DIAGNOSING ACUTE APPENDICITIS ON ULTRASOUND—WHERE DO WE STAND?

Joanne Howey,
Radiology Resident, PGY-4
McMaster University

Disclosure

- No relevant financial or non-financial relationships to disclose

Outline

- Background/Aim of study
- Standard
- Target
- Methodology
- Results
- Intervention/Action plan
- Conclusion

Background/Aim

- Acute appendicitis is a common acute surgical condition of the abdomen in adults
- Ultrasound can be of great value
  - *Availability*
  - *Lack of ionizing radiation*
  - *Dynamic*
- Aim to determine the sensitivity of ultrasound in detecting acute appendicitis in adults at two tertiary care centres (Site 1 and Site 2)
- Compare with values obtained from the literature
- Make departmental changes to try and improve our sensitivity

Standard

- Literature review
  - *2007 systematic review[1] (25 studies and 9,121 patients): sensitivity of 83.7%*
  - *2006 meta-analysis[2] (15 studies and 1,947 patients): sensitivity of 83%*

1.Al-Khayal KA, Al-Omran MA. Computed tomography and ultrasonography in the diagnosis of equivocal acute appendicitis. A meta-analysis. Saudi Med J. 2007;28(2):173–180.

2.Doria AS, Moineddin R, Kellenberger CJ, et al. US or CT for Diagnosis of Appendicitis in Children and Adults? A Meta-Analysis. Radiology. 2006;241(1):83–94.

Radiology

US or CT for Diagnosis of Appendicitis in Children and Adults? A Meta-Analysis[1]

Andrea S. Doria, MD, MSc, PhD
Rahim Moineddin, PhD
Christian J. Kellenberger, MD
Monica Epelman, MD
Joseph Beyene, PhD
Suzanne Schuh, MD
Paul S. Babyn, MD
Paul T. Dick, MD, MSc

