

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Buckius MT, McGrath B, Monk J, Grim R, Bell T, Ahuja V. Changing epidemiology of acute appendicitis in the United States: study period 1993-2008. <i>J Surg Res.</i> 175(2):185-90, 2012 Jun 15.	Review/Other-Dx	3,913,030 cases	To examine if the incidence of appendicitis and mean age of diagnosis has changed, and whether demographics are related to the frequency of admissions and incidence rate of acute appendicitis (AA).	The annual rate of AA increased from 7.62 to 9.38 per 10,000 between 1993 and 2008. The highest frequency of AA was found in the 10-19 y age group, however occurrence in this group decreased by 4.6%. Persons between ages 30 and 69 y old experienced an increase of AA by 6.3%. AA rates remained higher in males. Hispanics, Asians, and Native Americans saw a rise in the frequency of AA, while the frequencies among Whites and Blacks decreased.	4
2. Raja AS, Wright C, Sodickson AD, et al. Negative appendectomy rate in the era of CT: an 18-year perspective. <i>Radiology.</i> 256(2):460-5, 2010 Aug.	Observational-Dx	719-bed tertiary care adult teaching hospital; 58,000 annual emergency department visits	To estimate the correlation between the negative appendectomy rate and the rate of preoperative CT in patients suspected of having acute appendicitis who presented to the emergency department during an 18-year period.	From 1990 to 2007, the negative appendectomy rate decreased significantly from 23.0% to 1.7% (P<.0001), the annual number of appendectomies decreased significantly from 217 per year to 119 per year (P=.0003), and the proportion of patients undergoing appendectomy who underwent preoperative CT increased significantly from 1% to 97.5% (P<.0001).	4
3. Man E, Simonka Z, Varga A, Rarosi F, Lazar G. Impact of the Alvarado score on the diagnosis of acute appendicitis: comparing clinical judgment, Alvarado score, and a new modified score in suspected appendicitis: a prospective, randomized clinical trial. <i>Surg Endosc.</i> 28(8):2398-405, 2014 Aug.	Experimental-Tx	269 patients	To compare the reliability of the Alvarado score and clinical judgment and to refine the score to make it easier to use.	The study investigated 269 patients (131 in group A and 138 in group B). The groups were homogeneous in terms of mean age, gender, body mass index, and American Society of Anesthesiologists score. The number of negative appendectomies was 12 (9.16%) in group A versus 5 (3.6%) in group B (p = 0.063). The clinical judgment had better specificity and sensitivity than the Alvarado score. For that reason, the specificity of the Alvarado score was refined using statistical methods, with weighting of certain clinical data and inclusion of new ones (e.g., ultrasound investigation). Consequently, the area under the curve by receiver operating characteristic analysis gradually increased, and the Alvarado score became more accurate.	2

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4. Apisarntharak P, Suvannarerg V, Pattaranutaporn P, Charoensak A, Raman SS, Apisarntharak A. Alvarado score: can it reduce unnecessary CT scans for evaluation of acute appendicitis?. <i>Am J Emerg Med.</i> 33(2):266-70, 2015 Feb.	Observational-Dx	158 subjects	To assess the utility of Alvarado score in the diagnosis of acute appendicitis and the utility of computed tomographic (CT) scan for evaluation of acute appendicitis when stratified by Alvarado scores.	In a cohort of 158 subjects, 73 (46.2%) had clinical diagnoses of acute appendicitis. The accuracy, sensitivity, specificity, positive predictive value, and negative predictive value of CT scan in the diagnosis of acute appendicitis were 97.5%, 98.6%, 96.5%, 96.0%, and 98.8%, respectively. The mean Alvarado score for subjects with complicated appendicitis was significantly higher (7.95) than subjects with uncomplicated appendicitis (6.67) and those with other diagnoses (5.95). Acute appendicitis was confirmed in 2 (13.3%) of 15 subjects with low probability Alvarado scores, 16 (30.8%) of 52 subjects with equivocal scores, and 55 (60.4%) of 91 subjects with high probability scores.	2
5. Tan WJ, Acharyya S, Goh YC, et al. Prospective comparison of the Alvarado score and CT scan in the evaluation of suspected appendicitis: a proposed algorithm to guide CT use. <i>J Am Coll Surg.</i> 220(2):218-24, 2015 Feb.	Observational-Dx	350 patients	To compare the performance statistics of the Alvarado Score (AS) with those of computed tomography (CT) scan in the evaluation of suspected appendicitis, with the aim of identifying a subset of patients who will benefit from CT evaluation.	The study included 134 males (38.3%) and 216 females (61.7%). The overall prevalence of appendicitis was 44.3% in the total study population; 37.5% in females and 55.2% in males. There were 168 patients (48%) who underwent surgery, with a negative appendectomy rate of 7.7%. Positive likelihood ratio of disease was significantly greater than 1 only in patients with an AS of 4 and above. An AS of 7 and above in males and 9 and above in females has a positive likelihood ratio comparable to that of CT scan.	2

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6. Hendriks IG, Langen RM, Janssen L, Verrijth-Wilms IM, Wouda S, Janzing HM. Does the Use of Diagnostic Imaging Reduce the Rate of Negative Appendectomy?. Acta Chir Belg. 115(6):393-6, 2015 Nov-Dec.	Review/Other-Dx	N/A	To provide guidelines for the diagnosis and treatment of acute appendicitis.	A significant decline in the percentage of negative appendectomies was found from an average of 18.0% before implementation of the guideline towards an average of 9.2% after implementation of the guideline (p<0.001). The percentage of patients with appendicitis in which the appendix perforated remained about the same; 20.9% before implementation of the guideline compared to 19.2% after implementation of the guideline (p=0.527).	4
7. Krajewski S, Brown J, Phang PT, Raval M, Brown CJ. Impact of computed tomography of the abdomen on clinical outcomes in patients with acute right lower quadrant pain: a meta-analysis. Can J Surg. 2011;54(1):43-53.	Meta-analysis	28 articles	To evaluate the impact of abdominal CT on the clinical outcomes of patients presenting with suspected appendicitis.	The negative appendectomy rate was 8.7% when using CT compared with 16.7% when using clinical evaluation alone (P<0.001). There was also a significantly lower negative appendectomy rate during the CT era compared with the pre-CT era (10.0% vs 21.5%, P<0.001). Time to surgery was evaluated in 10 of the 28 studies, 5 of which demonstrated a significant increase in the time to surgery with the use of CT. Appendiceal perforation rates were unchanged by the use of CT (23.4% in the CT group vs 16.7% in the clinical evaluation group, P=0.15). Similarly, the perforation rate during the CT era was not significantly different than that during the pre-CT era (20.0% vs 19.6%, P=0.74).	Good
8. Garcia Pena BM, Mandl KD, Kraus SJ, et al. Ultrasonography and limited computed tomography in the diagnosis and management of appendicitis in children. JAMA. 1999; 282(11):1041-1046.	Observational-Dx	139 children and adolescents	Prospective study to determine the value of a protocol involving US and CT in the diagnosis and management of appendicitis in children and adolescents.	Protocol had a sensitivity of 94%, specificity of 94%, PPV of 90%, NPV of 97%, and accuracy of 94%. CT following a negative or indeterminate US result is highly accurate in the diagnosis of appendicitis in children.	3

