Improving 3D MRCP Image Quality

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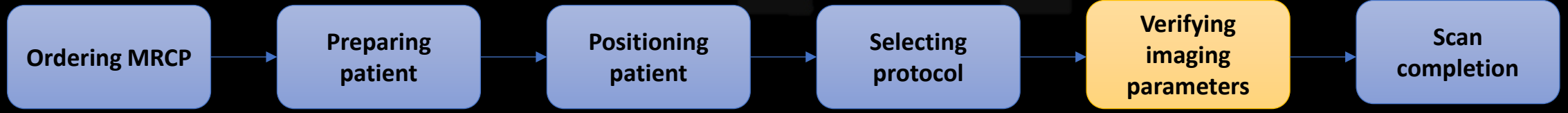
Background

- MRCP provides noninvasive imaging assessment of the biliary and pancreatic ductal systems without exposure to ionizing radiation
- Commonly used to assess a variety of disorders children
- MRCP image quality can be limited due to multiple factors: physical movement during exam, respiratory motion, and artifacts

Our goal: To improve the quality and consistency of MRCP exams

Methods

- Setting: MRCP-dedicated MRI units
- *Realizing Improvement Through Team Empowerment* (*RITE*) *methodology:* PDSA framework
- Team-based approach: Radiologists, MRI physicist, MRI technologists, QI specialists, research personnel
- Gemba walks: Team visited the MRI units used for MRCP acquisition
- Identified the steps that are followed from the moment the MRCP order was placed to the completion of the scan

