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Development of a Quality Assurance Program for Breast Magnetic Resonance Imaging Can Significantly Decrease Defect Rates

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Introduction

- Non diagnostic and suboptimal breast MRI studies waste time and money, and can cause both radiologist and patient dissatisfaction.
- Any study which could not be read was considered defective.
- Over a period of 2 months, 66 studies were performed.
- 17% of studies (11 studies) were defective and could not be read.
- Of these, 6% (4 studies) were so severe, that a repeat study was necessary (patient callback).
- Using LEAN principles, we developed a quality assurance program to decrease this defect rate.

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Key Stakeholders investigated defects

- Key Stakeholders
  - MRI operational manager RT(R)(MR)(M)
  - Breast MRI section head MD,MS
- Stakeholders
  - All Radiologists who read Breast MRI's
- Pareto Chart tallied frequency of each defect

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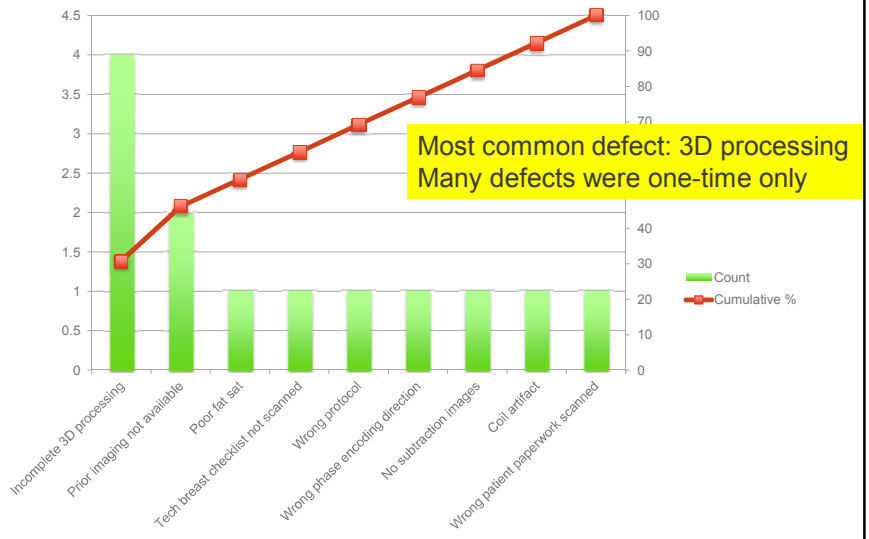
Pareto Chart to Identify Defects



Most common defect: 3D processing
Many defects were one-time only

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Fishbone Diagram

- Used in Root Cause Analysis.
- Identified all contributing causes to problem.
- Characterized defects by common themes or responsibilities.

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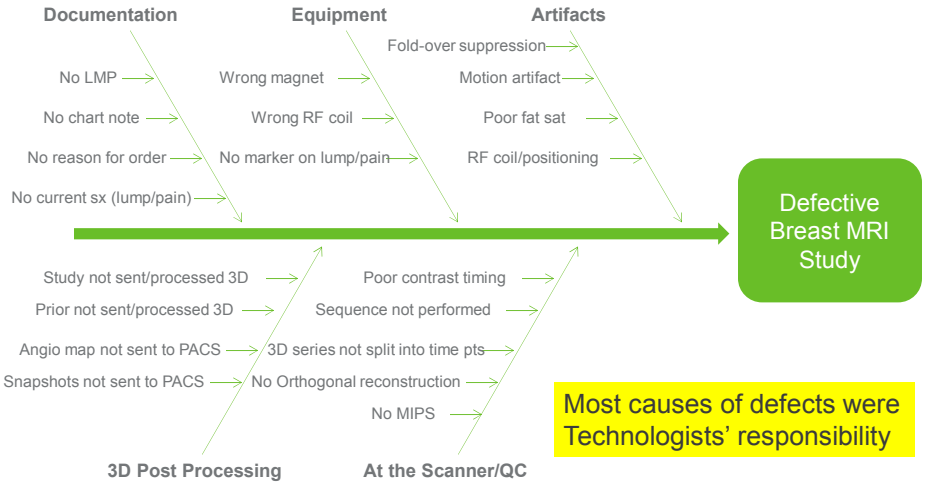
Breast MRI Study Defects which cause Failure



Most causes of defects were Technologists' responsibility

Proposed Technologist Re-education

- As most of the identified causes of defects were the technologists' responsibility, technologist re-education was proposed.
- The MRI Accreditation Requirements for Technologists by the ACR was used as a reference.