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9. Jeffrey RB Jr, Laing FC, Lewis FR. Acute appendicitis: high-resolution real-time US findings. Radiology. 163(1):11-4, 1987 Apr.	Observational-Dx	90 patients	To evaluate 90 patients with clinically suspected acute appendicitis.	The overall sensitivity was 89%, the specificity was 95%, and the accuracy was 93%. When the results in women were analyzed separately (n = 49), the overall accuracy was 96%. Several important limitations of ultrasound (US) scanning were encountered. There were three false-positive examinations in patients with a sonographically visible appendix whose symptoms spontaneously resolved. Another patient had a normal compressible appendix with a thin (2-mm), symmetric wall surrounded by ascites. There were three nondiagnostic studies (3%) due to inability to compress the cecum and right lower quadrant adequately because of exquisite tenderness (two patients) or massive ascites (one patient).	3
10. Jeffrey RB Jr, Laing FC, Townsend RR. Acute appendicitis: sonographic criteria based on 250 cases. Radiology. 167(2):327-9, 1988 May.	Observational-Dx	112 males; 138 female subjects	To report two questions: (a) can a normal appendix be visualized during high-resolution ultrasound (US)? and (b) are the dimensions of the visualized appendix useful criteria to diagnose acute appendicitis and guide clinical management?	Of 84 patients with visible appendixes measuring greater than 6 mm in maximal diameter, 78 had surgically confirmed acute appendicitis. In the remaining six, symptoms resolved spontaneously, and no surgery was required.	2

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<p>11. Lee JH, Jeong YK, Park KB, Park JK, Jeong AK, Hwang JC. Operator-dependent techniques for graded compression sonography to detect the appendix and diagnose acute appendicitis. <i>AJR Am J Roentgenol.</i> 184(1):91-7, 2005 Jan.</p>	<p>Experiment al-Dx</p>	<p>877 subjects</p>	<p>To evaluate the value of various operator-dependent techniques that allow graded compression sonography to detect normal or abnormal vermiform appendix.</p>	<p>The initial graded compression sonography examination depicted the appendix in 170 (84%) of 202 subjects in the control group and 601 (89%) of the 675 patients in the patient group. We then added operator-dependent techniques to graded compression sonography for the remaining patients in whom the appendix could not be detected. The additional use of the posterior manual compression technique, low-frequency convex transducer, upward graded compression technique, or left oblique lateral decubitus change of body position allowed graded compression sonography to depict the appendix in an additional 10, eight, six, and four patients in the control group, respectively, and in an additional 27, 23, 11, and seven patients in the patient group. The number of identified appendixes was increased to 198 (98%) of the 202 patients in the control group and to 669 (99%) of the 675 patients in the patient group. Graded compression sonography with operator-dependent techniques in the patient group yielded a sensitivity of 99% (319/321 patients), specificity of 99% (350/354), and an accuracy of 99% (669/675) for acute appendicitis.</p>	<p>2</p>

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12. Rioux M.. Sonographic detection of the normal and abnormal appendix. AJR Am J Roentgenol. 158(4):773-8, 1992 Apr.	Observational-Dx	170 patients	To assess the value of sonography in detecting the normal and abnormal appendix.	Of 60 patients who underwent surgery, appendicitis was proved in 45. The remaining 110 patients who did not have surgery, contacted by telephone at the end of the study, had no clinical follow-up evidence of acute appendicitis. A normal appendix was clearly identified in 102 (82%) of 125 patients without acute appendicitis. The sensitivity of sonographic examination in detecting appendicitis was 93%, the specificity was 94%, and the accuracy was 94%. The predictive value of a positive test was 86%; that of a negative test was 98%. Ruptured appendicitis was predicted in all cases (11/11).	3
13. Puylaert JB.. Acute appendicitis: US evaluation using graded compression. Radiology. 158(2):355-60, 1986 Feb.	Review/Other-Dx	60 patients	To present a technique involving a small linear-array transducer that enables direct visualization of the inflamed appendix and report the study results of 60 consecutive patients with clinical signs of acute appendicitis.	In 25 (89%) of 28 patients with confirmed appendicitis, the inflamed appendix was visualized by US. Perforation was predictable in six of seven patients. In 32 patients without appendicitis, the appendix was not visualized.	4