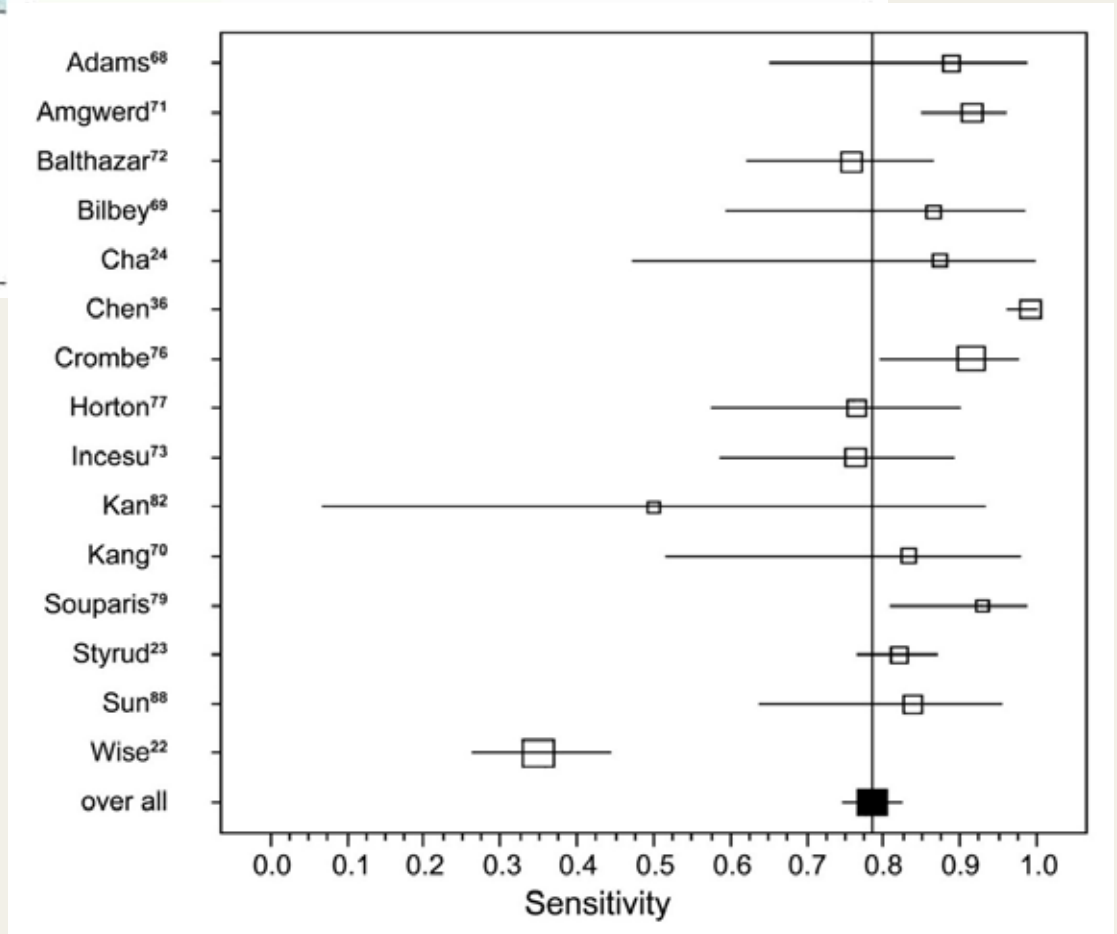

Figure 1e: Graph show sensitivity recorded in individual series of US for adults. Point estimates (□) and 95% CIs (horizontal lines) are given for each series. The meta-analytic summary estimate is represented by the vertical line. Outliers have not been excluded on these graphs.

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Review Article

Computed tomography and ultrasonography in the diagnosis of equivocal acute appendicitis

A meta-analysis

Khayal A. Al-Khayal, MD, Mohammed A. Al-Omran, MD, MSc.

Table 3 - Summary of individual ultrasonography studies' sensitivities and specificities with their 95% confidence intervals.

Study	TP	TN	FP	FN	Sensitivity (95% CI)	Specificity (95 % CI)
Schwerk et al[21]	115	394	8	15	88.46 (81.83- 92.88)	98.01 (96.12-98.99)
Rubin and Martin et al[22]	40	84	5	5	88.89 (76.50-95.16)	94.38 (87.51-97.58)
Skaane et al[23]	67	141	13	19	77.91 (68.05-85.38)	91.56 (86.09-95.00)
Schwerk et al[24]	174	651	12	20	89.69 (84.61-93.23)	98.19 (96.86- 98.96)
Rioux[25]	42	118	7	3	93.33 (82.14-97.71)	94.40 (88.89-97.26)
Sivit et al[26]	46	123	5	6	88.46 (77.03-94.60)	96.09 (91.18-98.32)
Chesbrough et al[27]	128	84	10	14	90.14 (84.13-94.04)	89.36 (81.51-94.12)
Balthazar et al[14*]	41	42	4	13	75.93 (63.05-85.36)	91.30 (79.68-96.57)
Jahn et al[28]	38	101	14	40	48.72 (37.95-59.61)	87.83 (80.60-92.61)
Zielke et al[29]	94	378	13	19	83.19 (75.23-88.960	96.68 (94.40-98.05)
Galindo et al[30]	83	87	4	18	82.18 (73.58-88.42)	95.60 (89.24-98.28)
Schulte et al[31]	110	1154	12	9	92.44 (86.25-95.97)	98.97 (98.21-99.41)
Zielke et al[32]	114	509	17	29	79.72 (72.39-85.49)	96.77 (94.89-97.97)
Allemann et al[33]	89	399	2	6	93.68 (86.90-97.07)	99.50 (98.20-99.86)
Franke et al[34]	120	571	29	97	55.30 (48.65-61.77)	95.17 (93.14-96.61)
Garcia Pena et al[35*]	22	83	6	28	44.00 (31.16-57.69)	93.26 (86.06-96.87)
Rice et al[35]	36	55	7	5	87.80 (74.46-94.68)	88.71 (78.48-94.42)
Garcia-Aguayo and Gil[36]	150	185	12	13	92.02 (86.83-95.28)	93.91 (89.66-96.48)
Pickuth et al[16**]	81	20	7	12	87.10 (78.79-92.46)	74.07 (55.32-86.83)
Rettenbacher et al[37]	68	109	29	12	85.00 (75.59-91.21)	78.99 (71.45-84.95)
Sivit et al[17]	65	215	17	18	78.31 (68.30-85.82)	92.67 (88.58-95.37)
Kaiser et al[38]	94	165	9	15	86.24 (78.53-91.48)	94.83 (90.46-97.26)
Poortman et al[39]	184	52	15	28	78.72 (72.83-84.36)	77.61 (66.29-85.94)
Kessler et al[39]	54	48	1	1	98.18 (90.39-99.68)	97.96 (89.31-99.64)
Lee et al[40]	319	350	4	2	99.38 (97.76-99.85)	98.87 (97.13-99.56)
Summary	**2294**	**6118**	**262**	**447**	83.69 (82.26-85.03)	95.89 (95.38-96.35)

* Studies comparing the role of ultrasonography and computed tomography in the diagnosis of patients with equivocal appendicitis.
TP=true positive result, TN=true negative result, FP=false positive result, FN=false negative result.

