and SD.

EI



K_a



K_a

- Cassette (CR) or wood board with cut-out for dosimeter
  - Use of cassette more accurately simulates clinical response
- Ion chamber measurements will included backscatter
  - Solid-state dosimeter with lead backing are more appropriate for measuring K_a

Pre-Detector K_a

- For DR systems with fixed detector have to measure the K_a outside the bucky
  - Don’t have to worry about backscatter
  - BUT have to account for grid

EI

- ROI can matter
  - Make sure to use the appropriate exam tag
  - Know the VOI used for EI calculation
- If using a target EI:
  - Must verify accuracy of exposure indicator and account for it
  - For CR
    - Time between image and readout must be kept consistent
    - Use QC plate or plate of median sensitivity

Exposure Index *(IEC 62494-1)*

- **IEC 62494-1 standard states that the EI shall be calibrated such that:**

$$EI = C_0 \cdot K_{CAL}$$

- **Where**
  - **K_{CAL} is the receptor air kerma (in µGy) under calibration conditions**
  - **C_0 = 100 μGy^{-1}**

Exposure Index *(IEC 62494-1)*

- **Inverse calibration function is defined as:**

$$K_{CAL} = g(V_{CAL}) = f^{-1}(V_{CAL})$$

- **Inverse calibration function should have an uncertainty of *less than 20%***

Calibration Conditions *(IEC 62494-1)*

- Fixed radiation quality
  - RQA5
- Homogenous irradiation of image receptor
- Measurement of incident air kerma (free in air, no backscatter)
- Value of Interest (VOI) calculated from central 10% of image area for flat field images

Remember

- You want to neutralize image processing!
  - Processing can affect quantitative analysis and reproducibility
  - You want a fixed relationship between PV and incident air kerma under a defined beam quality

Choice of Target

- Most newer DR systems provide recommended target K_a or EI values for AEC calibration

DR MANUFACTURERS
AEC Sensitivity Calibration

	kVp	Grid?	Phantom	Target K_a
GE Flashpad (CsI)	80	No	20 mm Al	2.5
Siemens (CsI)	70	No	0.6 mm Cu	2.5
Agfa DX-D (CsI)	70	No	25 mm Al	2.5
Philips	70	No	25 mm Al	2.5
Carestream DRX1-C	80	--	0.5 mm Cu + 1.0 mm Al	2.5
Canon CXDI-70C	80	Yes	20 cm PMMA	2.5

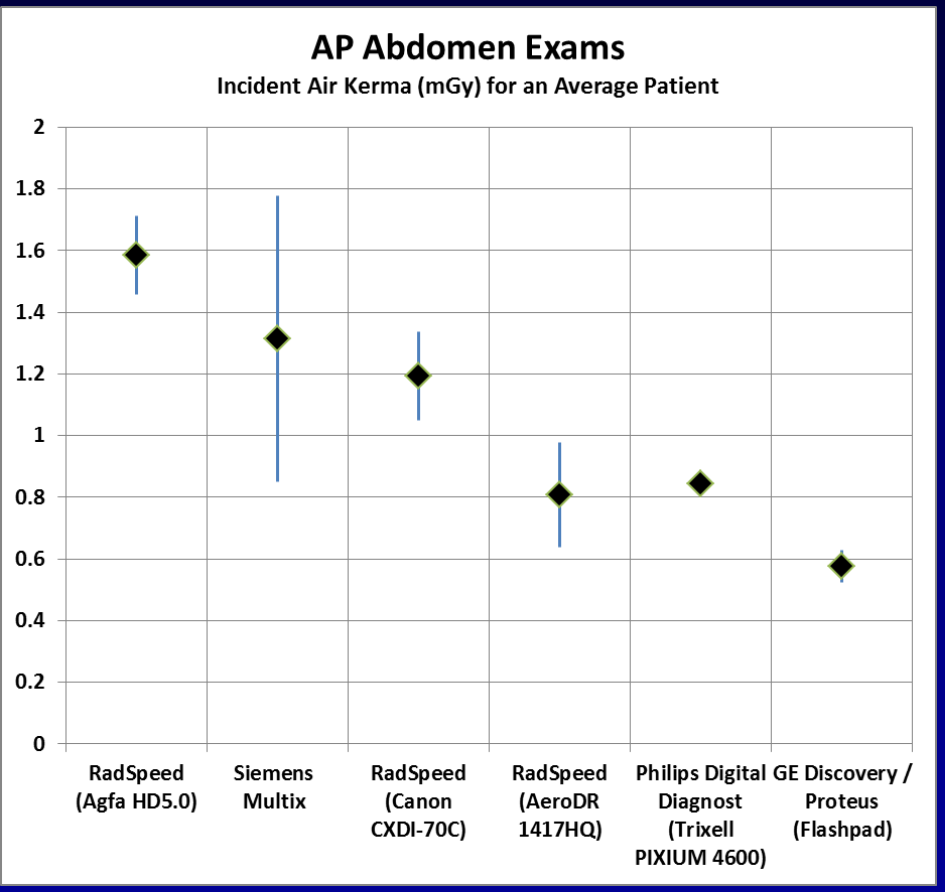
- Can calculate expected EI or PV for target K_a under AEC calibration conditions