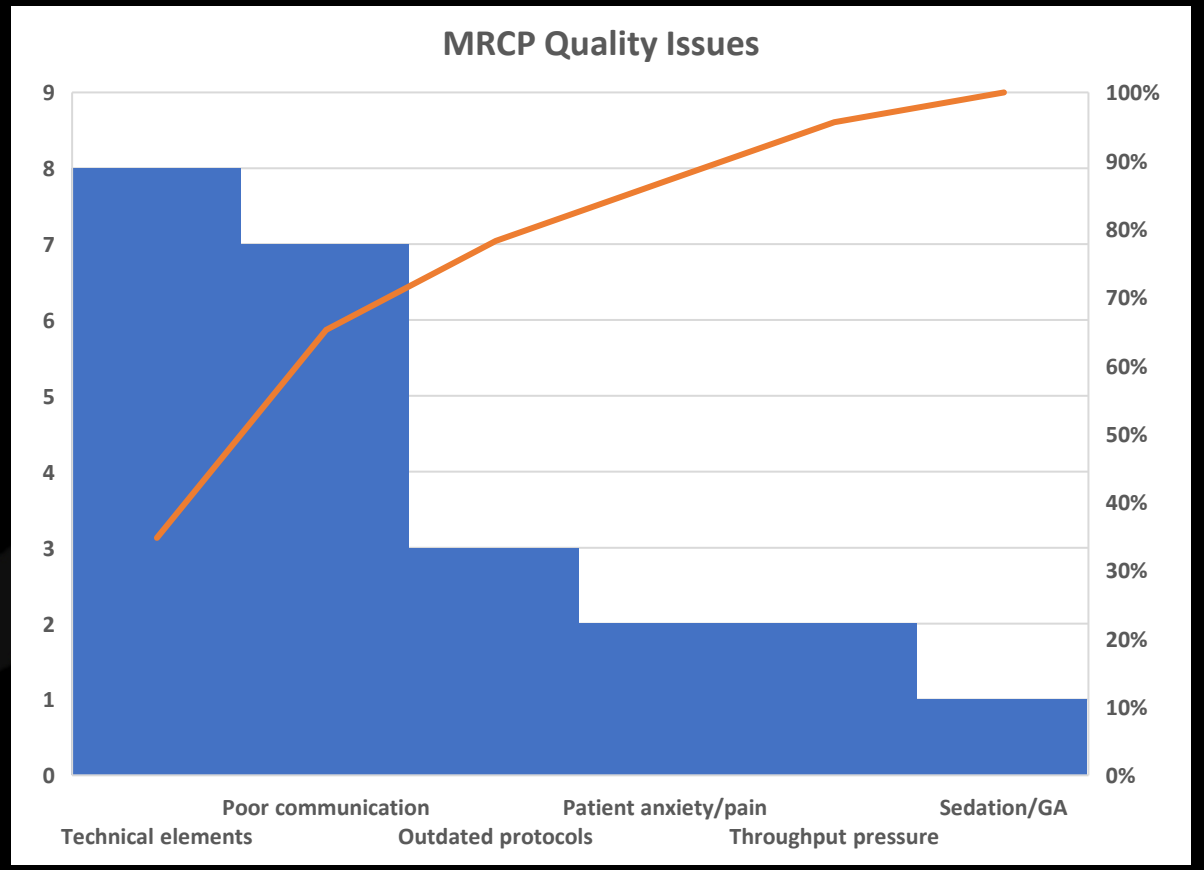


Factors Influencing MRCP Quality

1. Technical parameters variable among technologists – standardization was needed

2. Communication/feedback between radiologists, trainees, and technologists about image quality was lacking

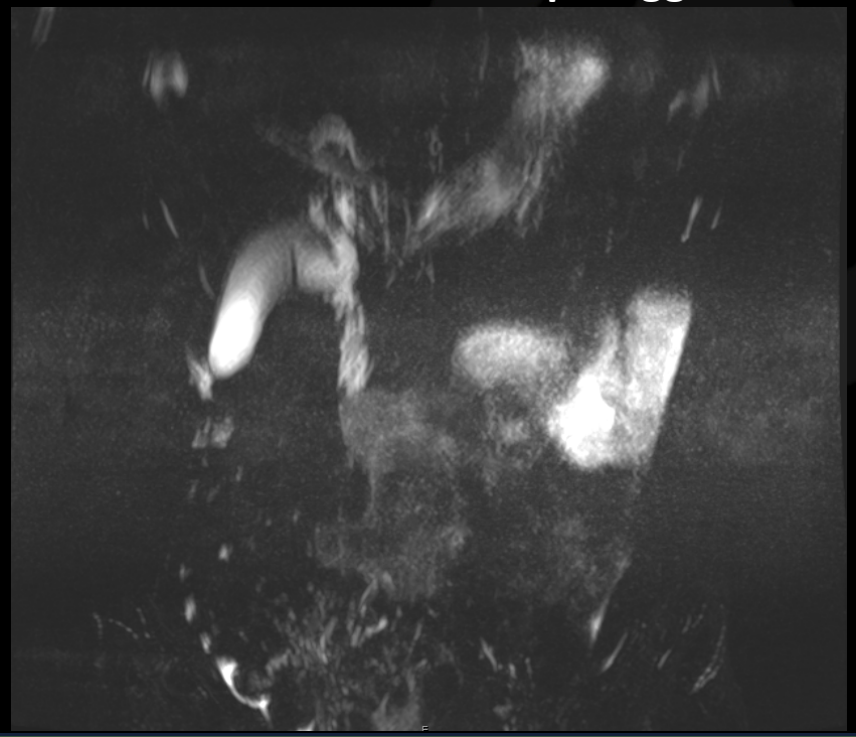