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14. Avcu S, Cetin FA, Arslan H, Kemik O, Dulger AC. The value of diffusion-weighted imaging and apparent diffusion coefficient quantification in the diagnosis of perforated and nonperforated appendicitis. <i>Diagn Interv Radiol.</i> 19(2):106-10, 2013 Mar-Apr.	Observational-Dx	60 cases	To evaluate the effectiveness of diffusion-weighted magnetic resonance imaging (DW-MRI) and apparent diffusion coefficient (ADC) values in the diagnosis of acute appendicitis and differentiation of perforated and nonperforated appendicitis cases, with histopathologic correlation.	Of the 60 cases, 44 had a radiological diagnosis of acute appendicitis, and 16 were regarded as normal. Of the 40 patients who underwent surgical operation, 12 had a histopathological diagnosis of perforated appendicitis, and 28 had nonperforated appendicitis. Mean ADC value in patients with acute appendicitis ( $1.01 \pm 0.26 \times 10^{-3}$ mm <sup>2</sup> /s) was lower than the control group ( $1.85 \pm 0.13 \times 10^{-3}$ mm <sup>2</sup> /s) ( $P < 0.001$ ). Mean ADC value of the perforated group ( $0.79 \pm 0.19 \times 10^{-3}$ mm <sup>2</sup> /s) was lower than the nonperforated group ( $1.11 \pm 0.22 \times 10^{-3}$ mm <sup>2</sup> /s) ( $P < 0.001$ ). The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy rate of DW-MRI in the diagnosis of acute appendicitis were 97.5%, 100%, 97.5%, 100%, and 98.1%, respectively.	3
15. Leeuwenburgh MM, Wiarda BM, Bipat S, et al. Acute appendicitis on abdominal MR images: training readers to improve diagnostic accuracy. <i>Radiology.</i> 264(2):455-63, 2012 Aug.	Observational-Dx	230 patients	To estimate the accuracy of magnetic resonance imaging (MRI) in distinguishing between simple and perforated appendicitis, and to compare MRI against ultrasound imaging with selected additional (conditional) use of computed tomography (CT).	MRI was performed in 223 of 230 included patients. Acute appendicitis was the final diagnosis in 118 of 230 patients, of whom 87 had simple and 31 perforated appendicitis. MRI correctly identified 17 of 30 patients with perforated appendicitis (sensitivity 57 (95 per cent confidence interval 39 to 73) per cent), whereas ultrasound imaging with conditional CT identified 15 of 31 (sensitivity 48 (32 to 65) per cent) ( $P = 0.517$ ). All missed diagnoses of perforated appendicitis were identified as simple acute appendicitis with both imaging protocols. None of the MRI features for perforated appendicitis had a positive predictive value higher than 53 per cent.	2

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16. Inci E, Kilickesmez O, Hocaoglu E, Aydin S, Bayramoglu S, Cimilli T. Utility of diffusion-weighted imaging in the diagnosis of acute appendicitis. <i>Eur Radiol.</i> 21(4):768-75, 2011 Apr.	Observational-Dx	92 patients	To evaluate the value of Magnetic Resonance Imaging diffusion-weighted (MRI (DWI)) in the diagnosis of acute appendicitis.	Histopathology revealed appendicitis in 79/92 patients (78%) who had undergone surgery. On visual evaluation, except for one patient with histopathologically proven appendicitis all inflamed appendixes were hyperintense on DWI (98.7%). Quantitative evaluation with DW signal intensities and apparent diffusion coefficient (ADC) values revealed a significant difference with normal and inflamed appendixes ( $p < 0.001$ ). The best discriminative parameter was signal intensity (b 500). With a cut-off value of 56 for the signal intensity the ratio had a sensitivity of 99% and a specificity of 97%. The cut-off ADC value at 1.66 mm <sup>2</sup> /s had a sensitivity of 97% and a specificity of 99%.	2
17. Kim K, Kim YH, Kim SY, et al. Low-dose abdominal CT for evaluating suspected appendicitis. <i>N Engl J Med.</i> 366(17):1596-605, 2012 Apr 26.	Experimental-Dx	891 patients	To evaluate the rate of negative (unnecessary) appendectomy after low-dose vs standard-dose abdominal CT in young adults with suspected appendicitis.	The negative appendectomy rate was 3.5% (6/172 patients) in the low-dose CT group and 3.2% (6/186 patients) in the standard-dose CT group (difference, 0.3 percentage points; 95% CI, -3.8 to 4.6). The 2 groups did not differ significantly in terms of the appendiceal perforation rate (26.5% with low-dose CT and 23.3% with standard-dose CT, $P=0.46$ ) or the proportion of patients who needed additional imaging tests (3.2% and 1.6%, respectively; $P=0.09$ ).	1



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18. Yang HK, Ko Y, Lee MH, et al. Initial Performance of Radiologists and Radiology Residents in Interpreting Low-Dose (2-mSv) Appendiceal CT. [Erratum appears in AJR Am J Roentgenol. 2016 Apr;206(4):901 Note: multiple investigator names added; PMID: 27003056]. AJR Am J Roentgenol. 205(6):W594-611, 2015 Dec.	Observational-Dx	199 readers	To prospectively evaluate the initial diagnostic performance and learning curve of a community of radiologists and residents in interpreting 2-mSv appendiceal computed tomography (CT).	Diagnostic performance gradually improved with years of training. The average Area under curve (AUC) was 0.94 (95% CI, 0.90-0.98), 0.92 (0.88-0.96), 0.90 (0.85-0.96), and 0.86 (0.80-0.92) for the attending radiologists, senior residents, 2nd-year residents, and 1st-year residents, respectively. We did not observe any notable intrareader learning curves over the training course of the 30 cases except a decrease in reading time. Diagnostic accuracy and sensitivity were significantly affected by the reader training level and prior overall experience with appendiceal CT but not by the prior specific experience with low-dose appendiceal CT.	2
19. Yun SJ, Kim HC, Yang DM, et al. Diagnostic Usefulness of Low-Dose Nonenhanced Computed Tomography With Coronal Reformations in Patients With Suspected Acute Appendicitis: A Comparison With Standard-Dose Computed Tomography. J Comput Assist Tomogr. 40(3):485-92, 2016 May-Jun.	Observational-Dx	452 patients	To evaluate the usefulness of low-dose (LD) nonenhanced computed tomography (NECT) with coronal reformation in diagnosing acute appendicitis and to compare LD NECT with standard-dose (SD) NECT and SD contrast-enhanced CT (CECT).	Although the area under the curves of both reviewers of LD NECT were lower than those of SD CECT2, area under the curves of both reviewers for SD NECT were not significantly different for SD CECT1 and LD NECT (all $P > 0.05$ ). The interobserver agreements within each scan were excellent (all kappa $> 0.8$ ).	2
20. Brassart N, Winant C, Tack D, Gevenois PA, De Maertelaer V, Keyzer C. Optimised z-axis coverage at multidetector-row CT in adults suspected of acute appendicitis. Br J Radiol. 86(1028):20130115, 2013 Aug.	Observational-Dx	46 patients	To compare diagnostic performances of two reduced z-axis coverages to full coverage of the abdomen and pelvis for the diagnosis of acute appendicitis and alternative diseases at unenhanced computed tomography (CT).	46 patients had a definite diagnosis of appendicitis and 53 of alternative diseases. The frequency of appendix visualisation was lower for set S than set L for both readers (89% and 84% vs 95% and 91% by Readers A and B, respectively; $p=0.021$ and $0.022$ ). The probability of giving a correct diagnosis was lower for set S (68%) than set L (78%; odds ratio, 0.611; $p=0.008$ ) for both readers, without significant difference between sets L and M (77%, $p=0.771$ ); z-axis coverage being reduced by 25% for set M.	2