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ACR requires tech to perform 50 Breast MRI studies /2 yrs

Breast Magnetic Resonance Imaging (MRI) Accreditation Program Requirements

ACR® AMERICAN COLLEGE OF RADIOLOGY

Technologist

All technologists performing breast MRI examinations ***must*** meet the minimum criteria in the table below. The ACR ***recommends*** that technologists be certified and actively registered in the modality they perform. In addition, the ACR ***recommends*** that technologists performing breast MRI hold the Current Basic Life Support certification and be capable of using an automatic external defibrillator.

Qualifications	Technologist
Initial	• Registered in MRI by the – American Registry of Radiologic Technologists (ARRT), ***or*** – American Registry of MRI Technologists (ARMRIT), ***or*** – Canadian Association of Medical Radiation Technologists (CAMRT) **OR** • Registered in radiography by the ARRT and/or unlimited state license, ***and*** • 6 months supervised clinical MRI scanning experience **OR** • Associate's or bachelor's degree in an allied health field, ***and*** • Certification in another clinical imaging field (e.g., ARDMS or NMTCB), ***and*** • 6 months supervised clinical MRI scanning experience
	AND • Licensure in the state in which he/she practices (if required for MRI technologists)
	AND • Supervised experience in breast MRI, ***and*** • Supervised experience in the intravenous administration of MR contrast (if contrast administration is performed by the technologist)
Continuing Experience	Upon renewal, ***50*** breast MRI examinations in the prior ***24 months***
Continuing Education	• Registered technologists – In compliance with the CE requirements of their certifying organization for the imaging modality in which they perform services – CE includes credits pertinent to the technologist's ACR accredited clinical practice • State licensed technologists – 24 hours of CE every 2 years – CE is relevant to imaging and the radiologic sciences, patient care – CE includes credits pertinent to the technologist's ACR accredited clinical practice • All others – 24 hours of CE every 2 years – CE is relevant to imaging and the radiologic sciences, patient care – CE includes credits pertinent to the technologist's ACR accredited clinical practice

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Technologist Selection and Certification

- The breast MRI volume at our main facility maximally supported 15 technologists.
- 15 technologists were selected by the stakeholders to undergo the certification process (3 techs were dropped based on volume).
- The certification process included:
  - Key stakeholders created a checklist (of output variables) which defined a quality study.
  - Key stakeholders reviewed 5 random studies performed by each tech against checklist.
  - At least 1 of the 5 studies must be from each of the 2 different magnet vendors.
- If all 5 studies passed the entire checklist, the technologist was certified.
- If any study had a defect in any output variable, the technologist was on probation and had to complete an additional 5 studies defect-free under the supervision of a "Super-tech"

