Implementation of the ACR DMQC Manual in a Large-Scale Enterprise

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Cleveland Clinic

Disclosures

- Member of the ACR Subcommittee on Breast X-ray Imaging Physics
- ACR Mammography Phantom Reviewer

Aims

- Share our experience
  - Our motivation for transitioning to the ACR Digital Mammography QC (DMQC) Manual
  - The steps that were involved in implementing a new QC program for a large and interconnected enterprise
  - “Lessons learned”

Resources

https://www.acraccreditation.org/resources/digital-mammography-qc-manual-resources

- QC Manual – UPDATED MAY 2020!!
- FAQ
- Physicist and Technologist Webinars

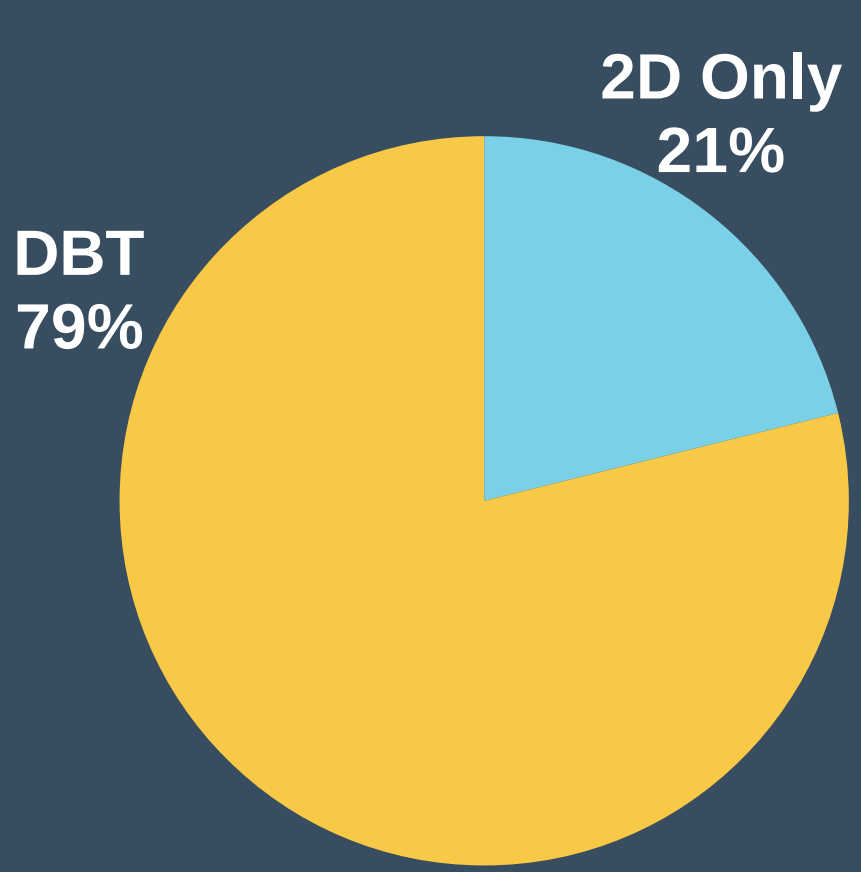
A multi-geographic enterprise

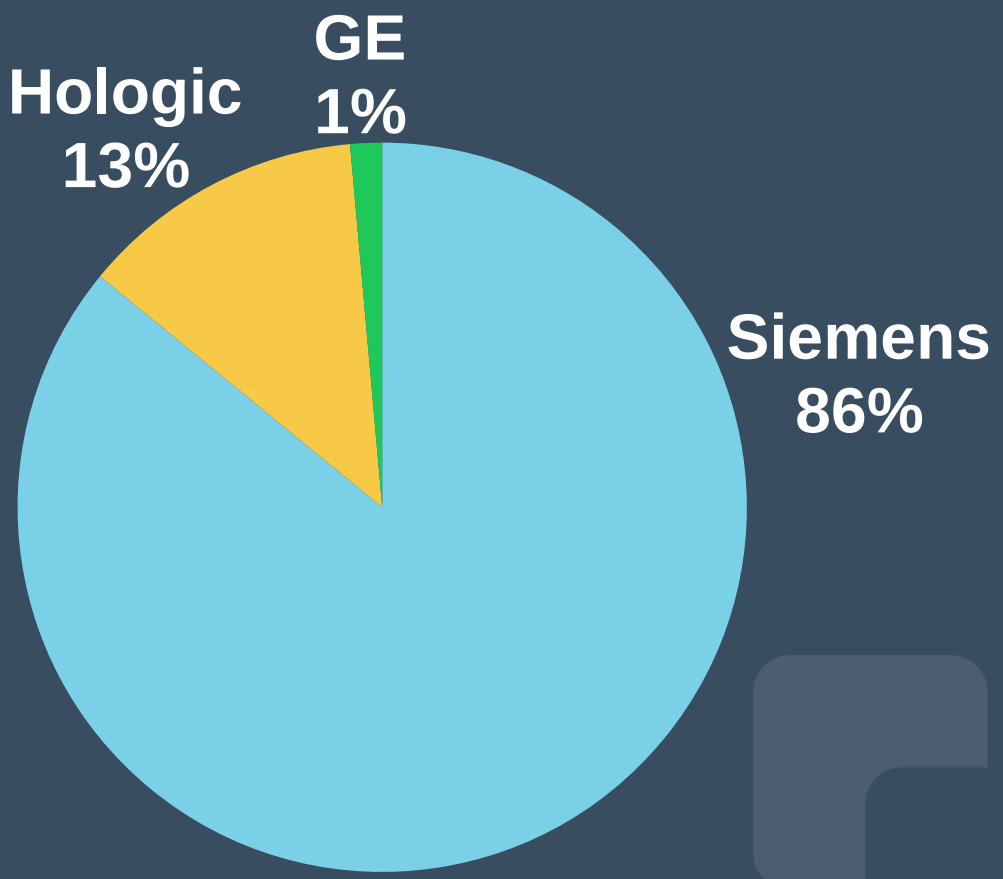
- 41 sites offering mammography services
  - 2 states (OH, FL)

A multi-geographic enterprise

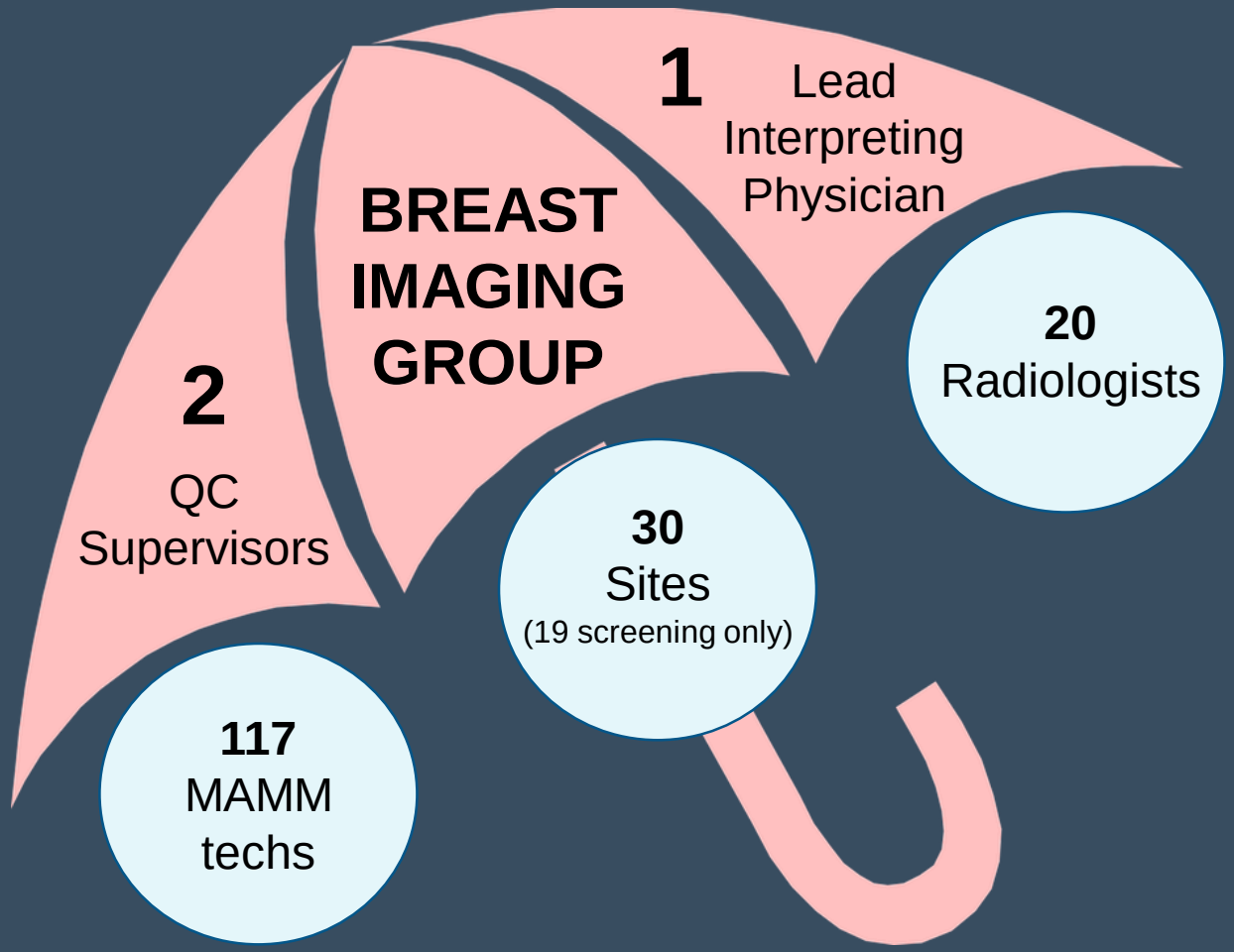
- 41 sites
  - 23 Screening-only
  - 18 Scr+Diagnostic
- 42 Radiologist Workstations
  - Located at DIAGNOSTIC sites