Target

- To meet or surpass the standard

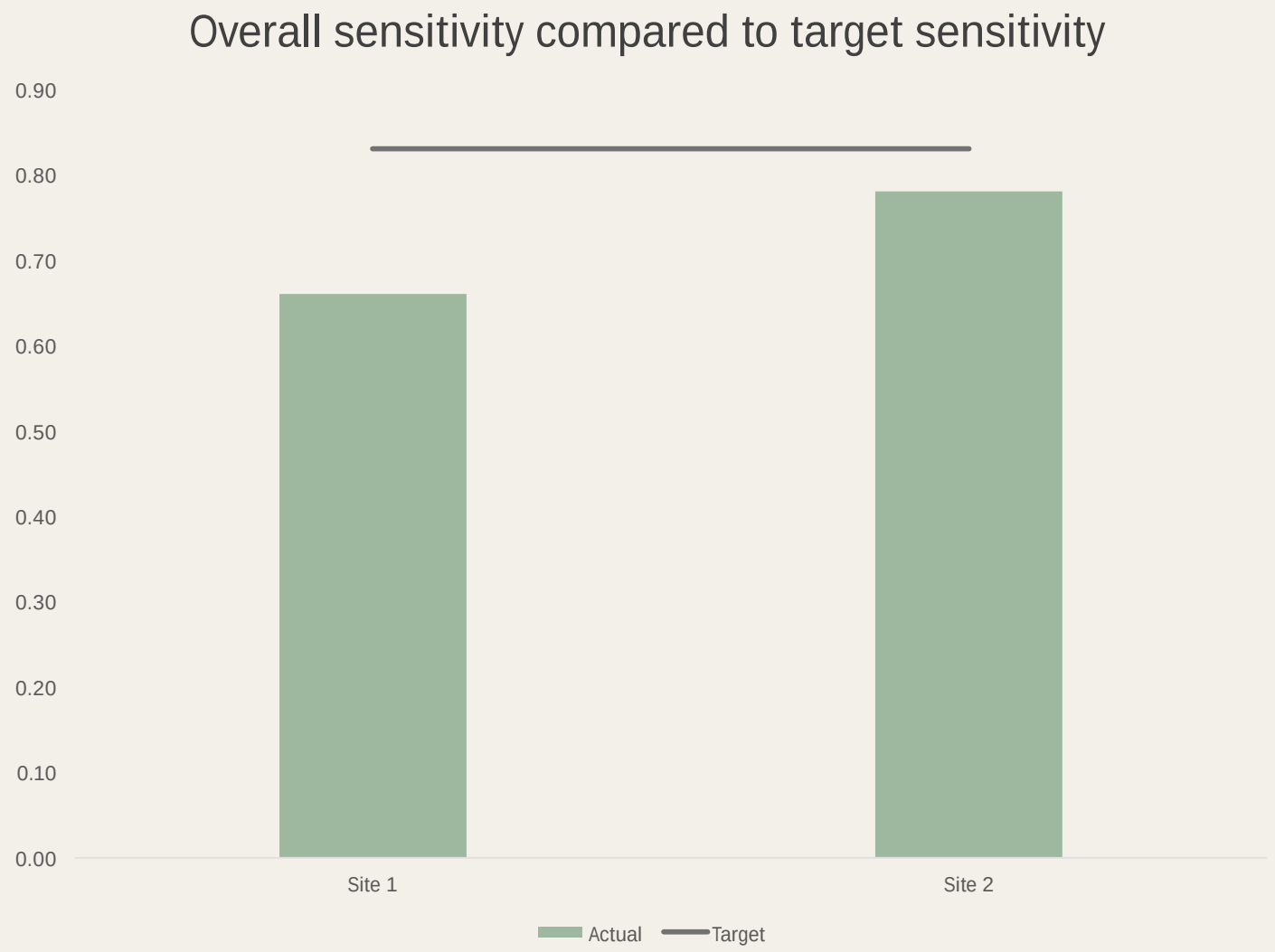
Methodology

- Surgical database from HGH and JHCC was searched and data collected over a six year time period (October 1, 2007 - September 30, 2013)
  - *664 reports, 402 of which were included in the audit*
  - *Inclusion criteria:*
    - histopathology-proven diagnosis of acute appendicitis and utilization of pre-operative ultrasound (alone or with CT)
- Ultrasound reports retrieved from PACS were classified as:
  - *Negative: appendix normal, equivocal or not visualized*
  - *Positive: appendix in keeping with acute appendicitis*
- Statistical analysis
  - *Sensitivity*