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21. Corwin MT, Chang M, Fananapazir G, Seibert A, Lamba R. Accuracy and radiation dose reduction of a limited abdominopelvic CT in the diagnosis of acute appendicitis. <i>Abdom Imaging</i> . 40(5):1177-82, 2015 Jun.	Observational-Dx	235 patients	To determine the accuracy and radiation dose reduction of a limited abdominopelvic computed tomography (CT) from the bottom of T10 to the top of the pubic symphysis in patients with suspected acute appendicitis.	235 patients (89 male, mean age 44.6 years) were included. The limited scan resulted in a mean Z-axis length reduction of 5.1 cm superiorly, 6.1 cm inferiorly, and a total reduction of 11.2 cm (24%). The mean whole body effective dose was 11.8 and 9.1 mSv for the original and limited scans, respectively (23% reduction). The entire appendix or cecum was visualized in all cases. Appendicitis was present in 24 cases and an alternative diagnosis was made in 75. No cases of appendicitis or alternative diagnoses were missed using the limited scan.	2
22. O'Malley ME, Alharbi F, Chawla TP, Moshonov H. CT following US for possible appendicitis: anatomic coverage. <i>Eur Radiol</i> . 26(2):532-8, 2016 Feb.	Observational-Dx	99 patients	To determine superior-inferior anatomic borders for computed tomography (CT) following inconclusive/nondiagnostic ultrasound (US) for possible appendicitis.	The study group included 83 women and 16 men; mean age 32 (median, 29; range 18-73) years. Final diagnoses were: nonspecific abdominal pain 50/99 (51%), appendicitis 26/99 (26%), gynaecological 12/99 (12%), gastrointestinal 9/99 (10%), and musculoskeletal 2/99 (2%). Median dose-length product for standard CT was 890.0 (range, 306.3 - 2493.9) mGy.cm. To confidently diagnose/exclude appendicitis or identify alternative diagnoses, maximum superior-inferior anatomic CT coverage was the superior border of L2-superior border of pubic symphysis, for both reviewers. Targeted CT would reduce anatomic coverage by 30-55% (mean 39%, median 40%) compared to standard CT.	2
23. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. <i>Am J Epidemiol</i> . 1990; 132(5):910-925.	Review/Other-Dx	N/A	To describe epidemiology of appendicitis in the United States.	Rates of appendectomy in different subgroups. Highest rate was found in women (35-44 years). Overall, an estimated 36 incidental procedures are performed to prevent one case of appendicitis.	4

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24. Soyer P, Dohan A, Eveno C, et al. Pitfalls and mimickers at 64-section helical CT that cause negative appendectomy: an analysis from 1057 appendectomies. Clin Imaging. 37(5):895-901, 2013 Sep-Oct.	Observational-Dx	18 patients	To determine the rate of negative appendectomy and clarify the causes of negative appendectomy in patients with clinically suspected acute appendicitis who had surgery after 64-section helical computed tomography (CT).	The negative appendectomy rate was 1.7% (18/1057). Appendix enlargement (>6 mm) and fat stranding were present in 17 (17/18; 94%) and 6 patients (6/18; 33%), respectively. In 13 patients (13/18; 72%) 64-section helical CT findings were consistent with acute appendicitis. Interpretive errors in original imaging reports were identified in five patients (5/18; 28%).	2
25. Chiu YH, Chen JD, Wang SH, et al. Whether intravenous contrast is necessary for CT diagnosis of acute appendicitis in adult ED patients?. Acad Radiol. 20(1):73-8, 2013 Jan.	Observational-Dx	100 subjects	To assess the necessity of intravenous contrast medium for abdominopelvic computed tomography (CT) diagnosis of acute appendicitis (APP) among adult patients with right lower quadrant (RLQ) abdominal pain at emergency department (ED).	Forty-two (42.0%) of the 100 patients (55 males, 45 females; age range, 16-90 years; mean age, 49.3 years) were APP. There was no significant difference for the visibility of appendix (94% vs. 91%; P = .589) and radiological characters between the contrast-enhanced CT (CCT) and noncontrast CT (NCT) groups. There were significant differences between the two groups for sensitivity (100% vs. 90.5%; P = .036), specificity (94.8% vs. 100%; P = .038), PPV (93.3% vs. 100%; P = .021), NPV (100% vs. 93.5%; P = .021), but no significant difference for accuracy (97% vs. 96%; P = 1). The appendix was easier to detect on CCT than NCT images (P = .013).	3