71 FFDM Units





Management Trends

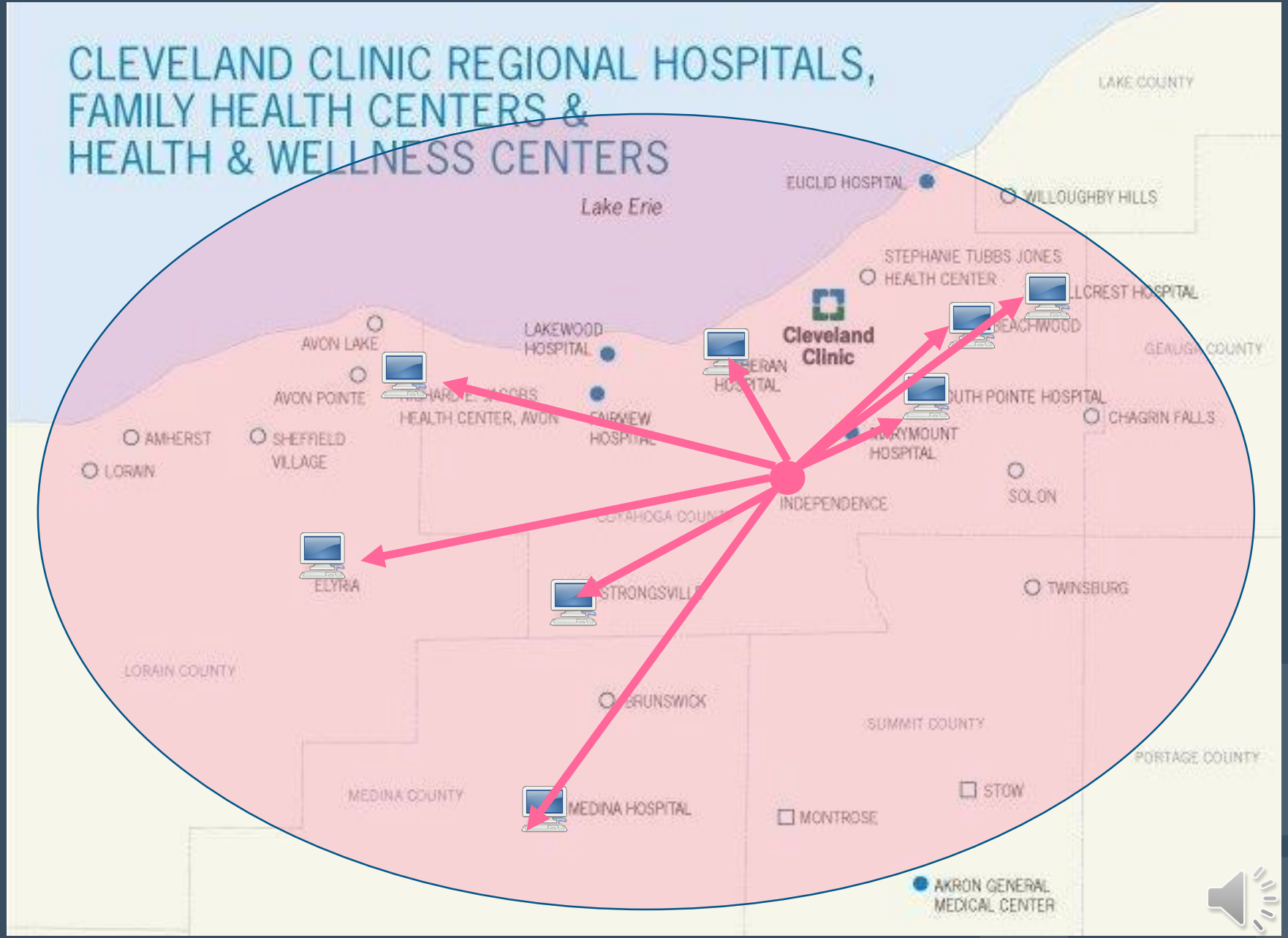


Subset of sites (~73%) fall under centralized management

~14k exams / month
(screening + diagnostic)

- Breast Imaging Radiologists rotate between diagnostic sites

- Screening exam acquired at a Breast Imaging facility can be read from ANY diagnostic site



Management Trends

- Single LIP is responsible for the programs at a large number of sites
  - 2 QC Supervisors responsible for preparing for and attending all MQSA inspections
    - Conduct quarterly QC reviews on behalf of LIP
- Some technologists travel between sites, must be familiar with the equipment and QC programs at each of those sites

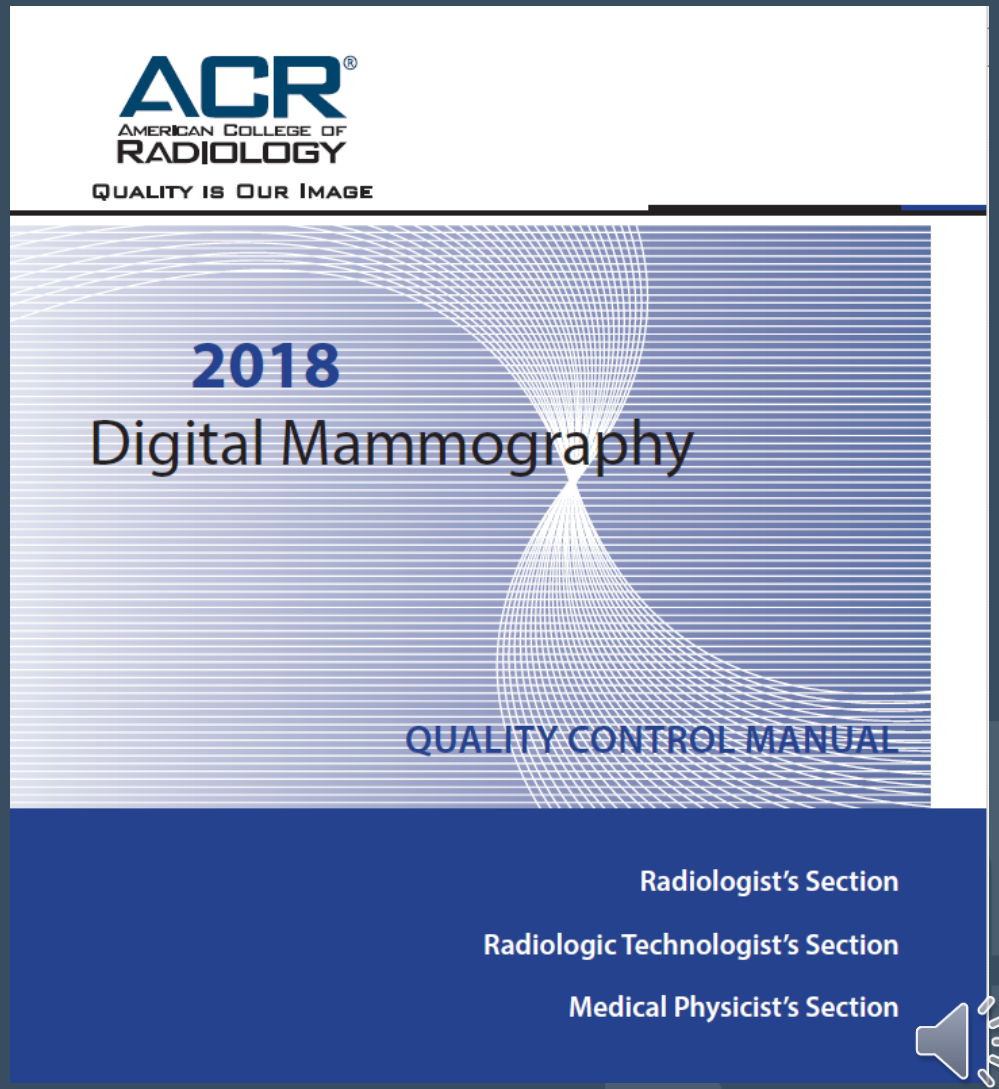
Management Trends

- Highly integrated system
- QC program managed by a small group of people
- Need tools that:
  - Facilitate remote oversight
  - Automate standardized workflows
  - Streamline routine clerical activities