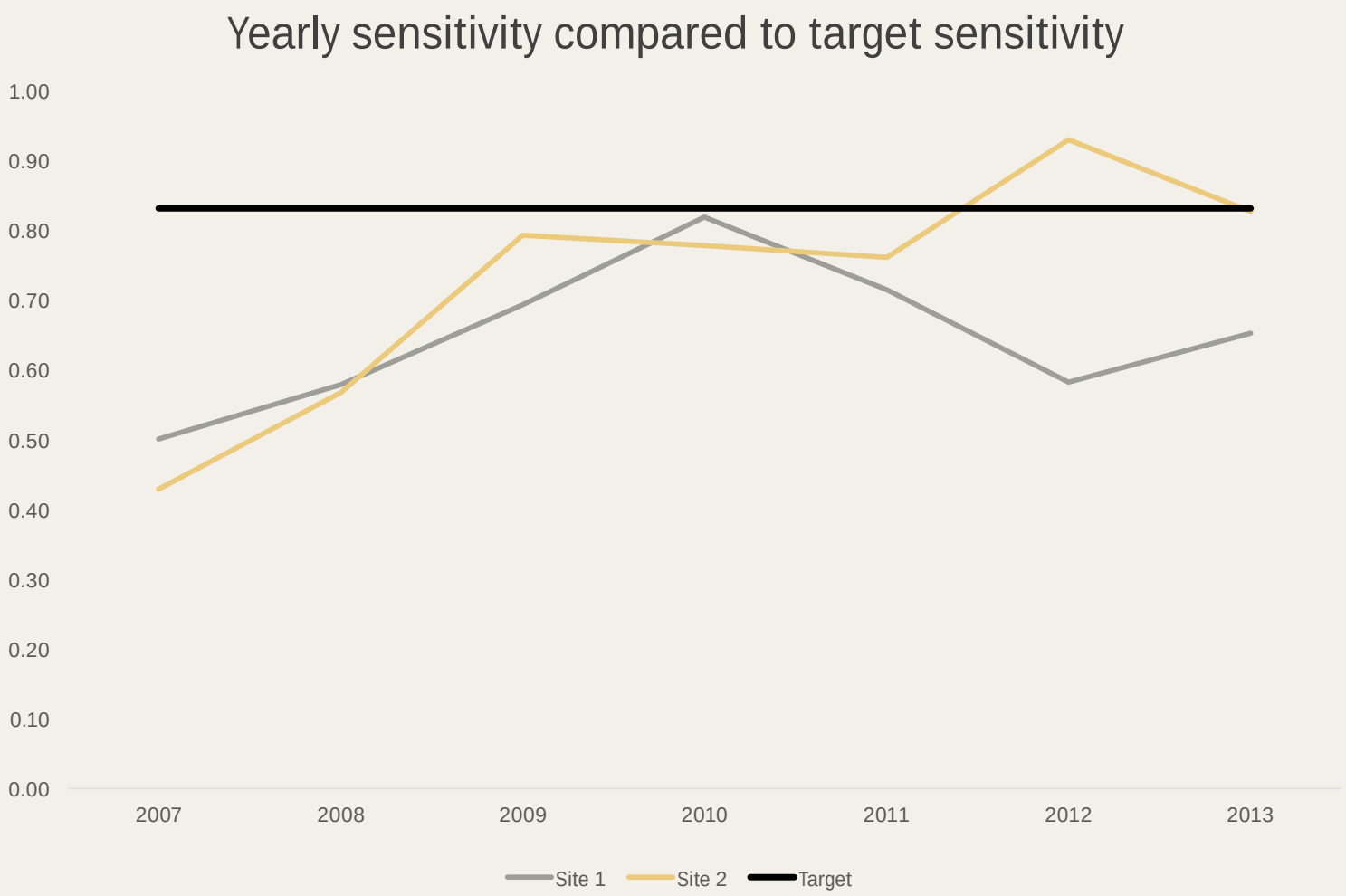
Results

- Combined average sensitivity for Site 1 and Site 2 = 0.72
- Average sensitivity for Site 1 = 0.66
- Average sensitivity for Site 2 = 0.78
- Trend over time, 2007-2013:
  - *Site 1 = 0.50 to 0.65*
  - *Site 2 = 0.43 to 0.83*