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26. Drake FT, Alfonso R, Bhargava P, et al. Enteral contrast in the computed tomography diagnosis of appendicitis: comparative effectiveness in a prospective surgical cohort. <i>Ann Surg.</i> 260(2):311-6, 2014 Aug.	Observational-Dx	9047 patients	To perform a comparative effectiveness study of intravenous (IV)-only versus IV + enteral contrast in computed tomographic (CT) scans performed for patients undergoing appendectomy across a diverse group of hospitals.	A total of 9047 adults underwent appendectomy and 8089 (89.4%) underwent CT, 54.1% of these with IV contrast only and 28.5% with IV + enteral contrast. Pathology findings correlated with radiographic findings in 90.0% of patients who received IV + enteral contrast and 90.4% of patients scanned with IV contrast alone. Hospitals were categorized as rural or urban and by their teaching status. Regardless of hospital type, there was no difference in concordance between IV-only and IV + enteral contrast. After adjusting for age, sex, comorbid conditions, weight, hospital type, and perforation, odds ratio of concordance for IV + enteral contrast versus IV contrast alone was 0.95 (95% CI: 0.72-1.25).	2
27. Xiong B, Zhong B, Li Z, et al. Diagnostic Accuracy of Noncontrast CT in Detecting Acute Appendicitis: A Meta-analysis of Prospective Studies. [Review]. <i>Am Surg.</i> 81(6):626-9, 2015 Jun.	Meta-analysis	7 studies	To evaluate the diagnostic accuracy of noncontrast computed tomography (CT) in detecting acute appendicitis.	The pooled sensitivity and specificity were 0.90 (95% CI: 0.86-0.92) and 0.94 (95% CI: 0.92-0.97), respectively. The pooled positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio was 12.90 (95% CI: 4.80-34.67), 0.09 (95% CI: 0.04-0.20), and 162.76 (95% CI: 31.05-853.26), respectively. The summary receiver-operating characteristic curve was symmetrical and the area under the curve was 0.97 (95% CI: 0.95-0.99).	Good
28. Wadhvani A, Guo L, Saude E, et al. Intravenous and Oral Contrast vs Intravenous Contrast Alone Computed Tomography for the Visualization of Appendix and Diagnosis of Appendicitis in Adult Emergency Department Patients. <i>Can Assoc Radiol J.</i> 67(3):234-41, 2016 Aug.	Observational-Dx	211 patients	To compare radiologist's ability to 1) visualize the appendix; 2) diagnose acute appendicitis; and 3) diagnose alternative pathologies responsible for acute abdominal pain among adult patients undergoing computed tomography (CT) scan with 3 different protocols: 1) intravenous (IV) contrast only; 2) IV and oral contrast with 1-hour transit time; and 3) IV and oral contrast with 3-hour transit time.	Frequency of visualizing the appendix within IV group alone was 87.3%, IV with oral for 1 hour was 94.1%, and IV with oral for 3 hours was 93.8%. Both oral contrast groups had 100% sensitivity and negative predictive value in diagnosis of acute appendicitis. Specificity for the 1- and 3-hour oral contrast groups was 94.1% and 96.1%, respectively and positive predictive value for both groups was 92%.	2

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29. Uyeda JW, Yu H, Ramalingam V, Devalapalli AP, Soto JA, Anderson SW. Evaluation of Acute Abdominal Pain in the Emergency Setting Using Computed Tomography Without Oral Contrast in Patients With Body Mass Index Greater Than 25. <i>J Comput Assist Tomogr.</i> 39(5):681-6, 2015 Sep-Oct.	Observational-Dx	1992 patients	To evaluate the rate of delayed or missed diagnoses and need for additional computed tomography (CT) imaging in emergency department patients with abdominal pain who are imaged without oral contrast.	Of the 1992 patients included in this study, 4 patients (0.2%) underwent repeat CT studies directly related to the absence of oral contrast on the original examination. Of the 1992 CT scans, 1193(59.8%) were interpreted as negative, none of which required surgery or direct intervention. In patients with acute appendicitis, there was a sensitivity of CT in this patient population of 100% with a specificity of 99.5%.	3
30. Park G, Lee SC, Choi BJ, Kim SJ. Stratified computed tomography findings improve diagnostic accuracy for appendicitis. <i>World J Gastroenterol.</i> 20(38):13942-9, 2014 Oct 14.	Observational-Dx	224 patients	To improve the diagnostic accuracy in patients with symptoms and signs of appendicitis, but without confirmative computed tomography (CT) findings.	The two groups showed significant differences with respect to appendiceal diameter, and the presence of periappendiceal fat stranding and intraluminal air in the appendix. A larger proportion of patients in the appendicitis group showed distended appendices larger than 6.0 mm (66.3% vs 37.0%; $P < 0.001$ ), periappendiceal fat stranding (34.1% vs 8.9%; $P = 0.001$ ), and the absence of intraluminal air (67.6% vs 48.9%; $P = 0.024$ ) compared to the non-appendicitis group. Furthermore, the presence of two or more of these factors increased the odds ratio to 6.8 times higher than baseline (95% CI: 3.013-15.454; $P < 0.001$ ).	3
31. Lai V, Chan WC, Lau HY, Yeung TW, Wong YC, Yuen MK. Diagnostic power of various computed tomography signs in diagnosing acute appendicitis. <i>Clin Imaging.</i> 36(1):29-34, 2012 Jan-Feb.	Review/Other-Dx	100 patients	To review the diagnostic power of various computed tomography (CT) signs in acute appendicitis, in particular those initially classified as inconclusive.	All CT signs show statistically significant occurrences in acute appendicitis. Their respective cut-off values with best sensitivity and specificity were calculated. Those from the inconclusive cases were also reviewed.	4

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32. Kim MY, Kim Y, Ryu JA, Kim TY. How to evaluate appendices with borderline diameters on CT: proposal of a quick solution to overcome the limitations of the established CT criteria. Acad Radiol. 21(12):1573-8, 2014 Dec.	Observational-Dx	216 patients	To propose a useful computed tomography (CT) criterion, the diameter with compression (DWC), especially in appendices with borderline diameters.	The areas under the receiver operating characteristic curve (AUC) of the MOD and the DWC were 0.967 and 0.973, respectively. The optimal cutoff value was 8.2 mm for the MOD and 6.6 mm for the DWC. Twenty-five of the 80 appendicitis patients (31.2%) and 62 of the 136 nonappendicitis patients (45.6%) had MODs between 5.7 mm and 9.8 mm in the overlap between the two groups. In this overlap, the AUC of the MODs declined sharply to 0.767, whereas the AUC of the DWCs remained 0.923. Use of the criterion of DWC >6.6 mm yielded a sensitivity of 84.0%, a specificity of 88.7%, and an accuracy of 87.4%. There were no other criteria with both sensitivity and specificity >80% in the range of overlap.	3
33. Verma R, Grechushkin V, Carter D, Barish M, Pryor A, Telem D. Use and accuracy of computed tomography scan in diagnosing perforated appendicitis. Am Surg. 81(4):404-7, 2015 Apr.	Review/Other-Dx	102 patients	To assess the use and accuracy of computed tomography (CT) scans in diagnosing perforated appendicitis without phlegmon or abscess.	Analysis of patient populations demonstrated patients with perforation were significantly older (45 vs 34 years, P = 0.002), had longer operative times (132 vs 81 minutes, P = 0.001), and longer length of stay (8.2 vs 1.5 days, P < 0.001). Nineteen perforations (37%) were correctly diagnosed by CT scan. The sensitivity of CT scan to detect perforation was 38 per cent, specificity 96 per cent, and positive predictive value of 90 per cent. After multivariate analysis of significant variables, three were demonstrated to significantly correlate with presence of perforation: presence of extraluminal air (odds ratio [OR], 28.9; P = 0.02); presence of intraluminal fecalith (OR, 5.7; P = 0.03); and wall thickness greater than 3 mm (OR, 3.2; P = 0.02).	4