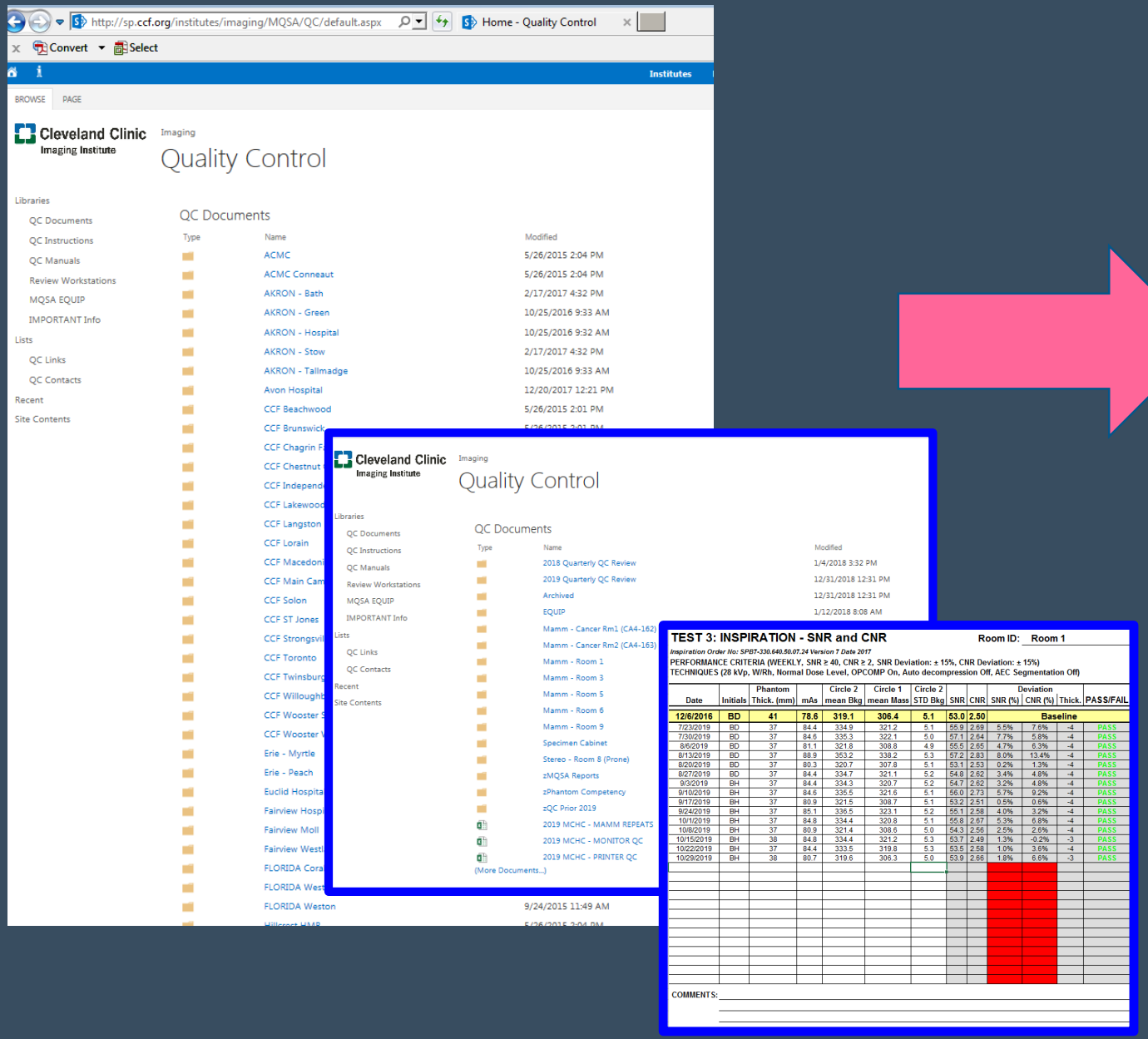
One QC manual to unite them all...

Standardization of mammography QC across all vendors and models

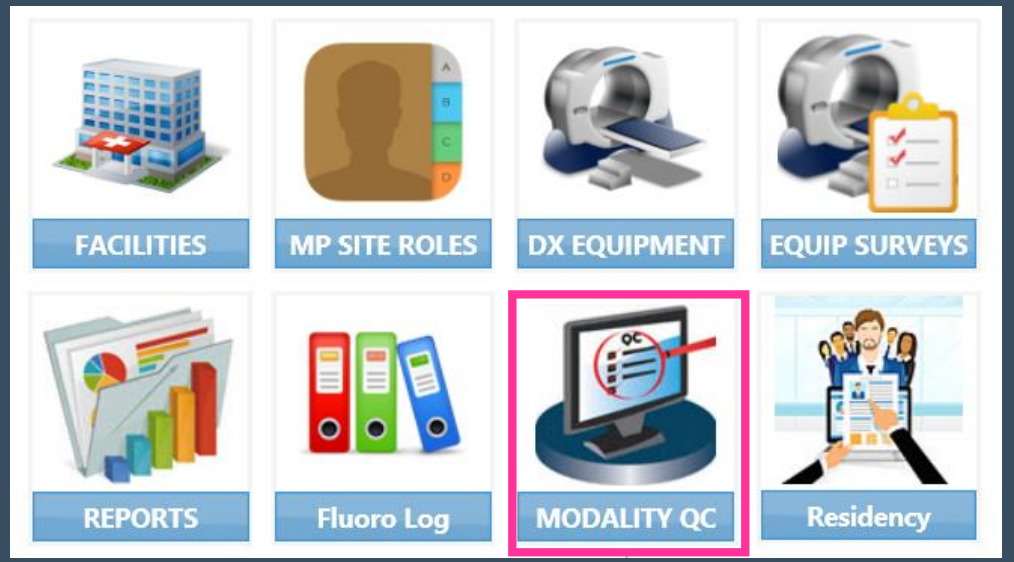
- ACR manuals are updated infrequently (unlike vendor QC manuals)