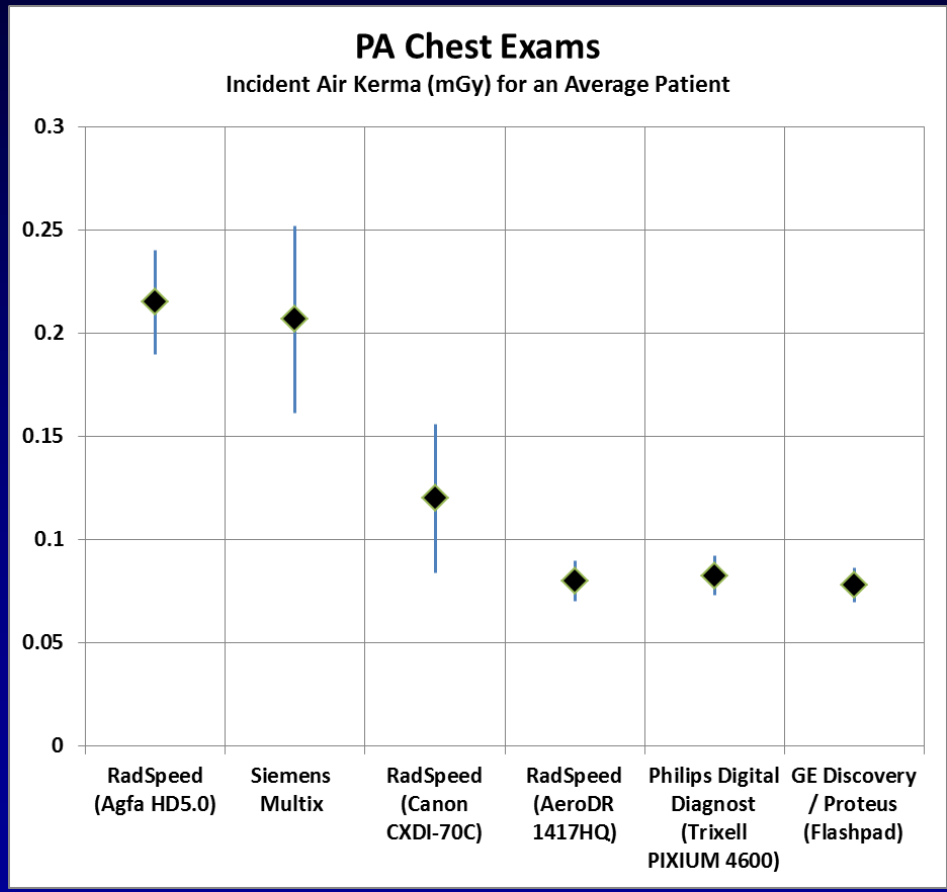
AEC Calibration Phantoms

AEC Calibration Phantoms

- **Beam spectra is IMPORTANT**
- **Using 21 mm Al vs. 20 cm PMMA**
  - **will get fairly equivalent results for sensitivity calibration and kVp correction (Doyle 2006)**
- **Using 'large' amounts of Copper (2 mm) will affect kVp correction curve**
  - **~10% difference compared to other phantoms**
  - **higher correction @>80, lower <80**
  - **0.5 mm Cu equivalent spectrum to 20cm PMMA, but results in VERY short exposure times (Doyle 2006)**
- **EI Calibration and AEC Calibration conditions are not always the same!**

Where we are NOW:





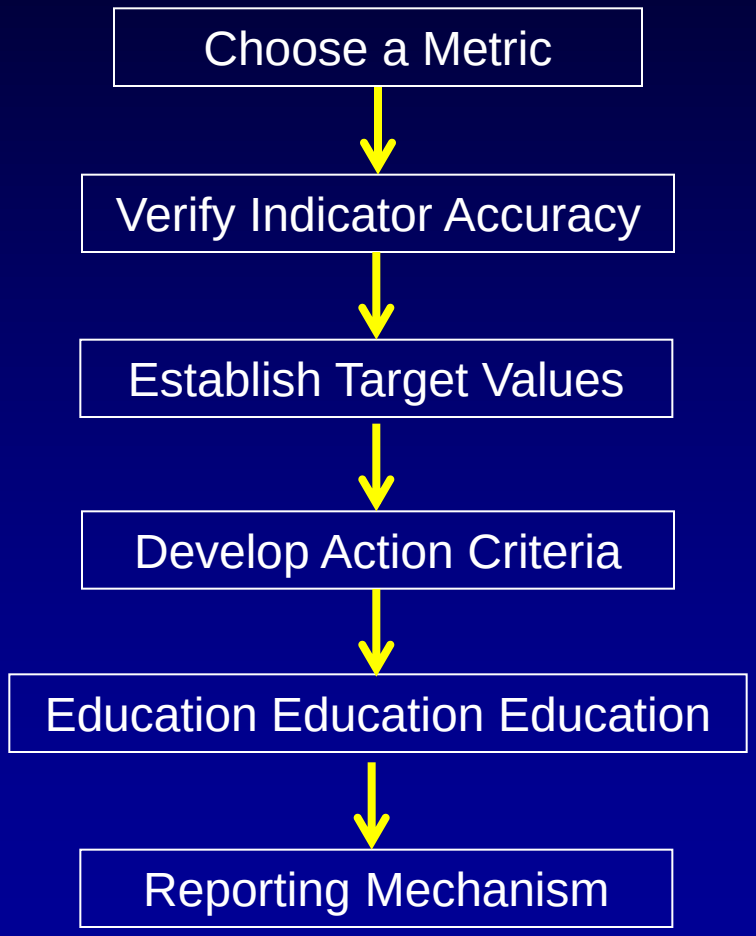
Next Steps

- **Establish upper and *lower* action limits for IAK**
  - **Stratified by system / detector**

Ongoing Exposure Analysis

Still in it’s infancy….

Dose Tracking – Ongoing



$K_{a,i}$ - Limitations

- 'Average' patient doses do not necessarily reflect actual patient dose or the distribution in patient doses
  - Measurements do not indicate adherence to technique charts (manual)
- Phantoms represent a limited range of exam types and body parts
- Metrics are not suitable for ONGOING QC
  - Require a level of expertise (and equipment) to measure

Dose Tracking – Ongoing

WHAT INFORMATION IS AVAILABLE TO YOU??

- **Exposure Index**
  - DICOM tags*: EI(0018,1411), TEI (0018,1412), DI (0018,1413)
  - Available for all systems that have adopted IEC standard
- **Entrance Dose**
  - DICOM tags:
    - Entrance Dose (0040,0302)
    - Entrance Dose in mGy (0040,8302)
  - Available on systems with integrated generator
- **Area Dose Product**
  - DICOM tag:
    - Image and Fluoroscopy Area Dose Product (0018,115E)
  - Available on systems with integrated generator

**DICOM Correction item 1024 – 'Exposure Index Macro'*

Exposure Index / Deviation Index

- **Advantages**
  - Reflects receptor dose
  - Not as dependent on patient size/distribution
  - Standardized metric
- **Disadvantages**
  - Indirectly related to patient dose
  - Depends on beam quality, exam/view, as well as vendor-defined VOI
  - Collimation, prosthetics, etc. can affect calculated value

Establishing TEI Values

- DI is only useful if you have selected a reasonable TEI
- Some vendors will provide recommended TEI values

Establishing TEI Values

- The fewer sub-groups you have, the easier your TEI values are to implement…
  - Our Agfa CR systems currently set up with three TEI sub-groups
  - But are these right?
    - Chest (TEI – 350)
    - Non-Extremity (TEI – 400)
    - Extremity (TEI – 1000)

