

Quality Improvement: Implementation of Rapid MRI Protocol at GSMC for Further Evaluation of Suspected Pediatric Appendicitis

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Goal

Goal: To implement a rapid MRI abdomen protocol for workup of individuals 18 years of age or younger presenting to Grand Strand Medical Center (GSMC) emergency department with suspected appendicitis and inconclusive ultrasound findings in order to mitigate average radiation delivery via CT to pediatric populations.

Background

Acute atraumatic emergent abdominal pain is a challenging presentation in pediatric patients, having many potential underlying causes. The diagnosis and management of these patients proves to be complicated at times when patient cooperation and status makes assessment and further diagnostic testing difficult. Acute appendicitis is one of the most common causes of abdominal pain requiring surgical consultation, it accounts for up to 8% of children who undergo emergency evaluations for abdominal pain (Rothrock SG, 2000). It is the 3rd most common reason for emergency department visits among females, and the 6th most common among males under the age of 15 years old in United States (James K, 2020). Depending on the severity of the presentation and suspicion for complications, ultrasound is currently recommended for the initial assessment of suspected appendicitis in pediatric population (Warner J, 2020). **If initial primary assessment with ultrasound does not yield a likely diagnosis, escalation to cross-sectional imaging investigation is critical for further workup of this patient population.** Extensive literature review demonstrates **comparable sensitivity and specificity** of CT and MRI for detection of pediatric appendicitis

- 5-9 million CT examinations are performed annually on children (Pearce).
- Pediatric population is **significantly more sensitive** to radiation than adults due to longer life expectancy and resultant larger window of opportunity for expression of radiation damage (Pearce).
- Studies have shown a direct risk of cancer after CT scans in childhood and has found a clear dose to response relationship for both leukemia and brain tumors (Pearce).
- For cumulative radiation doses between 50 and 60 milli-gray exposure to individuals 18 years of age and under to bone marrow, there was a 3-fold increase in risk of leukemia (Pearce).

Methods

Inclusion Population: 18 years of age or younger presenting to GSMC ED between 8am-4:30pm Mon-Friday

- Who:** ...present with suspected appendicitis
AND
Feature: ...inconclusive ultrasound findings
AND
Next Step: ...would have required abdominal CT for further evaluation

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Methods Cont.

GS PEDS MRI Appendicitis Protocol. (Scan time: 3min 41 sec)

1. 3 Plane Localization
2. Coronal T2 SS FSE (25 sec)
3. Axial T2 SS FSE (47 sec)
4. Axial T2 SS FSE fat sat (47 sec)
5. Sagittal T2 SS FSE (29 sec)
6. Axial Diffusion weighted imaging (1 min) Optional

*All scans are performed free breathing (child not expected to hold breath)