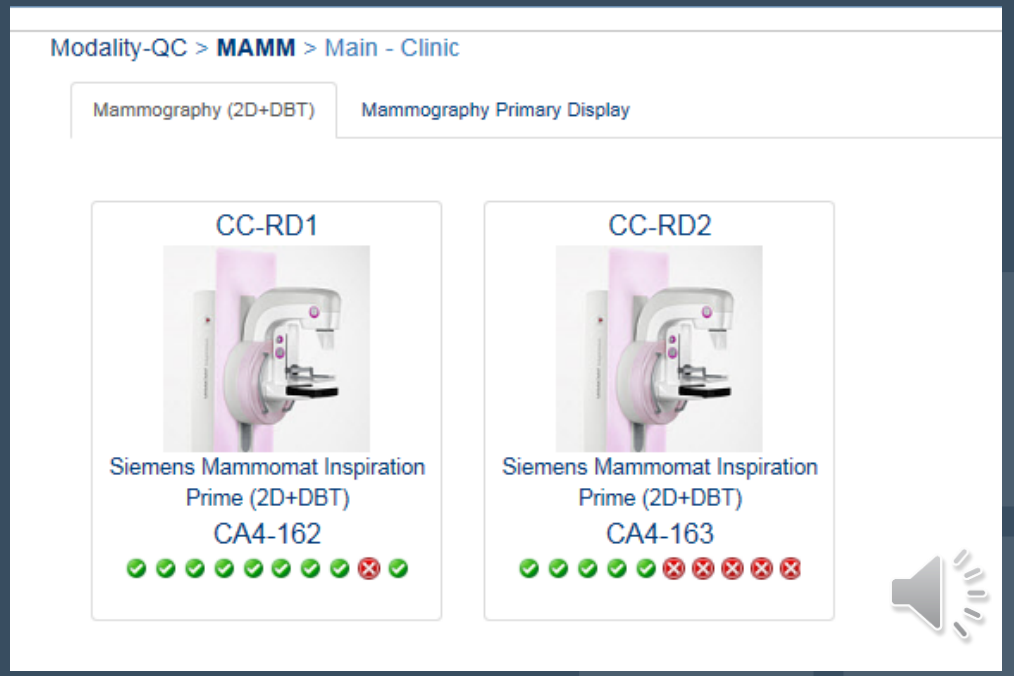


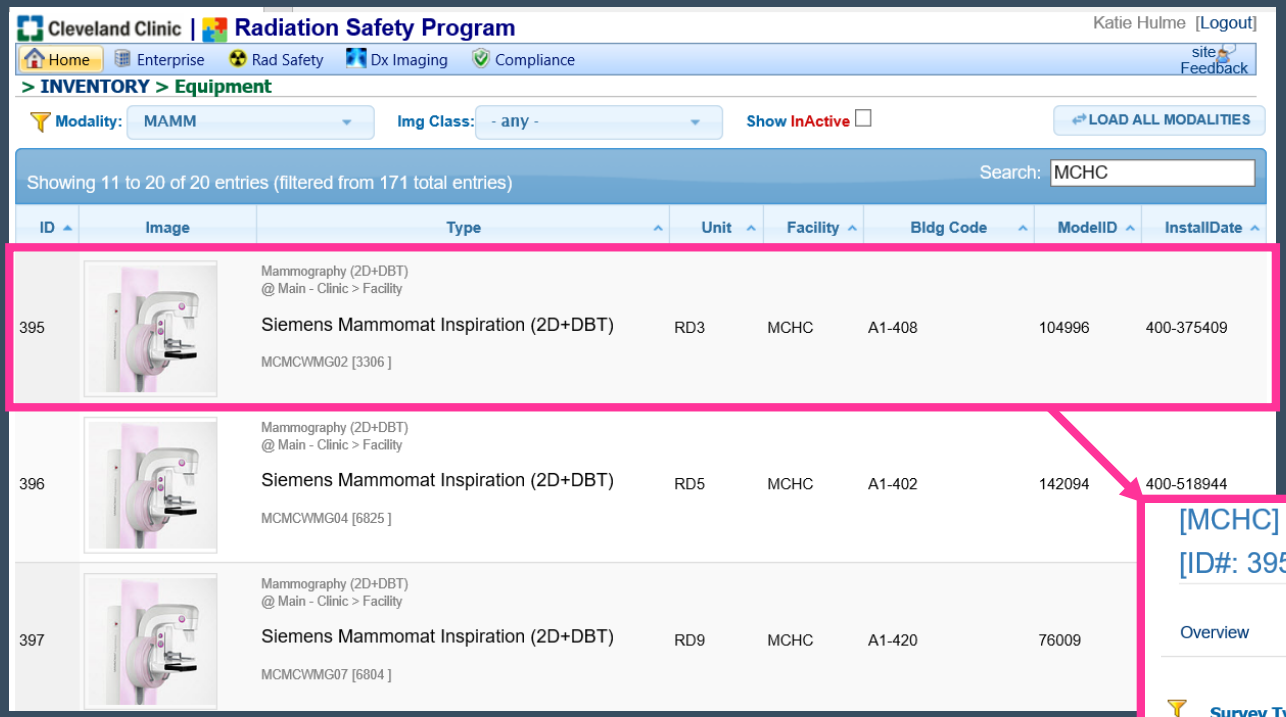
SharePoint+Excel

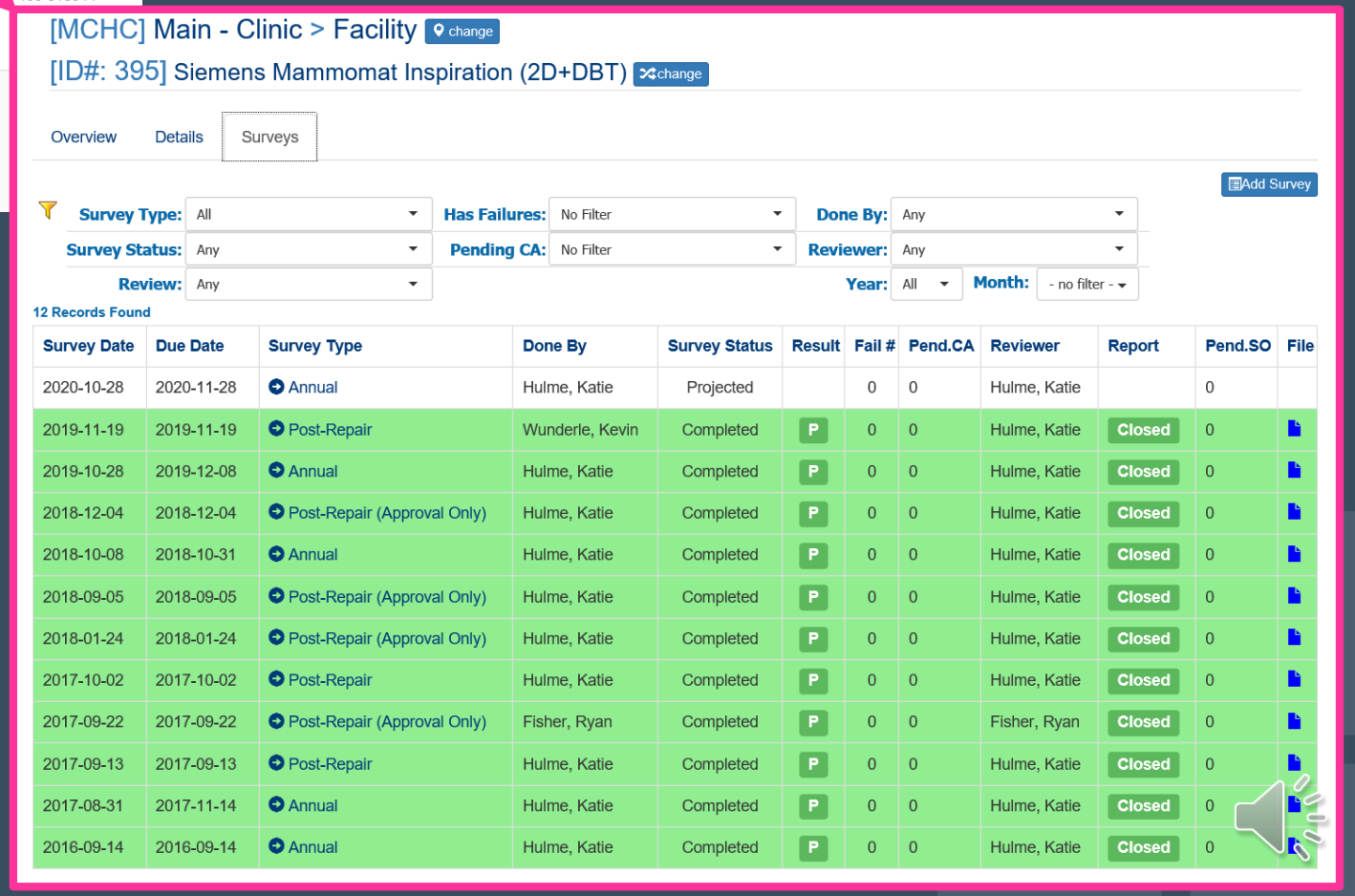


ModalityQC v.3









ModalityQC v.3 built off preexisting platform used for tracking inventory and physics surveys

Our Motivation

- QC logs can be transitioned off of SharePoint and into ModalityQC (electronic QC software)
  - Real-time notification of failures
  - Tracking of service tickets
  - Automatic report generation for:
    - ACR
    - MQSA Inspections
    - Quarterly QC reviews for MQSA EQUIP (eventually…)

All-or-nothing

- Highly integrated system
  - Breast Imaging sites
    - Transitioning a single mammography unit necessitated transitioning all workstations
  - Benefit achieved by transitioning ALL sites
    - Large scope, high cost
      - Transition needed to be carefully considered and planned out

Transition Timeline

2019 Q2

- Cost-benefit analysis presented to administration
- Obtained approval to transition enterprise in 2020

Costs and Considerations

- Transitioning does not necessarily make sense for everyone
- Costs need to be detailed to administration:
  - Phantoms
  - Technologist Training
  - Software and/or Development (tools, templates, etc.)

Costs and Considerations

- Vendor will not necessarily provide QC training specific to the ACR QC Manual for new sites or installs
  - Who will conduct this training?

Costs and Considerations

First unit transitioned starts the ticking clock for all peripheral equipment:

- All workstations that read for than unit must be transitioned before the next regularly scheduled annual survey for that mammography unit

The American College of Radiology Digital Mammography QC Manual: Frequently Asked Questions (revised 10/03/2019), p5. https://www.acraccreditation.org/-/media/ACRAccreditation/Documents/Resources/DMQC/DMQCFAQs.pdf?la=en

Gains/Impact

- Time Savings
  - Technologist
    - Streamlined routine QC
    - Dashboards and failure tracking
  - Lead Interpreting Physician
    - Electronic sign-off for quarterly reviews
  - Physicist
    - Minimal template management

Not about doing “less” ... About making it *easier* to do the *right thing better*

Tips

- Include your LIP and Mammography supervisors/administrators in conducting the cost-benefit analysis
  - Ensure you don’t miss anything
  - Knowing what the effort will involve (especially TIME) helps set expectations

Transition Timeline

2019 Q2

- Cost-benefit analysis presented to administration
- Obtained approval to transition enterprise in 2020

2019 Q3

- Develop beta version of ModalityQC v.3:
  - Online QC logs
  - Automatic reports
- Physics testing template

Meeting with QC Supervisors

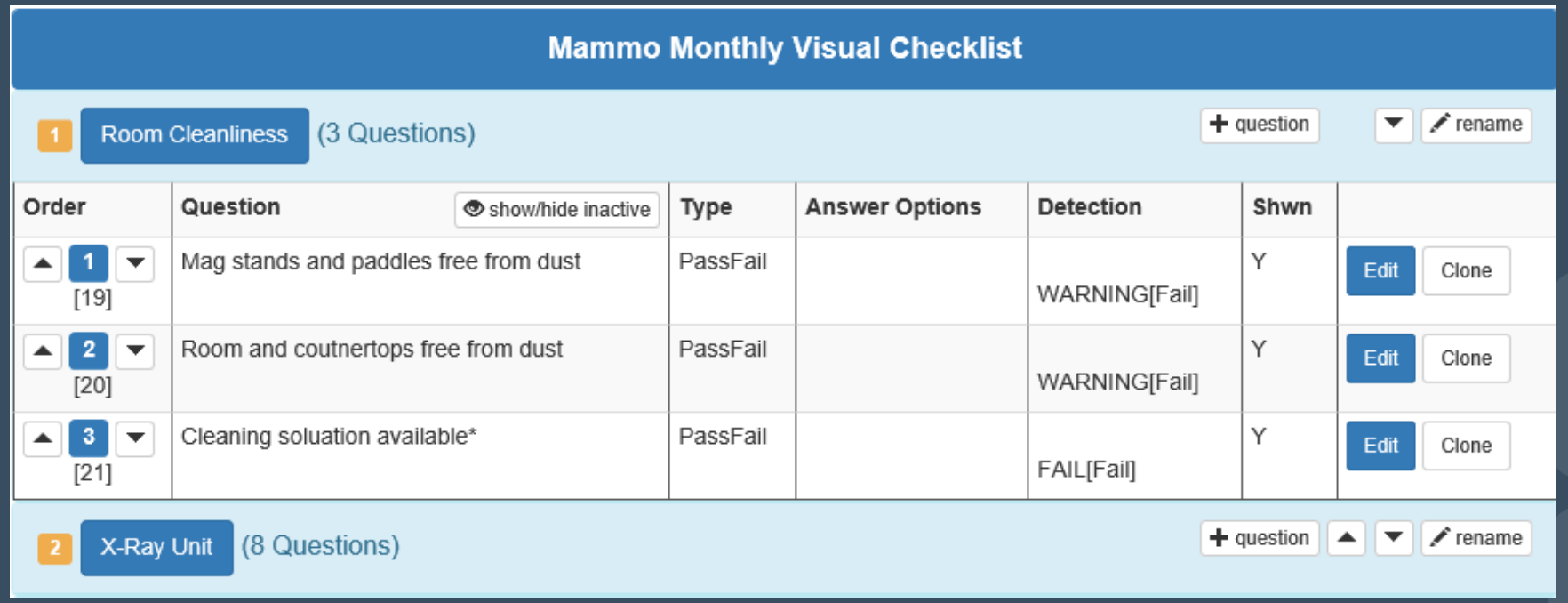
- Sat down with QC Supervisors before building out Modality QC v.3
  - Ultimately, this tool was for them and their techs
  - Opportunity for them to outline:
    - Wish-List
    - Biggest pain points
      - Keeping track of service tickets
      - Monitor QC