Setting Action Criteria

- Shape of distribution
- Expected variation

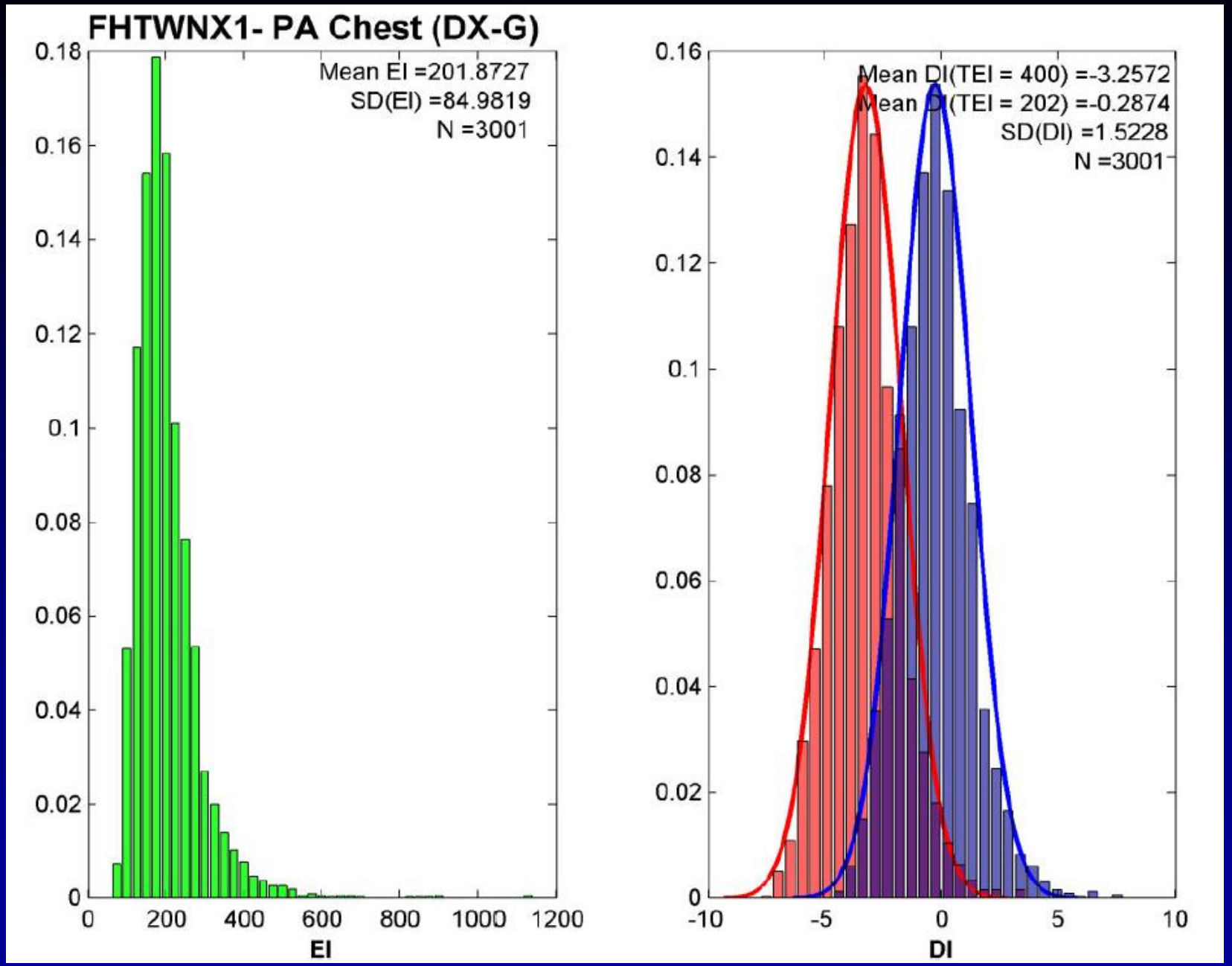
Exposure Indices

- Remember, clinical exposure indices will vary with
  - Manufacturer (different VOIs)
  - Anatomical view
  - Collimation
  - Exposure indicator accuracy
- Manual techniques will have larger variation than photo-timed exams
- Errors in detecting collimation borders can result in inaccurate calculation of EI
  - i.e. Merchant view for knees


L
WAJ

EI - Patterns

- Typically, 95% within +/- 2 DI
- SD in EI increases when manual techniques are used
- Log-normal distribution of EI
- Normal distribution of DI
  - SD in DI is independent of TEI
- Guidelines yet to be published
- Questions still to be answered:
  - What is a typical (acceptable) level of variation in the EI and DI
  - Are recommended TEI values optimized?