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
34. Azok JT, Kim DH, Munoz Del Rio A, et al. Intraluminal air within an obstructed appendix: a CT sign of perforated or necrotic appendicitis. <i>Acad Radiol.</i> 19(10):1175-80, 2012 Oct.	Observational-Dx	374 subjects	To evaluate the predictive value of intraluminal air for appendiceal necrosis and/or perforation when not apparent on imaging.	Image-ocult necrosis or perforation was present in 17.4% (65 or 374) of the study cohort. Intraluminal air and appendicoliths were predictive variables by univariate logistic regression ( $P = .001$ and $P \leq .001$ , respectively), with odds ratios of 2.64 (95% confidence interval, 1.48-4.73) for intraluminal air and 2.67 (95% confidence interval, 1.55-4.61) for appendicoliths. Both remained independent variables on multivariate modeling despite multicollinearity. Increasing age was also predictive (odds ratio, 1.25; 95% confidence interval, 1.09-1.44; $P = .002$ ), whereas gender was not ( $P = .472$ ).	2
35. Kim MS, Park HW, Park JY, et al. Differentiation of early perforated from nonperforated appendicitis: MDCT findings, MDCT diagnostic performance, and clinical outcome. <i>Abdom Imaging.</i> 39(3):459-66, 2014 Jun.	Observational-Dx	339 patients	To determine the computed tomography (CT) findings and assess their diagnostic performance in differentiating early perforated appendicitis from nonperforated appendicitis, and to compare therapeutic approaches and clinical outcomes between two types of appendicitis.	Univariate and multivariate logistic regression analysis were used to determine the CT findings for differentiating early perforated appendicitis from nonperforated appendicitis, a total of 75 (22%) of the 339 patients was diagnosed with early perforated appendicitis. Focal wall defect [adjusted odds ratio (aOR), 23.40; $p < 0.001$ ], circumferential periappendiceal changes (aOR, 5.63; $p < 0.001$ ), appendicoliths/fecaliths (aOR, 2.47; $p = 0.015$ ), and transverse diameter of the appendix (aOR, 1.22; $p = 0.003$ ) were independently differentiating variables for early perforated appendicitis. The transverse diameter of the appendix ( $\geq 11$ mm) had the highest sensitivity (62.7%) and focal wall defect in the appendiceal wall showed the highest specificity (98.8%). The prevalence of surgical drainage was higher ( $p = 0.001$ ) and the mean hospital stay was approximately one day longer ( $p < 0.001$ ) in the early perforated group than nonperforated group	2

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
36. Jones RP, Jeffrey RB, Shah BR, Dessler TS, Rosenberg J, Olcott EW. Journal Club: the Alvarado score as a method for reducing the number of CT studies when appendiceal ultrasound fails to visualize the appendix in adults. AJR Am J Roentgenol. 204(3):519-26, 2015 Mar.	Observational-Dx	119 patients	To evaluate the hypothesis that Alvarado scores of 3 or lower identify adult patients who are unlikely to benefit from computed tomography (CT) after appendiceal ultrasound fails to show the appendix and is otherwise normal.	No patients (0.0%, 0/49) with Alvarado scores 3 or lower had appendicitis, compared with 17.1% (12/70) of patients with Alvarado scores 4 or higher (p = 0.001), and CT showed neither appendicitis nor significant alternative findings in 85.7% (42/49) versus 58.6% (41/70) of these patients, respectively (p = 0.002). The rates of perforated appendicitis, as well as significant alternative CT findings, did not differ significantly.	3
37. Shah BR, Stewart J, Jeffrey RB, Olcott EW. Value of short-interval computed tomography when sonography fails to visualize the appendix and shows otherwise normal findings.[Erratum appears in J Ultrasound Med. 2015 Jul;34(7):1300 Note: Jeffery, R Brooke [corrected to Jeffrey, R Brooke]; PMID: 26112634]. J Ultrasound Med. 33(9):1589-95, 2014 Sep.	Observational-Dx	318 patients	To evaluate the type and incidence of disorders revealed by short-interval computed tomography (CT) in patients with suspected appendicitis after graded compression sonography fails to reveal the appendix and shows otherwise normal findings.	Of the 318 patients, short-interval CT revealed normal findings in 250 (78.6%). Appendicitis was revealed in 52 (16.4%) others, of whom 7 had perforation and all of whom had pathologic results confirming these CT findings. Important alternative diagnoses other than appendicitis were revealed in 16 (5.0%) others, including 2 (0.6%) who required urgent surgery and 14 (4.4%) who did not. No significant differences were observed between adult patients (>18 years) and pediatric patients	3



