Improving Radiologist Interpretation Confidence for Appendix Ultrasound Through Standardized Performance and Reporting

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Increasing radiologist certainty in the ultrasound diagnosis of acute appendicitis through standardized exam performance and reporting has been proven to decrease CT utilization, unnecessary surgeries and hospital length of stay. The goal of this project was to decrease the number of indeterminate studies in a community hospital setting and two free-standing emergency departments (FSEDs) by 50% over a period of 9 months.
PQI Project with retrospective review
- appendix ultrasounds in a suburban combined adult with two affiliated FSEDs
- December 2020 to June 2022
- before and after implementation of a nationally standardized pediatric appendix ultrasound protocol, sonographer worksheet and reporting template.

In September 2021 a 2-hr live hands-on training workshop was offered to credentialed radiologists and sonographers.

In March of 2022 a 2-hour virtual training with CME was mandated for all reading radiologists and all sonographers.

Methods

N = 308:
Before voluntary 2-hr live hands-on training N = 80/308 (Period 1)
After voluntary 2-hr live hands-on training N = 129/308 (Period 2)
After a mandatory 2-hr virtual training, N = 99/308 (Period 3)

Tracked:
- Standard protocol, standard sonographer worksheet and standard reporting template utilization
- Post-appendix ultrasound additional imaging
- Length of stay (LOS)
- Certainty of report impression defined as: positive for appendicitis, negative for appendicitis, equivocal (conflicting US findings), or merely descriptive
- Diagnostic accuracy
Period 1—mean age 10.67 years
Period 2—mean age 10.41 years
Period 3—mean age 10.17 years

LOS in time period 1 was significantly different from time period 3 (adj P = 0.017). LOS decreased by 3.8 hrs between periods 1 & 3. No significant difference between periods 1/2 (adj P = 0.585) or periods 2/3 (adj P = 0.11). Figure 1

Indeterminate/exams declined by time period (Fisher P = 0.004).
Indeterminate/descriptive exams in P3 significantly different from P1 (Fisher adj P = 0.004). Decrease in indeterminate exams from P1 to P3 by approximately 50.62%

No statistically significant difference between time periods 1/2 (Fisher adj P = 0.25) or 2/3 (Fisher adj P = 0.06). Figure 2

Percent of accurate exams was significantly different between time periods (Fisher P = 0.0075). Figure 2.

Significant increase in percentage of accurate exams between periods 3 and 1 (Fisher adj P = 0.009). No statistically significant difference between time periods 1/2 (Fisher adj P = 0.15) or 2/3 (Fisher adj P = 0.13). Figure 2.

No statistically significant difference in mean scan times between time periods (P = 0.0874)

Indeterminate/descriptive exams in P3 significantly different from P1 (Fisher adj P = 0.004). Decrease in indeterminate exams from P1 to P3 by approximately 50.62%.

No statistically significant difference between time periods 1/2 (Fisher adj P = 0.25) or 2/3 (Fisher adj P = 0.06). Figure 2

No significant change in the percent of exams that included Post U/S CT (Fisher P = 0.07). Figure 3.
Figure 1: Comparison of Length of Stay (LOS) across Training Phases

- P1: Before training
- P2: After live
- P3: After virtual

Adjusted P-values:
- adj P = 0.59
- adj P = 0.11
- adj P = 0.02
Figure 2

Distribution of impression by training status

- N=80
  - Before training: 42.5%
  - After live: 54.3%
  - After virtual: 71.7%
- N=129
  - Before training: 25.0%
  - After live: 18.6%
  - After virtual: 9.1%
- N=99
  - Before training: 20.0%
  - After live: 17.8%
  - After virtual: 13.1%

Impression:
- Positive
- Negative
- Indeterminate
- Descriptive
Figure 3

Post U/S CT Utilization

<table>
<thead>
<tr>
<th>Groups</th>
<th>Percent of Post U/S CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Training</td>
<td>63 (78.75%)</td>
</tr>
<tr>
<td>After Live Training</td>
<td>87 (67.44%)</td>
</tr>
<tr>
<td>After Virtual Training</td>
<td>79 (79.80%)</td>
</tr>
</tbody>
</table>

- No significant difference observed (P=0.07)
DISCUSSION

- 50.62 % decrease in indeterminate/descriptive US impressions between periods 1 and 3.
- LOS in time period 1 was significantly different from time period 3 (adj P=0.017). LOS decreased by 3.8 hrs between periods 1 & 3.
- No significant change in post-appendix ultrasound imaging utilization in our care setting during this time frame.
- Limitations include undefined impact of Covid 19 pandemic on healthcare utilization and other variables. Although training was mandated, only 22/25 (88%) sonographers and 13/37 (35.1%) interpreting radiologists completed the training.
THANKS

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The free appendix ultrasound training can be accessed here