Hulme et al, *A Method for Deriving Exam-Specific Target Exposure Indices (TEI) in Computed Radiography as a Function of a Reference TEI,* TU-A-116-4

TG-116 Recommendations

Table 2. Exposure Indicator DI Control Limits for Clinical Images

DI	*Range Action*
> +3.0	Excessive patient radiation exposure Repeat only if relevant anatomy is clipped or "burned out" Require immediate management follow-up.
+1 to +3.0	Overexposure: Repeat only if relevant anatomy is clipped or "burned out"
–0.5 to +0.5	Target range
Less than –1.0	Underexposed: Consult radiologist for repeat
Less than –3.0	Repeat

Data Collection

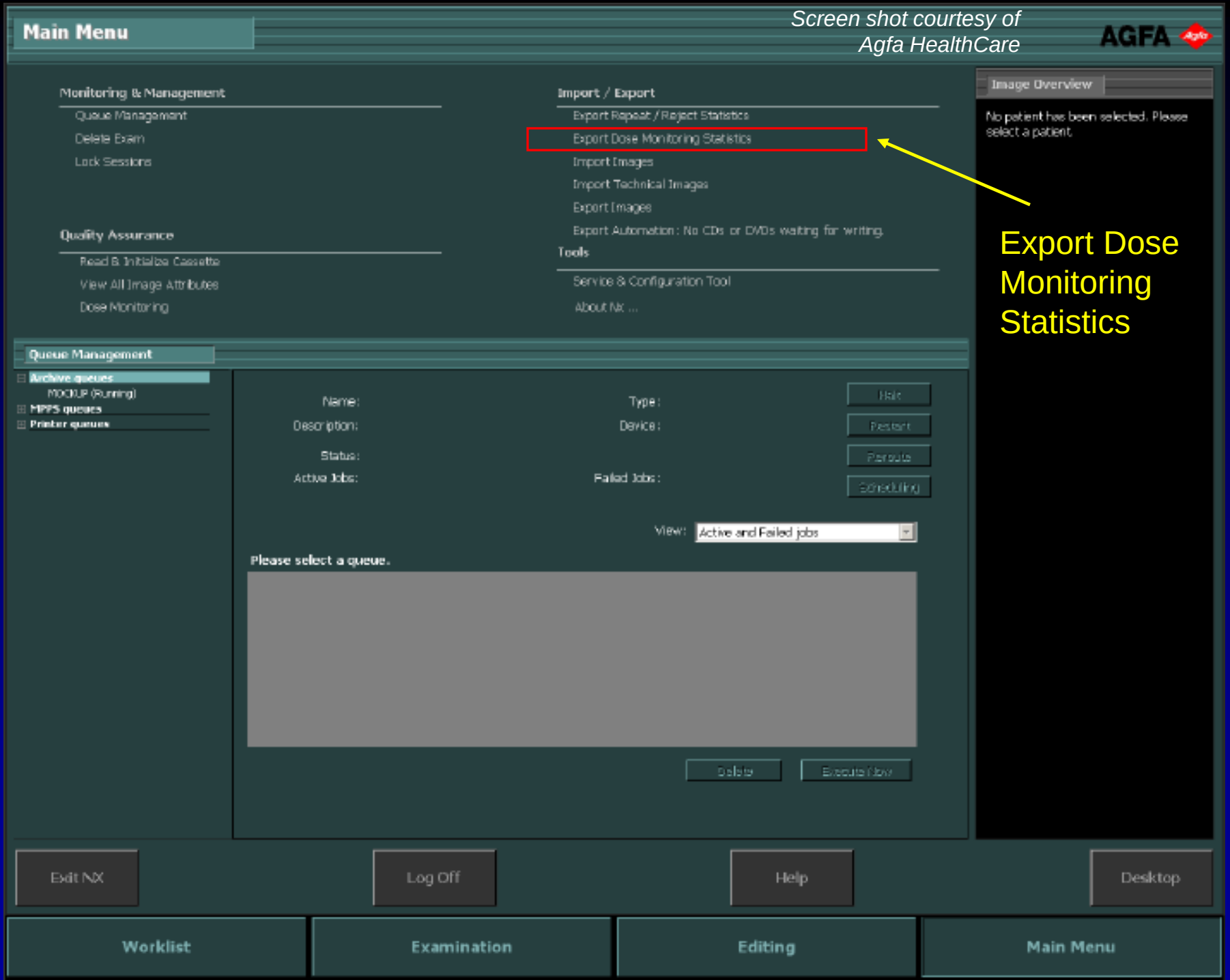
Multiple Options…… (TG-151)

- Paper (single site)
- Modality Performed Procedure Step (MPPS report)
- RIS – extract and archive data (DICOM RDSR or MPPS)
- Send images to a separate server and strip data