*Patient can enter the MRI machine feet first

*Patient can listen to music for the entire scan

Results

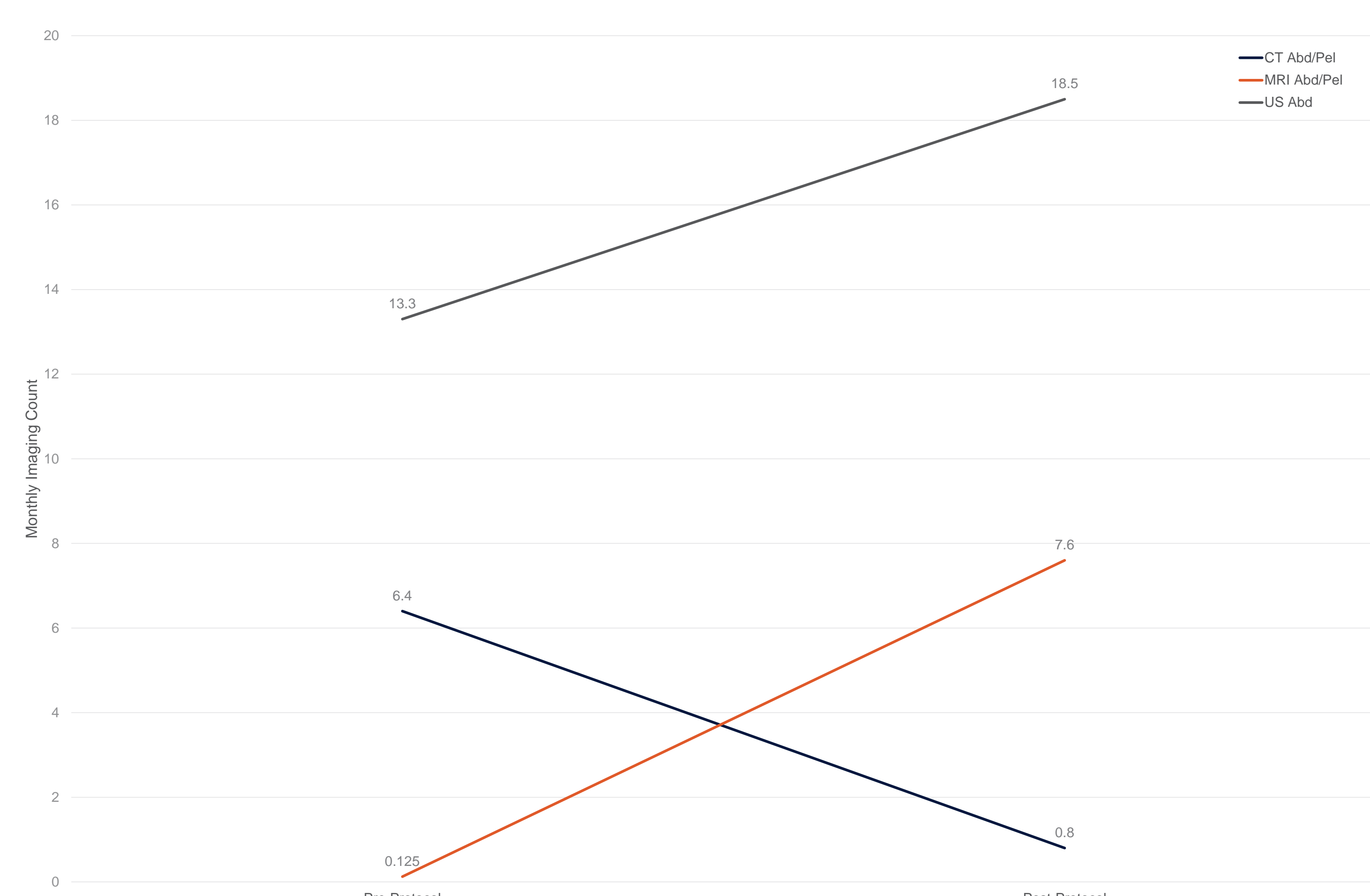
Collected Data

	Average Monthly Imaging Count Prior to Protocol Initiation	Average Monthly Imaging Count After Protocol Initiation	Average Monthly Percent Change
CT Abd/Pelvis	6.40	5.00	-21.90%
MRI Abd/Pelvis	0.125	2.00	+1,500%
Ultrasound Abd	13.30	18.50	+39.01%

Time Availability Corrected Data

	Average Monthly Imaging Count Prior to Protocol Initiation	Average Monthly Imaging Count After Protocol Initiation	Average Monthly Percent Change
CT Abd/Pelvis	6.40	0.80	-87.50%
MRI Abd/Pelvis	0.125	7.63	+6,004%
Ultrasound Abd	13.30	18.50	+39.01%

Corrected Monthly Imaging Modality Count:
Pre vs Post Protocol Initiation



Discussion

Successful Outcome Definition:

Individuals 18 years of age or younger with suspected appendicitis with inconclusive ultrasound findings and who would have required abdominal CT for further evaluation, there must be:

Greater than 25% decrease in CT abdomen/Pelvis use

AND

Greater than 25% increase in MRI abdomen/Pelvis use

Initial data from the months of January and February of 2023 demonstrates a **87.50% decrease in CT** use and **6,004% increase in MRI** use in the pediatric population presenting to GSMC ED for workup of suspected appendicitis when corrected for 25% protocol availability in a given month. While the preliminary data exceeds the goals initially set out for this quality improvement project, the results are limited due to short data collection time. While **these results demonstrate significant radiation reduction and utilization of more up to date modalities in this radiation sensitive population**, ongoing data collection over the next year is imperative to fully determine the effects of this protocol.

Conclusion

The resulted data demonstrates this QI project has exceeded the goals it set out to accomplish. The implementation of this protocol has significantly reduced ionizing radiation delivery to the pediatric population in the greater Grand Strand area. It is critical that our attempts to further improve safety in our patient populations undergoing diagnostic testing continue alongside the growing capabilities of our healthcare systems.

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