Objectives

- Ensure forms can be updated quickly, as necessary
- Make electronic QC logs simple to use and hard to screw up
- Make it easier to manage remote sites and know what's going on:
  - How many units down?
  - How many service calls open?

QC Log Design

- Dynamic smart-form designer
  - Can be used to build and design forms for any modality



Mammo Monthly Visual Checklist

1 Room Cleanliness (3 Questions) — + question — rename

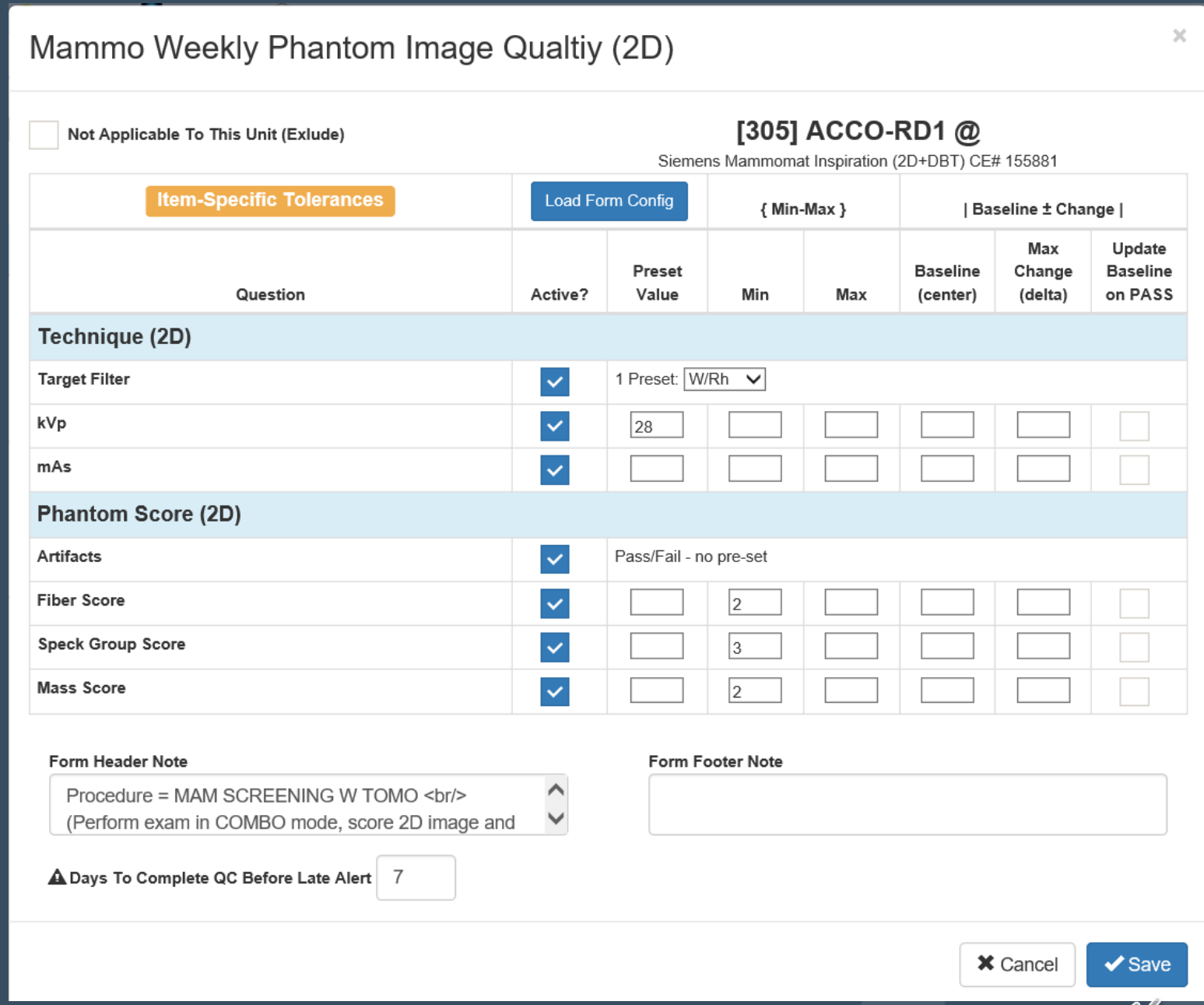
Order	Question (show/hide inactive)	Type	Answer Options	Detection	Shwn	
1 [19]	Mag stands and paddles free from dust	PassFail		WARNING[Fail]	Y	Edit Clone
2 [20]	Room and coutnertops free from dust	PassFail		WARNING[Fail]	Y	Edit Clone
3 [21]	Cleaning soluation available*	PassFail		FAIL[Fail]	Y	Edit Clone

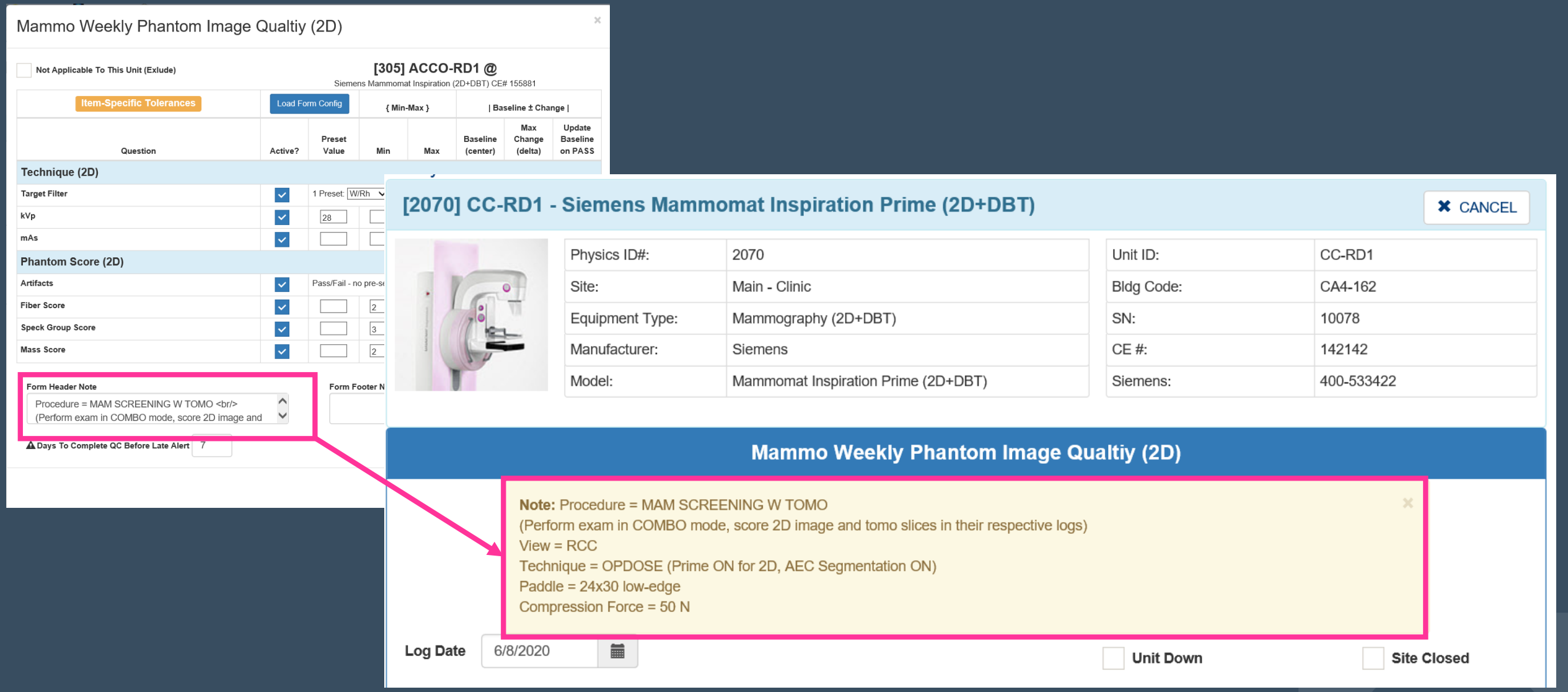
2 X-Ray Unit (8 Questions) — + question — rename