Results


Overall sensitivity compared to target sensitivity
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Site 1
Site 2
Actual
Target

Results

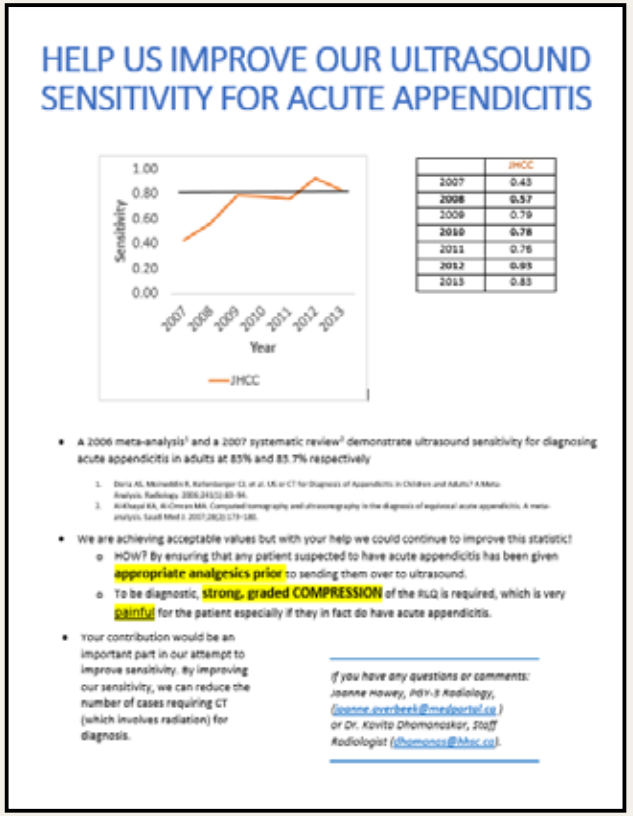

Yearly sensitivity compared to target sensitivity
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
2007
2008
2009
2010
2011
2012
2013
Site 1
Site 2
Target

Interventions/action plan

- Results provided to sonographers
- Suggest departmental changes:
  - *When calling for the patient from ER, ensure recent administration of analgesics*
  - *Begin in RLQ*
    - To ensure analgesics have not worn off and graded compression can be performed
    - To ensure enough time and attention is given to searching for the appendix
  - *Consider transvaginal imaging*
  - *If unsuccessful at finding the appendix*
    - Second look ultrasound by a more experienced sonographer
    - If appendix is found, first sonographer should try to reproduce the finding for optimal learning

Action plan for the Emergency Department

- Provide results to the ER physicians
- Request their cooperation with coordinating analgesics with ultrasound appointment



HELP US IMPROVE OUR ULTRASOUND SENSITIVITY FOR ACUTE APPENDICITIS

	JHCC
2007	0.43
2008	0.57
2009	0.79
2010	0.78
2011	0.76
2012	0.95
2013	0.83

- A 2006 meta-analysis[1] and a 2007 systematic review[2] demonstrate ultrasound sensitivity for diagnosing acute appendicitis in adults at 85% and 85.7% respectively

1. Doria AS, Moineddin R, Kellenberger CJ, et al. US or CT for Diagnosis of Appendicitis in Children and Adults? A Meta-Analysis. Radiology. 2006;241(1):83–94.
2. Al-Khayal KA, Al-Omran MA. Computed tomography and ultrasonography in the diagnosis of equivocal acute appendicitis. A meta-analysis. Saudi Med J. 2007;28(2):179–180.

- We are achieving acceptable values but with your help we could continue to improve this statistic!
  - HOW? By ensuring that any patient suspected to have acute appendicitis has been given **appropriate analgesics prior** to sending them over to ultrasound.
  - To be diagnostic, **strong, graded COMPRESSION** of the RLQ is required, which is very **painful** for the patient especially if they in fact do have acute appendicitis.
- Your contribution would be an important part in our attempt to improve sensitivity. By improving our sensitivity, we can reduce the number of cases requiring CT (which involves radiation) for diagnosis.

If you have any questions or comments:
Joanne Howey, PGY-3 Radiology,
(joanne.overbeek@medportal.ca)
or Dr. Kavita Dhomanaskar, Staff Radiologist (kdhomanaskar@hhsc.ca).

Conclusion

- Below standard at Site 1 and at standard for Site 2 for the most recent year of data
- The trend is that of improved sensitivity over time
- With departmental changes, hopefully the sensitivity will continue to improve
- Re-audit to assess compliance and determine whether sensitivity has increased

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