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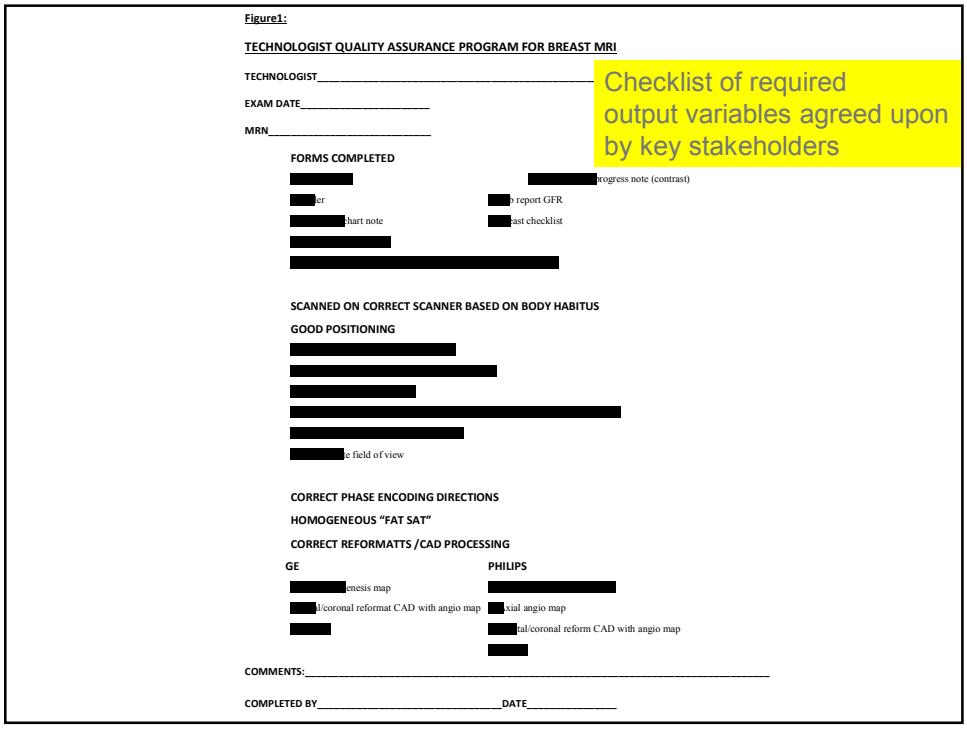

Figure1:

TECHNOLOGIST QUALITY ASSURANCE PROGRAM FOR BREAST MRI

TECHNOLOGIST_____

EXAM DATE_____

MRN_____

Checklist of required output variables agreed upon by key stakeholders

FORMS COMPLETED

[redacted]rogress note (contrast)

[redacted]er

[redacted]o report GFR

[redacted]hart note

[redacted]ast checklist

[redacted]

[redacted]

SCANNED ON CORRECT SCANNER BASED ON BODY HABITUS

GOOD POSITIONING

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]e field of view

CORRECT PHASE ENCODING DIRECTIONS

HOMOGENEOUS "FAT SAT"

CORRECT REFORMATTS /CAD PROCESSING

GE	PHILIPS
[redacted]enesis map	[redacted]
[redacted]l/coronal reformat CAD with angio map	[redacted]xial angio map
[redacted]	[redacted]tal/coronal reform CAD with angio map
	[redacted]

COMMENTS:_____

COMPLETED BY_____**DATE**_____

“Super-Techs”

- 4-5 certified technologists who showed interest and demonstrated skill as subjectively assessed by the key stakeholders were designated as Super-techs.
- At least one Super-tech was present on each shift.
- Super-tech responsibilities:
  - Supervised any technologist on probation on their shift.
  - Were available to answer any questions from certified technologists.

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Elimination of Waste

- A Value Stream Map was created to identify opportunities to decrease wasted effort.
- The LEAN term for waste is “Muda”.
- All stakeholders (all reading radiologists) agreed to the Muda classification of any activity prior to its elimination.

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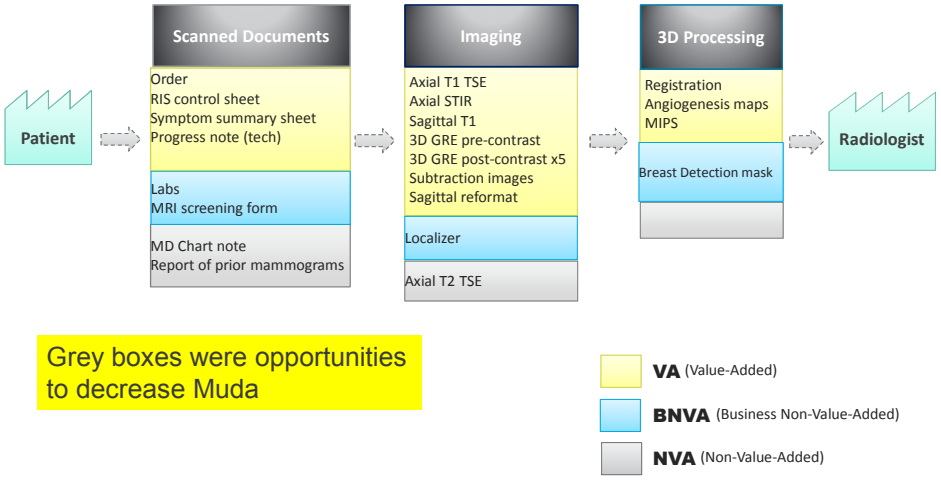
Breast MRI QI
Value Stream Mapping