Data Collection

Multiple Options…… (TG-151)

- **Export data from workstation**
  - **Easiest option but not always packaged in a manner useful to the technologist**
  - **Need the option to export data in both formats**
    - **xml or csv**
    - **SIMPLE report for routine QC**
  - **Accidental or intentional deletion of data can occur (i.e. during software upgrade by service engineer)**


Main Menu
Screen shot courtesy of
Agfa HealthCare
AGFA
Monitoring & Management
Queue Management
Delete Exam
Lock Sessions
Quality Assurance
Read & Initialize Cassette
View All Image Attributes
Dose Monitoring
Import / Export
Export Repeat / Reject Statistics
Export Dose Monitoring Statistics
Import Images
Import Technical Images
Export Images
Export Automation: No CDs or DVDs waiting for writing.
Tools
Service & Configuration Tool
About NX ...
Image Overview
No patient has been selected. Please select a patient.
Export Dose Monitoring Statistics
Queue Management
Archive queues
MOD1UP (Running)
MPPS queues
Printer queues
Name:
Type:
Description:
Device:
Status:
Active Jobs:
Failed Jobs:
Halt
Restart
Pause
Scheduling
View:
Active and Failed jobs
Please select a queue.
Delete
Execute Now
Exit NX
Log Off
Help
Desktop
Worklist
Examination
Editing
Main Menu

TEI vs. Exam Group

Exam Group (k)	N_k	Weighted Average*: $DI_{ref,k}$	Standard Error: $\Delta DI_{ref,k}$	$DI_{ref,k}$ *Sub-Group*	$K_{ref,k}$ *Sub-Group*	TEI_k (TEI_{ref}= 400)	TEI_k (TEI_{ref}= 350)	Weighted Average: $SD(DI_{ref,k})$	95% CI (±DI)
Chest	29078	-1.70	0.01	-2	0.6	252	221	0.79	1.6
Abdomen	3094	-1.30	0.03	-1	0.8	318	278	0.96	1.9
Abdomen GU	548	-1.24	0.03	-1	0.8	318	278	0.81	1.6
Mandible & TMJ	145	-0.76	0.07	-1	0.8	318	278	1.21	2.4
Nasal & Orbits	164	-0.63	0.08	-1	0.8	318	278	1.78	3.5
Spine	270	-0.51	0.05	0	1.0	400	350	2.26	4.4
C-Spine	7558	-0.37	0.01	0	1.0	400	350	1.01	2.0
Abdomen GI	536	-0.05	0.08	0	1.0	400	350	1.58	3.1
Full Leg / Full Spine	2863	0.20	0.01	0	1.0	400	350	1.78	3.5
T-Spine	1792	0.27	0.02	0	1.0	400	350	1.07	2.1
Shoulder	11367	0.38	0.01	0	1.0	400	350	0.95	1.9
Femur Knee Leg	27529	0.59	0.02	1	1.3	504	441	1.02	2.0
Skull, Sinus & Facial	465	0.89	0.06	1	1.3	504	441	0.98	1.9
L/S Spine	13172	0.94	0.02	1	1.3	504	441	0.82	1.6
Pelvis	60	1.05	0.24	1	1.3	504	441	1.87	3.7
Pelvis & Hip	10910	1.07	0.01	1	1.3	504	441	0.88	1.7
Lower Extremity	1124	2.08	0.03	2	1.6	634	555	2.68	5.3
Ankle & Foot	20519	3.26	0.01	3	2.0	798	698	0.83	1.6
Humerus, Elbow & Forearm	4400	4.10	0.03	4	2.5	1005	879	0.83	1.6
Hand & Wrist	11345	4.35	0.01	4	2.5	1005	879	0.75	1.5
Upper Extremity	680	4.43	0.08	4	2.5	1005	879	2.08	4.1

*Assuming an initial TEI of 400 for all exam tags

Hulme et al, *A Method for Deriving Exam-Specific Target Exposure Indices (TEI) in Computed Radiography as a Function of a Reference TEI,* TU-A-116-4

The Questions to Ask!!

…ideally at acceptance ;)

- How to access the raw DICOM image?
- If no access to raw, how to neutralize image processing?
- How to export the DICOM image (ROI tools are not always available on the workstation!!)?
- How to fix the VOI for EI calculation to the central 10% of the image?
- Is there automated Reject Analysis? How do you export the report?
- How to export dose monitoring statistics?
- Is there documentation regarding target metric and tolerances for AEC calibration?

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