3. MRCP protocols needed updates



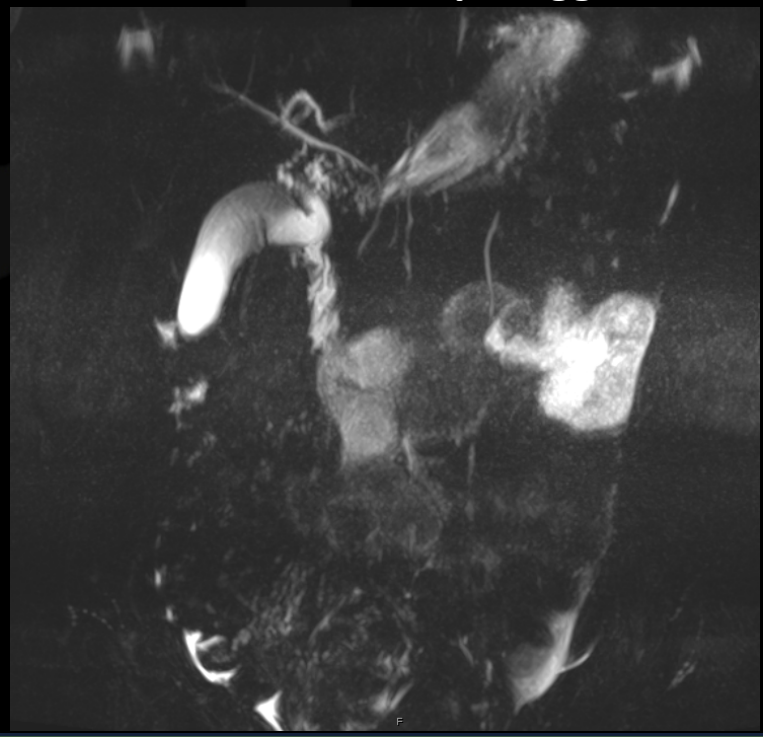
Respiratory gating

- The **3D T2W** sequence in the MRCP protocol needs to be respiratory-triggered
- If scan is performed without the trigger (free breathing) → decreased image quality was observed due to motion