**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
38. Barksdale AN, Hackman JL, Gaddis M, Gratton MC. Diagnosis and disposition are changed when board-certified emergency physicians use CT for non-traumatic abdominal pain. <i>Am J Emerg Med.</i> 33(11):1646-50, 2015 Nov.	Observational-Dx	547 patients	To determine the effect of abdominal computed tomographic (CT) scan results on diagnosis and disposition of patients with non-traumatic abdominal pain who were evaluated by board-certified emergency physicians (EPs).	Six hundred twenty-nine patients were entered and 547 remained after exclusions; 298 (54%) subjects had a change in diagnosis. In 6 categories, there was a statistically significant change, with non-specific abdominal pain the most common ( $P < .001$ ); followed by renal colic ( $P < .001$ ), appendicitis ( $P < .001$ ), diverticulitis ( $P < .001$ ), small bowel obstruction ( $P < .029$ ), and gynecologic process ( $P < .001$ ). The most common disposition plan was "admit for observation," which was reported in 262 patients and remained in only 122 post CT (47%); 301 (54%) patients whose initial plan was admission were ultimately managed otherwise.	2
39. Pooler BD, Lawrence EM, Pickhardt PJ. Alternative diagnoses to suspected appendicitis at CT. <i>Radiology.</i> 265(3):733-42, 2012 Dec.	Observational-Dx	1571 patients	To assess alternative diagnoses in adults undergoing computed tomography (CT) for suspected acute appendicitis in routine clinical practice.	A specific diagnosis at CT examination was made in 867 of 1571 (55.2%) patients. Acute appendicitis was favored in 371 of 1571 (23.6%) patients. An alternative diagnosis other than appendicitis was suggested in 496 of 1571 (31.6%) patients. Among patients with an alternative CT diagnosis, 204 of 496 (41.1%) were hospitalized and 109 of 496 (22.0%) underwent surgical or image-guided intervention for diagnoses other than appendicitis, compared with rates of 14.1% and 4.4%, respectively, among patients in whom a specific diagnosis was not made at CT ( $P < .0001$ ). The most common broad categories of disease included nonappendiceal gastrointestinal conditions (46.0%), gynecologic conditions (21.6%), genitourinary conditions (16.9%), and hepatopancreaticobiliary conditions (7.7%).	2

**Right Lower Quadrant Pain-Suspected Appendicitis  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
40. Piyaom P, Kaewlai R. False-negative appendicitis at ultrasound: nature and association. <i>Ultrasound Med Biol.</i> 40(7):1483-9, 2014 Jul.	Observational-Dx	112 patients	To describe nature and factors associated with false-negative ultrasound (US) for adult appendicitis.	There were 112 patients (40 men, mean age = 40 y, 56 true positives) included. Two factors were found differ significantly: abdominal wall thickness and pain score. Greater abdominal wall thickness (18.6 mm vs. 14.9 mm, p = 0.001) and lower pain score (6.6 vs. 7.5, p = 0.018) were statistically associated with false negativity. The two groups did not differ significantly in terms of weight, height, body mass index, symptom duration, Alvarado score, US examination time, appendix position/size, perforation rate and operator.	3
41. Al-Ajerami Y.. Sensitivity and specificity of ultrasound in the diagnosis of acute appendicitis. <i>East Mediterr Health J.</i> 18(1):66-9, 2012 Jan.	Observational-Dx	180 patients	To evaluate the sensitivity and specificity of ultrasound in the diagnosis of acute appendicitis at Al-Shefa hospital, Gaza Strip, Palestine.	The negative appendectomy rate was low, with only 4.4% (8/180) false positives. A significantly higher false diagnosis rate (false negatives + false positives) was obtained in female patients than in males: 38.5% versus 6.2%. A high proportion of falsely diagnosed cases had abnormal weight (overweight or obese) (82.1%). The overall sensitivity and specificity of ultrasound, using surgical outcome as the gold standard, were 84.8% and 83.3% respectively, and the positive and negative predictive values were 93.3% and 66.7% respectively. Sensitivity and specificity were higher in males (95.7% and 88.2% respectively) than females (84.6% and 71.4% respectively).	3
42. Boonstra PA, van Veen RN, Stockmann HB. Less negative appendectomies due to imaging in patients with suspected appendicitis. <i>Surg Endosc.</i> 29(8):2365-70, 2015 Aug.	Observational-Dx	466 patients	To evaluate the implementation of the guideline "diagnostics and treatment in acute appendicitis" in 2010. This guideline states that, in every patient with clinically suspected acute appendicitis, an ultrasonography or computed tomography (CT) scan is advised to confirm the diagnosis before surgery.	In 2008, 228 patients were treated for acute appendicitis. In 43 %, imaging was performed. In 2011, 238 patients were treated; in 99 % of the cases, imaging was performed. A decrease in patients with negative appendectomy was seen from 19 % in 2008 to 5 % in 2011. Financial analysis showed a reduction in costs favoring 2011.	3

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
43. Kaewlai R, Lertlumsakulsub W, Srichareon P. Body mass index, pain score and Alvarado score are useful predictors of appendix visualization at ultrasound in adults. <i>Ultrasound Med Biol.</i> 41(6):1605-11, 2015 Jun.	Observational-Dx	238 patients	To find factors predictive of ultrasound visualization of the appendix in patients with suspected appendicitis.	Ultrasound sensitivity, specificity and accuracy were 64%, 90% and 71%, respectively. The appendix was visualized at ultrasound in 126 patients (group 1) and not visualized in 112 patients (group 2). Group 1 had a lower body mass index, higher pain score and higher Alvarado score. The chances of visualizing the appendix in patients with body mass indexes $\leq 22$ , pain scores $\geq 6$ , and Alvarado scores $\geq 6$ were 2.3, 2.9, and 3.8 times higher than those of their counterparts, respectively.	3
44. Lourenco P, Brown J, Leipsic J, Hague C. The current utility of ultrasound in the diagnosis of acute appendicitis. <i>Clin Imaging.</i> 40(5):944-8, 2016 Sep-Oct.	Observational-Dx	354 patients	To evaluate the current performance of ultrasound in the diagnosis of acute appendicitis.	Our data demonstrates that ultrasound (US) relative to surgery-confirmed appendicitis has a sensitivity and specificity of 48.4% and 97.9%, respectively. The diagnostic accuracy was further increased when there was a low pre-test probability, with a negative predictive value (NPV) of up to 96.6%.	3
45. Stewart JK, Olcott EW, Jeffrey RB. Sonography for appendicitis: nonvisualization of the appendix is an indication for active clinical observation rather than direct referral for computed tomography. <i>J Clin Ultrasound.</i> 40(8):455-61, 2012 Oct.	Observational-Dx	260 patients	To determine the prevalence of perforated and nonperforated appendicitis in patients with nonvisualization of the appendix on ultrasound (US) performed for suspected appendicitis, and to evaluate the value of computed tomography (CT) in these patients.	Of the 400 patients, 140 (35%) had either a normal (80 patients, 25%) or an abnormal appendix (60 patients, 15%); 260 (65%) had nonvisualization of the appendix. Overall 75 patients had appendicitis (18.8%) and 17 (4.3%) had appendicitis with perforation. Of the 260 patients with nonvisualization of the appendix, 14 patients (5.4%) had appendicitis and 2 were perforated (0.8%). The prevalence of perforated and nonperforated appendicitis in this group was significantly lower than the overall group ( $p < 0.001$ and $p < 0.01$ , respectively). Of these 260 patients, 101 patients (38.8%) had CT within 48 hours and 79 (78.2%) had normal scans.	4