Option to deactivate form or fields that are not applicable

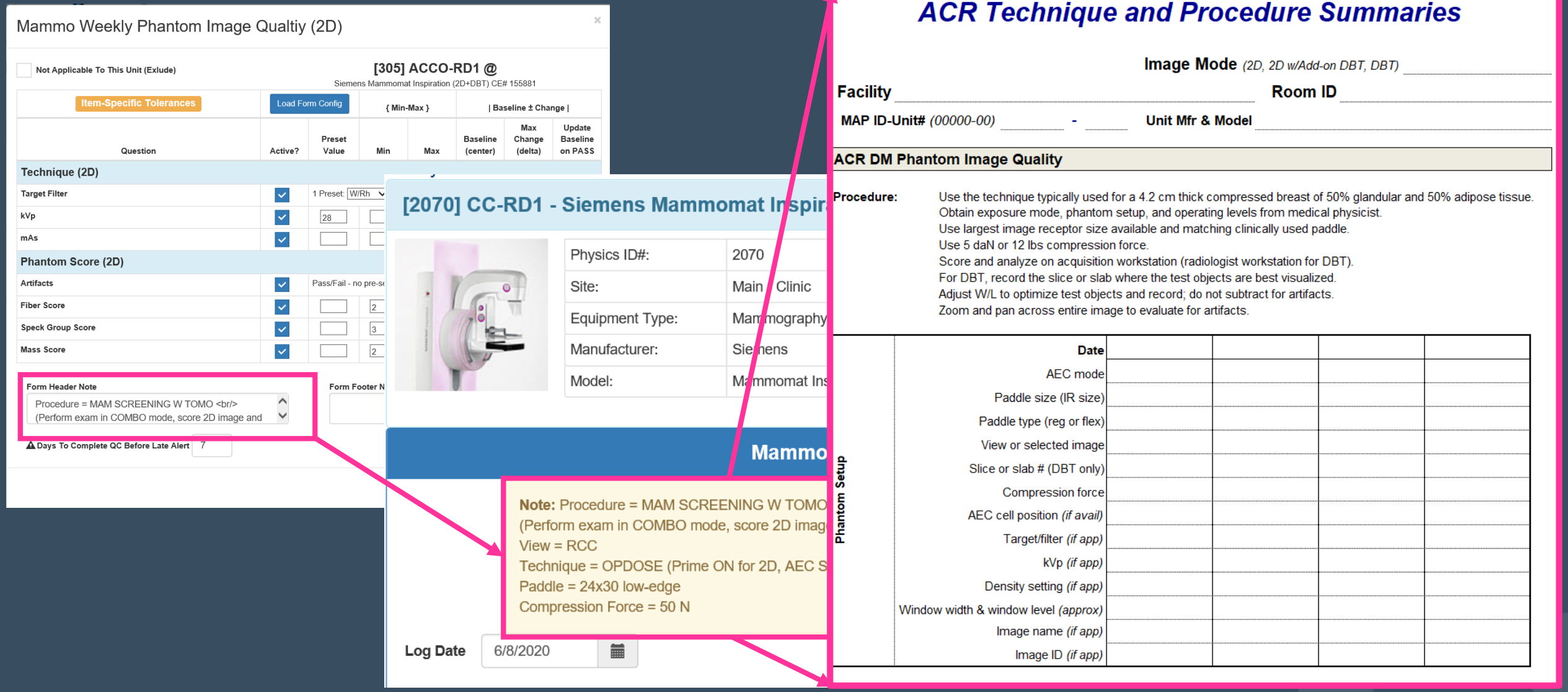
Customization at the item-level:

- Presets
- Tolerance criteria
- Headers/footers





Consolidated instructions for the technologist



Contains the information of the “ACR Technique and Procedures Summary”

Technique (2D)

Target Filter W/Rh

kVp 28

mAs

Phantom Score (2D)

Artifacts Pass | Fail

Fiber Score - select -

min passing: 2

Speck Group Score - select -

min passing: 3

Mass Score - select -

min passing: 2

Scoring Diagram

Scoring		Full Point	Half Point
	Fibers	≥ 8 mm long	≥ 5 and < 8 mm long
	Specks	4 - 6 specks	2 - 3 specks
	Masses	≥ ¾ border	≥ ½ & < ¾ border

Failures in phantom image quality MUST be corrected BEFORE clinical use.

Artifacts Pass | Fail

Fiber Score 0.5
min passing: 2

Speck Group Score 3.0
min passing: 3

Mass Score 1.0
min passing: 2

Scoring Diagram

Scoring		Full Point	Half Point
	Fibers	≥ 8 mm long	≥ 5 and < 8 mm long
	Specks	4 - 6 specks	2 - 3 specks
	Masses	≥ ¾ border	≥ ½ & < ¾ border

Alert

FAILURE DETECTED!
Please select **Action Taken** (or correct data entry)

OK

Summary of Failed Checks

- [Artifacts @ Fail]=[Fail]
- [Fiber Score @ 0.5] under {2}
- [Mass Score @ 1.0] under {2}

Action Taken Regarding Failed Checks - select -

- Will Repeat QC Test
- Medical Physicist Consulted AND Service Ordered
- Medical Physicist Consulted
- Service Ordered
- Other (specified in comments)

- select -

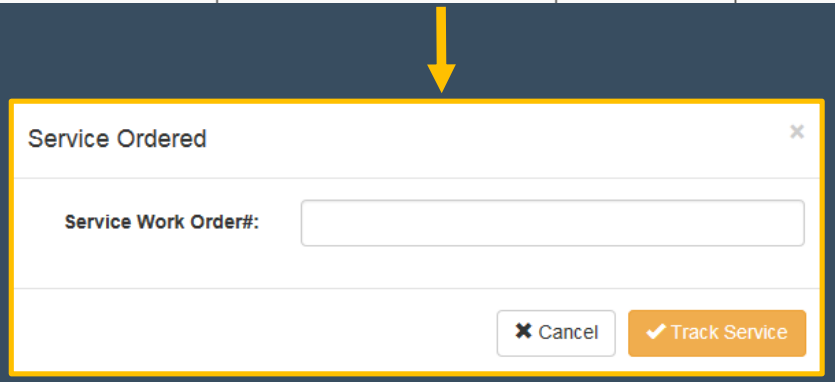
Alert

Comments are required when Quality Control checks fail or are outside the acceptable limits.

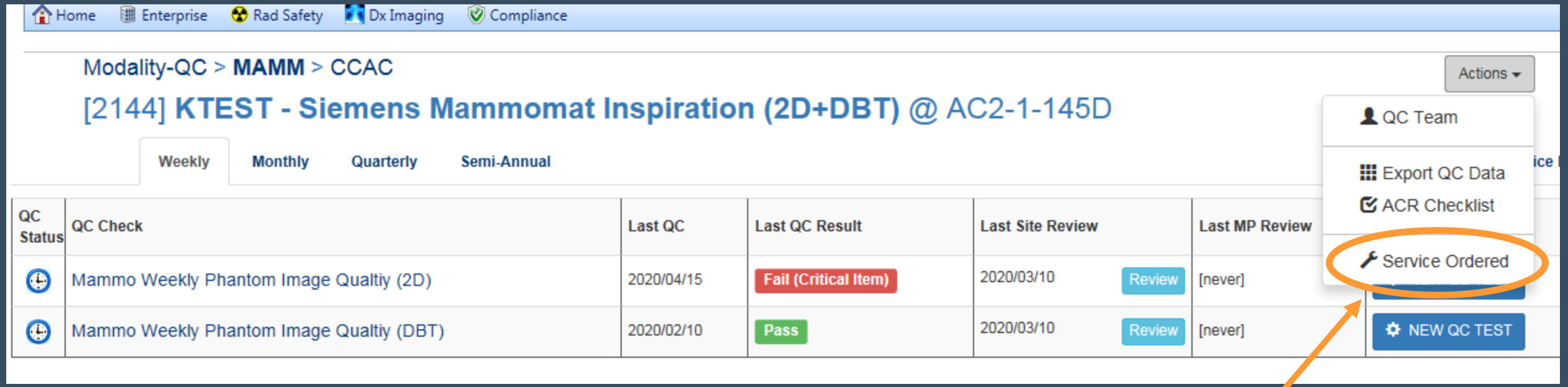
OK

Tracking Service

Log Date	Unit Status	QC Result	Logged By	Logged Date	Comments	Fail Action	Site Review	MP Review
2020-04-15	Active	Fail (Critical Item)	Hulme, Katie	2020-04-15 09:42	I called them>>[Artifacts @ Fail]=[Fail]; >>[Fiber Score @ 1.0] under {2};	Service Ordered Add WO		