3D T2W WITHOUT resp. trigger



3D T2W with resp. trigger



Interventions and Key-drivers

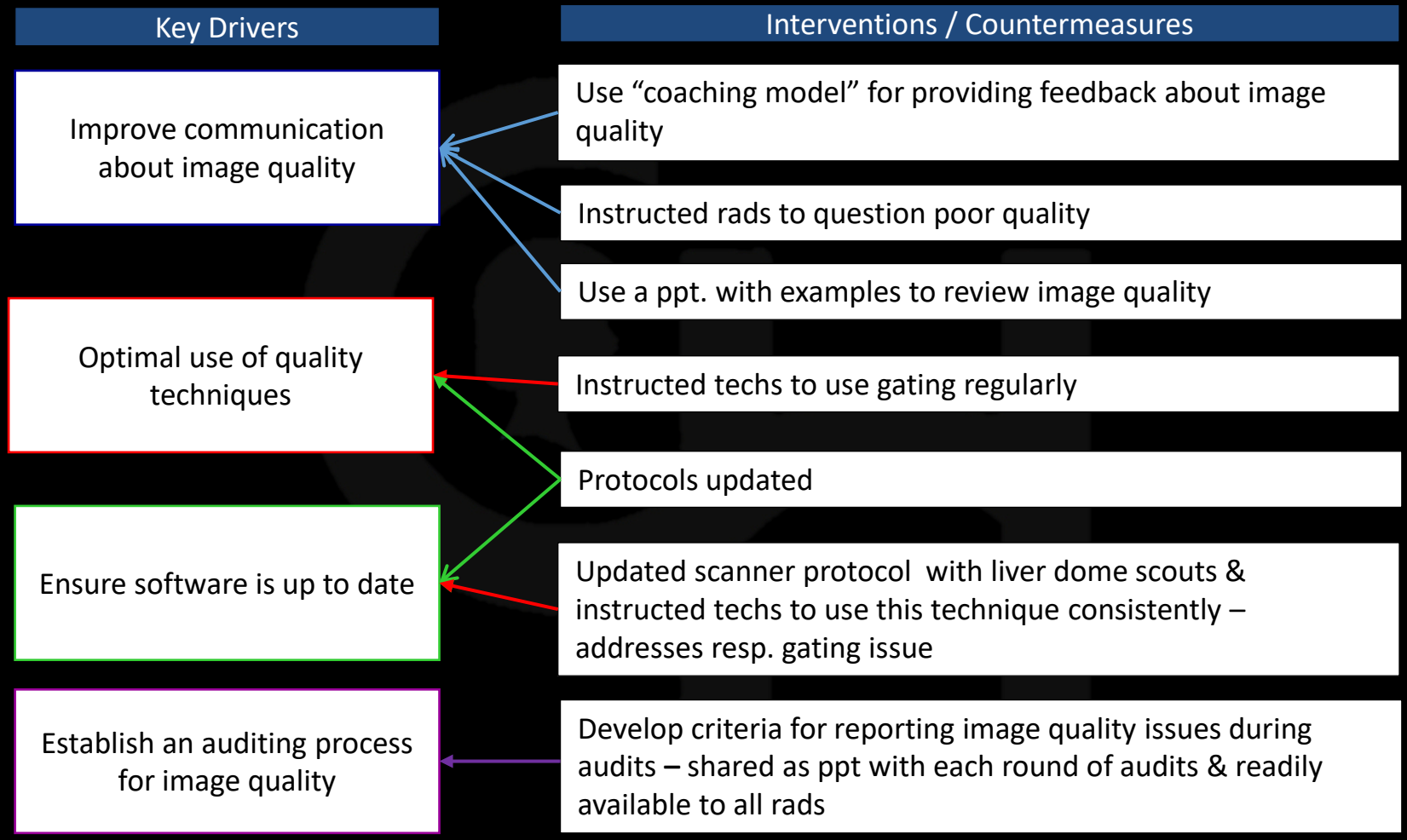


Image Quality Assessment

- Image quality was rated “subjectively” through a 5-point Likert scale
- 10 pediatric body radiologists: Experience ranging from 1 to >10 years

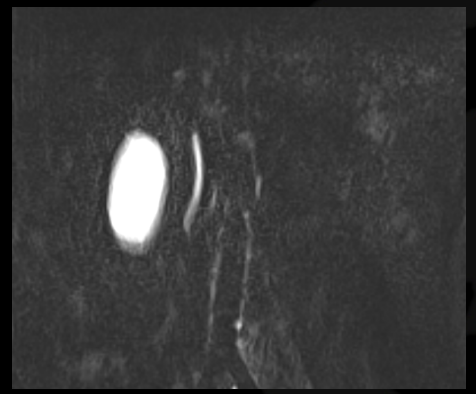
Quality Score Diagnostic confidence	1 Not diagnostic- absent diagnostic confidence	2 Inadequate-diagnostic Decreased diagnostic confidence	3 Adequate- Good quality Diagnostic confidence present	4 Very good quality Diagnostic confidence definitely present	5 Excellent quality Diagnostic confidence absolutely present
Artifacts	Severe artifacts- non-diagnostic exam (i.e. extreme motion, wrap artifacts)	Major artifacts present (major motion, with major wrap)	Moderate artifacts (moderate motion, with some wrap) Mild blurring around edge of ducts	Minor artifacts (minimal motion, minimal wrap)	No artifacts present
Background suppression on 3D SPACE seq	Very strong- making study non-diagnostic with no signal	Strong- difficult to interpret exam	Moderate- still diagnostic	Minor- no issue to interpret exam	None- study interpretable, no issue
Imaging quality/Visibility of ducts	No ducts visible	Visualization of CDB, non-vis of PD, moderate motion, but diagnostic at least for CBD and main CHD, may not see right and left hepatic ducts; Too large FOV	Adequate FOV on 3D seq Can see CBD, with CHD, right and left hepatic and as well as additional intrahepatic third level branches Minimal PD	Very good FOV on 3D seq No blurring at the ducts CBD, CHD, branches and other third level branches, Partial PD seen	Presence of rotating MIPS added feature Excellent FOV All ducts seen PD visualized in entirety