Grey boxes were opportunities to decrease Muda

VA (Value-Added)

BNVA (Business Non-Value-Added)

NVA (Non-Value-Added)

Muda

- **Documentation.** With our new EHR, some information was newly readily available. Scanning a document with the same information was redundant.
  - MD Chart note
  - Prior mammogram report
- **MRI Pulse sequence**. Minimizing number of pulse sequences reduced scan time, thereby decreasing risk of patient motion.
  - T2 TSE was eliminated after optimizing STIR and T1 TSE

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Post Technologist Certification Breast MRI

- All stakeholders (reading radiologists) were active participants.
- They flagged a study with a defect as either “Hold-do not read” or “Read-with subsequent quality review”.
- The Operational Manager was responsible for resolving any “Hold” issue within 2 hours (e.g. obtaining necessary documents, processing study on 3D software, implementing patient call-back procedure).
- The Operational Manager performed the “quality review” of the other flagged studies on a regular basis.

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Technologist Breast MRI Checklist

- A checklist was created by the key stakeholders for the technologists to keep by and use at the MRI console (Figure 2)

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Techs use Checklist at MRI console

Figure2

Technologist Breast MRI Checklist

- ☐ Mark area of lump or pain
- ☐ If patient is barrel chested or large breasted : switch to sentinelle table
- ☐ Breast MRI form must be completed by patient (need LMP)
- ☐ Check GFR/labs
- ☐ Follow appropriate Breast MRI protocol per ECMS guidelines
- ☐ Confirm positioning: Axillary tail, inframammary fold, breast not touching bottom
- ☐ Confirm phase encoding is Right to Left on axial images and Superior to Inferior on sagittal images
- ☐ Confirm good quality "fat sat" (do not inject if the fat sat is poor)and no artifacts
- ☐ Do subtractions
- ☐ On Philips scanner, do sagittal reformat on phase 1 post contrast scan.
- ☐ Send images to PACS, and then to CAD stream all at once
- ☐ Verify images are on PACS (sort the dynamic scan!)
- ☐ Verify Cad processed exam properly (GE has axial and coronal reformats, Philips needs sagittal and coronal reformats)
- ☐ Load prior studies to CAD
- ☐ Confirm all clinical documents are scanned, progress report, outside study reports and images are loaded to PACs.

Results

5 months after initiation of the technologist (re)training we measured the number of studies with defects (could not be read):

	Pre-intervention	Post-intervention
Total # studies	66	42
# studies w/defect	11	1
# studies w/severe defect	4	0

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Results

- Percentage of quality issues and rate of patient callback was calculated over a 2 month period after intervention (January-February 2015).
- A total of 42 studies were performed.
- Overall defect rate decreased from 17% to 2.4%. Using the Chi-square contingency table, the p value was calculated to be less than 0.02 ($p<0.02$) which is statistically significant.
- Severe defect rate (patient must be re-imaged) decreased from 6.1% to 0%. Due to the small number of severe defects, it is difficult to assess the statistical significance.

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Summary

- Identified key stakeholders (and all stakeholders)
- Identified and tallied defects (Pareto Chart)
- Categorized the defects (Fishbone Diagram)
- Identified who is responsible for the defects (technologists)
- Created technologist re-education and certification program
  - Identified maximal number of techs that could be supported by MRI volume
  - Created a checklist that defined a quality study
  - Certified techs based on checklist review of their studies on both magnets
  - Identified Super-techs
- Identified and eliminated waste (Value Stream Map identified Muda)
- Measured defect rate after intervention, decreased from 17% to 2%
- Future plans: Repeat every 1-2 years

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References

- Ref. (1). Michael L. George. *The Lean Six Sigma Pocket Tool Book*. McGraw-Hill, 2005.
- Ref (2). ACR. Breast Magnetic Resonance Imaging Accreditation Program Requirements, www.acr.org

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