Tracking Service



Tracking Service

Modality-QC > **MAMM** > Lorain FHSC

Actions

[2595] RD1 - Siemens Mammomat Inspiration Prime (2D+DBT) @ LR2-141

Weekly | Monthly | Quarterly | Semi-Annual | Survey and Service Log

Survey Type: All | **Has Failures:** No Filter | **Done By:** Any

Survey Status: Any | **Pending CA:** No Filter | **Reviewer:** Any

Review: Any | **Year:** All | **Month:** - no filter -

7 Records Found

Survey Date	Due Date	Survey Type	Done By	Survey Status	Result	Fail #	Pend.CA	Reviewer	Report	Pend.SO	Fil
2021-01-24	2021-02-24	Annual	[redacted]	Projected		0	0	Hulme, Katie		0	
2020-04-29	2020-05-30	Service	[redacted]	Completed	F-P3	1	0	Non-CCF/Service Engineer,	Closed	0	
2020-04-09	2020-05-22	Service	[redacted]	Completed	F-P3	1	0	Non-CCF/Service Engineer,	Closed	0	
2020-01-24	2020-03-10	Annual	[redacted]	Completed	P	0	0	Hulme, Katie	Closed	0	
2019-01-22	2019-01-22	Post-Repair (Approval Only)	[redacted]	Completed	P	0	0	Hulme, Katie	Closed	0	
2019-01-10	2019-11-27	Annual + Post-Repair	[redacted]	Completed	P	0	0	Hulme, Katie	Closed	0	
2018-09-27	2018-09-28	Acceptance	[redacted]	Completed	P	0	0	Hulme, Katie	Closed	0	

Site:	Lorain Family Health and Surgery Center	**Bldg Code:**	LR2-141
Equipment Type:	Mammography (2D+DBT)	**SN:**	11011
Manufacturer:	Siemens	**CE #:**	226705
Model:	Mammomat Inspiration Prime (2D+DBT)	**Siemens:**	400-606449

Survey Info

Updated: 4/30/2020 10:36:16 AM by WEBERR1

Survey Date:	04/29/2020	**Due Date:**	05/30/2020
Status:	Completed	**Review Status:**	Closed
Type:	Service	**Performed By:**	Non-CCF/Service Engineer, - *04/29/2020*
Repair Type:	Other	**Reviewer:**	Non-CCF/Service Engineer, - *04/29/2020*
Additional Staff:	-none-		

Add Staff

Send Failure Email Re-open Replace PDF

Survey Report and Failures

Survey Result: Fail - P3 (Non Urgent Scheduled Service)

Survey Report: View Report

Review started: **4/29/2020**

Edit **Comments:** Power Outage Unit will not come back up Service Ordered >> WO#[3608415]

	Failure Type	WO #	CA Documentation	Updated	Updated By	CA Done?	
	Equipment Issue Power Outage Unit will not come back up Service Ordered >> WO# [3608415]	3608415	Service Approval	4/30/2020 10:36:03 AM	WEBERR1		

Site:	Lorain Family Health and Surgery Center
Equipment Type:	Mammography (2D+DBT)
Manufacturer:	Siemens
Model:	Mammomat Inspiration Prime (2D+DBT)

Survey Info

Survey Date:	04/29/2020
Status:	Completed
Type:	Service
Repair Type:	Other
Additional Staff:	-none-

Add Staff

Send Failure Email

Survey Report and Failures

Survey Result: Fail - P3 (Non Urgent Scheduled Service)

Edit **Comments:** Power Outage Unit will not come back up Service Ordered >> WO#[3608415]

	Failure Type	WO #	CA D
	Equipment Issue Power Outage Unit will not come back up Service Ordered >> WO#[3608415]	3608415	

Corrective Action Log

Facility ..... **MAP ID#** *(00000-00)* ..... - .....

om or Equipment ID ..... **Date** .....

QC Test Name and # (if app):

Description:

Relevant Personnel Notified: (Radiologist, MP, tech, manager, service engineer)

Personnel Name:

Date/Time of Call/Notification:

Describe Actions Taken:

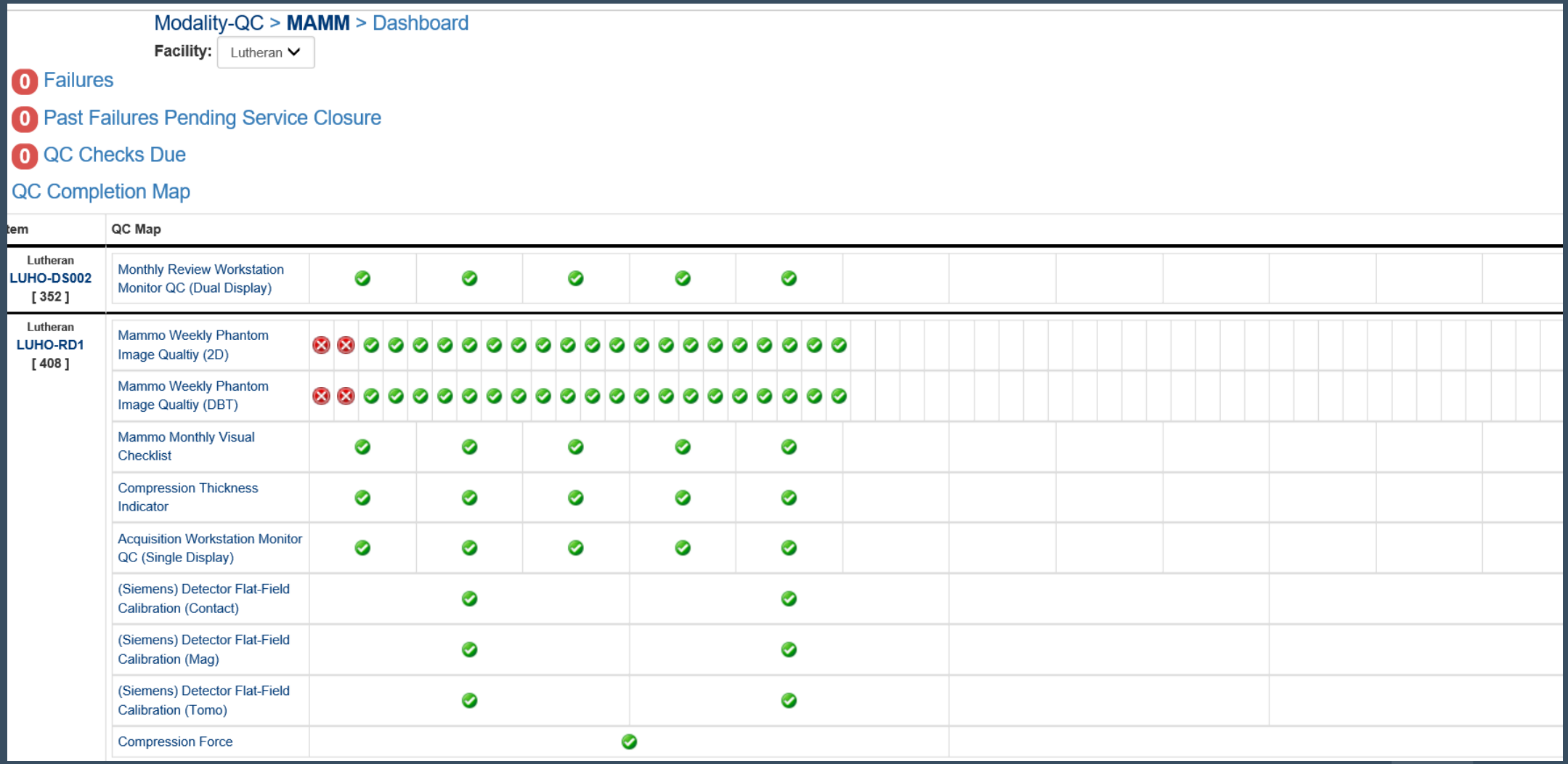
Confirmation of Resolution:

	Yes	To Be Monitored	NA
Event resolved?	☐	☐	☐
Documentation from service engineer obtained?	☐	☐	☐

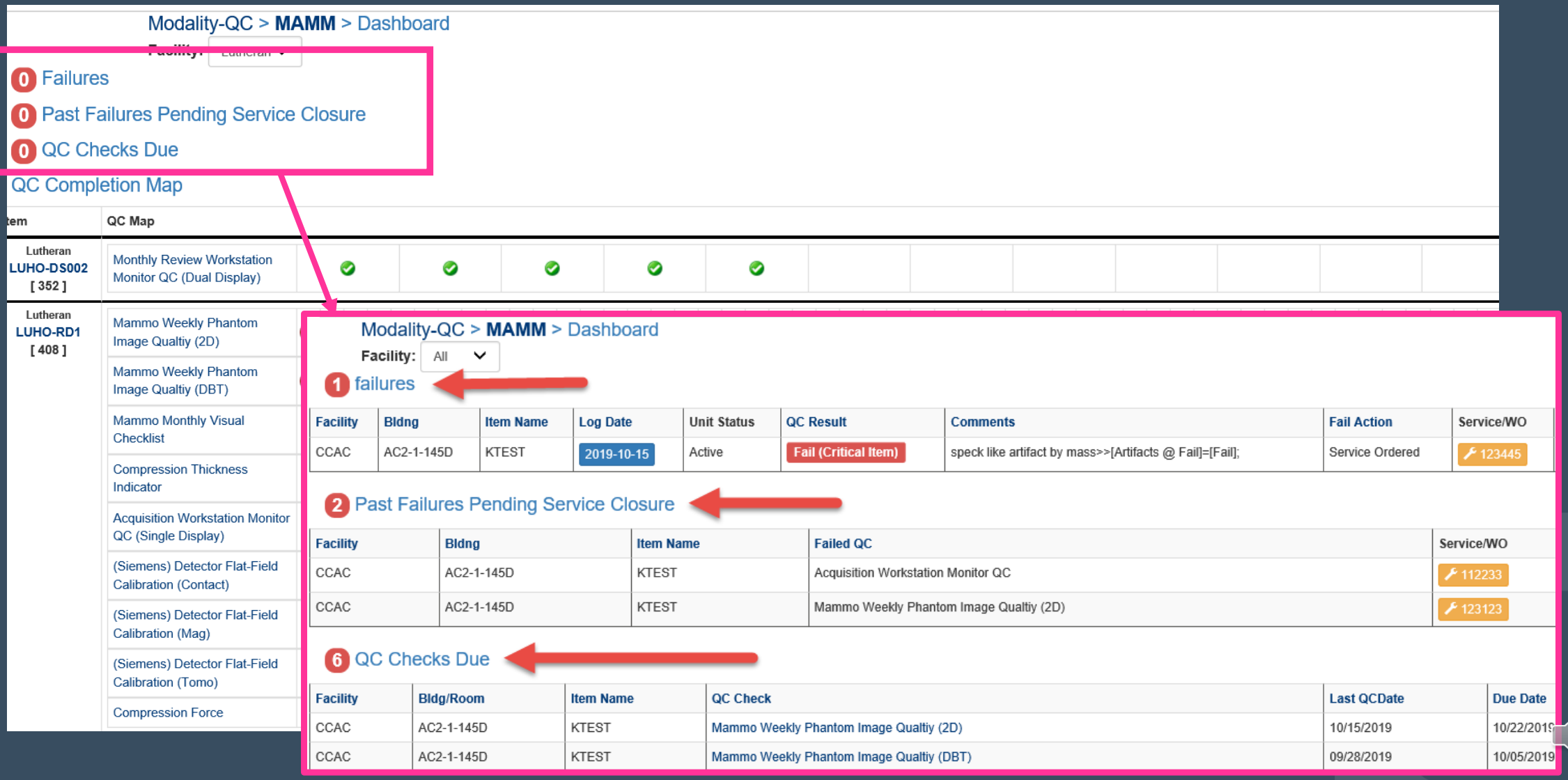
Tech Signature .....