MRCP Exams Scoring

- Unacceptable MRCP exams

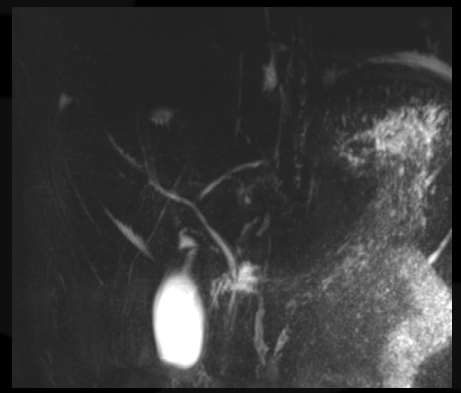
Scores 1 and 2

Score 1
Absent diagnostic confidence

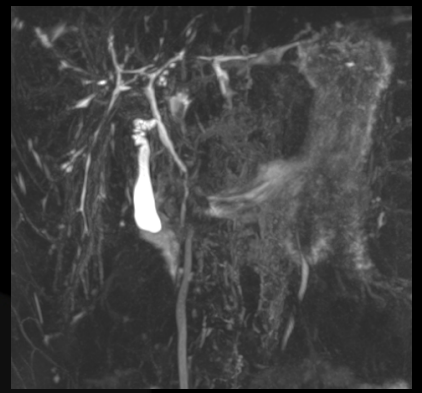


Score 2
Decreased diagnostic confidence

- Acceptable MRCP exams: Score ≥ 3



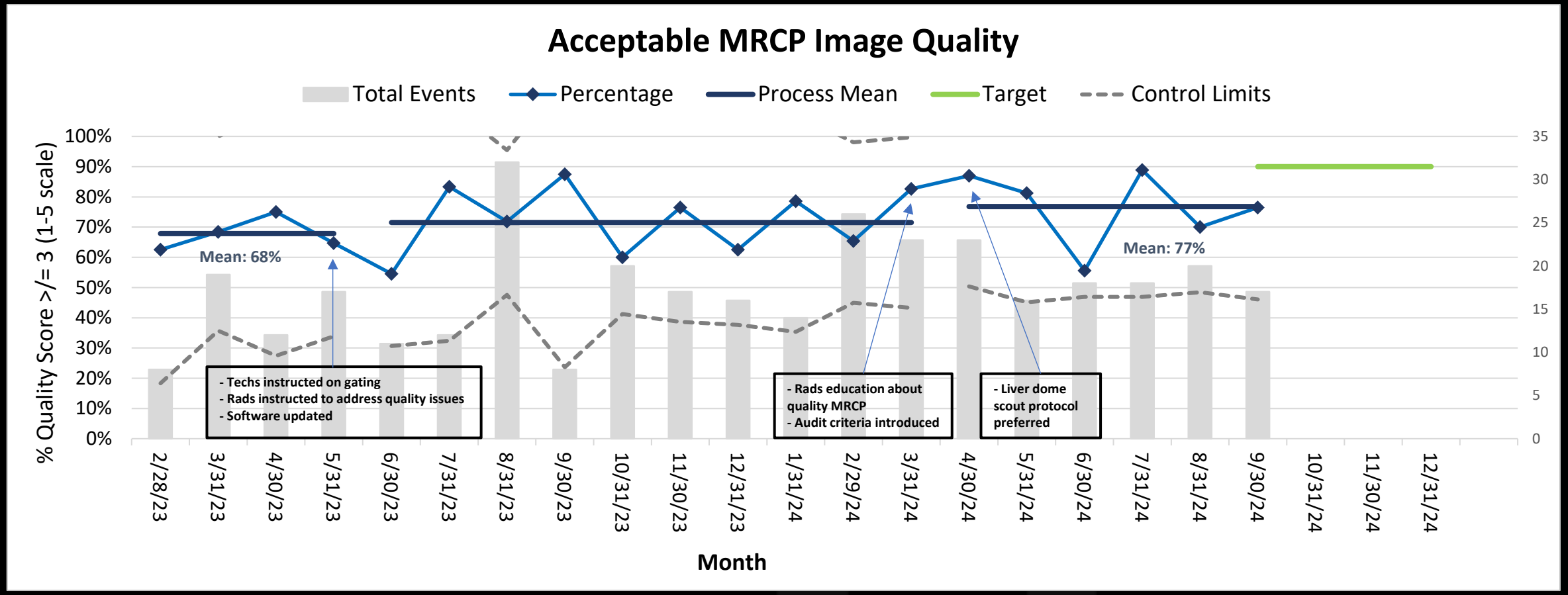
Score 3
Diagnostic confidence present



Score 4
Diagnostic confidence definitely present

Score 5
Diagnostic confidence absolutely present

Results



% of acceptable MRCP images improved from 68% to 77% by September 2024

Conclusion

- The use of respiratory gating overrides breathing motion and enhances MRCP Image quality
- Fostering communication between radiologists and MR technologists is important to avoid inadequate images
- Following a unified image auditing system avoids radiologist bias in assessing image quality
- Future steps:
  - Investigate process metrics
  - Adhere to a feedback cycle between technologists, radiologists, and team members