Date .....

Dashboards


Modality-QC > MAMM > Dashboard
Facility: Lutheran
0 Failures
0 Past Failures Pending Service Closure
0 QC Checks Due
QC Completion Map
tem
QC Map
Lutheran
LUHO-DS002
[352]
Monthly Review Workstation Monitor QC (Dual Display)
Lutheran
LUHO-RD1
[408]
Mammo Weekly Phantom Image Qualtiy (2D)
Mammo Weekly Phantom Image Qualtiy (DBT)
Mammo Monthly Visual Checklist
Compression Thickness Indicator
Acquisition Workstation Monitor QC (Single Display)
(Siemens) Detector Flat-Field Calibration (Contact)
(Siemens) Detector Flat-Field Calibration (Mag)
(Siemens) Detector Flat-Field Calibration (Tomo)
Compression Force

Dashboards


Modality-QC > MAMM > Dashboard
0 Failures
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(Siemens) Detector Flat-Field Calibration (Contact)
(Siemens) Detector Flat-Field Calibration (Mag)
(Siemens) Detector Flat-Field Calibration (Tomo)
Compression Force
Modality-QC > MAMM > Dashboard
Facility: All
1 failures
Facility | Bldng | Item Name | Log Date | Unit Status | QC Result | Comments | Fail Action | Service/WO
CCAC | AC2-1-145D | KTEST | 2019-10-15 | Active | Fail (Critical Item) | speck like artifact by mass>>[Artifacts @ Fail]=[Fail]; | Service Ordered | 123445
2 Past Failures Pending Service Closure
Facility | Bldng | Item Name | Failed QC | Service/WO
CCAC | AC2-1-145D | KTEST | Acquisition Workstation Monitor QC | 112233
CCAC | AC2-1-145D | KTEST | Mammo Weekly Phantom Image Qualtiy (2D) | 123123
6 QC Checks Due
Facility | Bldg/Room | Item Name | QC Check | Last QCDate | Due Date
CCAC | AC2-1-145D | KTEST | Mammo Weekly Phantom Image Qualtiy (2D) | 10/15/2019 | 10/22/2019
CCAC | AC2-1-145D | KTEST | Mammo Weekly Phantom Image Qualtiy (DBT) | 09/28/2019 | 10/05/2019

Physics Template

- Changes made to ACR template to adapt it for internal use:
  - Imported inventory from SQL database to auto-populate “Facility, Unit and Test Equipment” page
  - Created look-up tables with the settings to use for each test based on Make/Model

Items of Clarification

- AEC settings for Phantom Image Quality (AEC Segmentation ON or OFF)?

Q. When performing the Phantom Image Quality test, what settings should be used to acquire the phantom image?

A. Some manufacturers have historically included in their QC manual phantom image quality test procedure a step to fix the AEC "sensor" position, or to fix automatic segmentation features, or fix kVp settings, in order to ensure the phantom image quality acquisitions are consistently performed. With ACR's QC manual and the new, larger phantom, this accommodation is unnecessary. For facilities using the ACR manual, the phantom image quality test must be performed using the same image acquisition settings that are used in routine patient screening mammography exams.

The American College of Radiology Digital Mammography QC Manual: Frequently Asked Questions (revised 10/03/2019), p8-9. https://www.acraccreditation.org/-/media/ACRAccreditation/Documents/Resources/DMQC/DMQCFAQs.pdf?la=en

Transition Timeline

2019 Q2

- Cost-benefit analysis presented to administration
- Obtained approval to transition enterprise in 2020

2019 Q3

- Develop beta version of ModalityQC v.3:
  - Online QC logs
  - Automatic reports
- Physics testing template

2019 Q4

- Beta test ModalityQC v.3 at MC
- Beta test Medical Physics annual testing on select units
- Annual Mammography QC Meeting

Modality QC - Beta Testing

- 2 units + 2 workstation + 2 techs
  - Trained technologists on ACR QC and electronic QC logs
    - Conducted ACR QC in conjunction with manufacturer QC for 1 month
  - Purpose
    - Identify bugs in the software
    - Opportunity to develop training materials early and obtain technologist feedback

Annual Mammography QC Meeting

- Early December
- Attendees:
  - Lead QC techs and administrators from all CCF facilities
  - Physicists that perform mammography surveys

Annual Mammography QC Meeting

- Objectives:
  - Review programmatic changes for the new year, including:
    - ACR QC Manual Transition
      - Motivations
      - Roll-out schedule
      - Where and when to order the phantom

Annual Mammography QC Meeting

- Conducted hands-on ACR QC Training session for Phase 1 sites immediately following annual meeting
  - Dropped this for Phase 2 sites, on-site training the day of was found to be sufficient

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2019 Q3

- Develop beta version of ModalityQC v.3:
  - Online QC logs
  - Automatic reports
- Physics testing template

2019 Q4

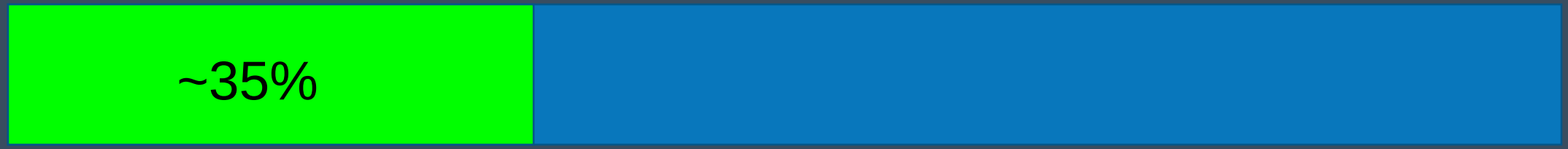
- Beta test ModalityQC v.3 at MC
- Beta test Medical Physics annual testing on select units
- Annual Mammography QC Meeting

2020 Q1

- Phase1 of roll-out begins

Current Status

- As of this presentation, have transitioned:
  - 15/41 sites
  - 24/71 units



Transitioning a Site

- Sites cannot transition to the ACR QC Manual until the physicist has conducted an annual survey of the digital mammography unit using the ACR DM QC manual and phantom (transition survey)

Single-Unit Sites

- Physics Testing - AM
- Technologist QC Training (1 hour) - PM
  - Conducted on-site immediately following physics testing
  - Perform and log all weekly, monthly, semi-annual QC
    - Siemens: only tests NOT performed were the quarterly detector calibrations, date of last calibration was logged and recorded

Hands-On Training

- Q1 - All hands-on QC training conducted on-site by Medical Physics
- Q2 - QC Supervisors trained and hands-on QC training split between Medical Physics and QC Supervisors

Lessons Learned:

- Execution stage easier than the planning stage ☺
- None of the sites that have transitioned have had an MQSA inspection yet…
  - Physicist will attend the first few inspections as there will surely be some bumps!

Lessons Learned:

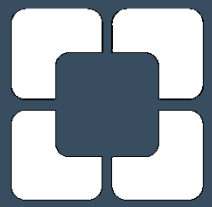
- Anticipate possible issues with ROI measurements for DBT and have a plan in place
  - Export your DICOM images or have the facility burn you a CD
  - Possible DICOM readers w/ ROI statistics:
    - Osirix
    - K-PACS

Lessons Learned

- Remind them to buy their phantom!
  - Divided sites up by quarter, sent reminder email the 2nd month of the preceding quarter
- Emphasize the purpose behind what is happening
  - If it is not in their best interest, you shouldn't be doing it!
- Your confidence helps their confidence

Acknowledgements

- Vadim Kartuzov (our computer whiz)
- Grant Fong, MS
- Shelly Weber, RT
- Pat Murphy, RT



Cleveland Clinic

Every life deserves world class care.