**Right Lower Quadrant Pain-Suspected Appendicitis  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
46. Bondi M, Miller R, Zbar A, et al. Improving the diagnostic accuracy of ultrasonography in suspected acute appendicitis by the combined transabdominal and transvaginal approach. <i>Am Surg.</i> 78(1):98-103, 2012 Jan.	Observational-Dx	292 patients	To report an update of combined transabdominal ultrasonography (TAS) and transvaginal ultrasonography (TVUS) in patients referred with suspected acute appendicitis (AA)	Of the 135 women with negative ultrasound examinations, 14 underwent surgery in which four cases of appendicitis were found. The sensitivity of the combined approach was 97.3 per cent, the specificity 91 per cent, the positive predictive value 91.7 per cent, and the negative predictive value 97 per cent.	3
47. D&#39;Souza N, D&#39;Souza C, Grant D, Royston E, Farouk M. The value of ultrasonography in the diagnosis of appendicitis. <i>Int J Surg.</i> 13:165-9, 2015 Jan.	Observational-Dx	573 patients	To elucidate the real-world value of ultrasonography in the diagnosis of appendicitis, and its impact on negative appendectomy rates (NAR)	573 patients underwent ultrasonography prior to appendectomy. The appendix was not visualised in 45% of scans. The sensitivity and specificity of ultrasonography for the diagnosis of appendicitis was 51.8% and 81.4%. The mean NAR was 26.7%, or 18.3% after a positive ultrasound scan.	3

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
48. Kouame N, N&#39;goan-Domoua AM, N&#39;dri KJ, et al. The diagnostic value of indirect ultrasound signs during acute adult appendicitis. <i>Diagn Interv Imaging</i> . 93(3):e24-8, 2012 Mar.	Observational-Dx	620 patients	To evaluate the diagnostic value of indirect ultrasound signs during acute appendicitis.	The positive predictive value of the indirect signs of appendicitis on the ultrasound scan was 95.8% if the three indirect signs were associated, 87.5% for the association of pain and hypertrophy of the peritoneal fat (HPF), 45.8% for the association of pain and localised hypokinesia in the digestive loops (LHL), and 25% if there was just pain. The negative predictive value of the indirect signs of appendicitis on the ultrasound scan was 57.2% if the three signs were associated, 65.9% for the association of pain and HPF and 60.7% for the association of pain and LHL, with 83.3% for pain alone. The sensitivity of the indirect signs was 83.9% if the three signs were associated, 31.8% for the association of pain and HPF, 50% for the association of pain and LHL, and 50% if there was just pain. The specificity of the indirect signs was 85.7% if the three signs were associated, 96.7% for the association of pain and HPF, 56.7% for the association of pain and LHL, and 62.5% if there was just pain.	3
49. Petkovska I, Martin DR, Covington MF, et al. Accuracy of Unenhanced MR Imaging in the Detection of Acute Appendicitis: Single-Institution Clinical Performance Review. <i>Radiology</i> . 279(2):451-60, 2016 May.	Observational-Dx	403 patients	To determine the accuracy of unenhanced magnetic resonance (MR) imaging in the detection of acute appendicitis in patients younger than 50 years who present to the emergency department with right lower quadrant (RLQ) pain.	Of the 403 patients, 67 had MR imaging findings that were positive for acute appendicitis, and 336 had negative findings. MR imaging had a sensitivity of 97.0% (65 of 67) and a specificity of 99.4% (334 of 336). The mean total room time was 14 minutes (range, 8-62 minutes). An alternate diagnosis was offered in 173 (51.5%) of 336 patients.	2

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
50. Byott S, Harris I. Rapid acquisition axial and coronal T2 HASTE MR in the evaluation of acute abdominal pain. <i>Eur J Radiol.</i> 85(1):286-90, 2016 Jan.	Observational-Dx	468 cases	To assess T2 HASTE MR in acute abdominal imaging and ascertain if it is a reliable alternative to CT in patients under 60.	468 cases included in the study. 349 were negative for acute abdominal pathology, 116 positive for acute abdominal pathology and 3 were indeterminate. In the MR positive group (n=116), 64 had surgery confirming findings (34 appendicitis, 14 SBO, 3 ovarian torsion, 3 LBO, intussusception, ovarian carcinoma, ovarian dermoid, 2 pelvic inflammatory disease, diverticular abscess, crohns, 4 endoscopy for acute bowel pathology) while 51 were managed conservatively with concordant follow up (4 SBO, 11 diverticulitis, 6 pelvic inflammatory disease, 7 inflammatory bowel disease, 7 colitis, 6 pyelonephritis, 2 cholecystitis, renal abscess, pseudomembranous colitis, splenic haematoma, mesenteric adenitis, 2 pancreatitis, lymphoma, epiploic appendagitis). 1 patient had an MR diagnosis of appendicitis but at laparoscopy a sigmoid diverticular perforation was diagnosed and the appendix was normal. In the MR negative group (n=349), 324 had uneventful follow-up, 22 had negative laparoscopies, while 3 had subsequent appendectomies, with appendicitis on histology (3 days, 10 days and 2 months post scan). In the MR indeterminate group (n=3), one was treated conservatively with uneventful follow up, one had laparoscopic appendectomy with normal appendix on histology, one had laparoscopic appendectomy with acute appendicitis on histology. When MR correlated with clinical follow up (n=468), overall diagnostic accuracy is 99% (463/468). When MR findings correlated with direct visualisation at surgery/endoscopy (n=90), sensitivity is 98% (95% CI) and specificity is 92% (95%	3

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
				CI).	
51. Heverhagen JT, Pfestroff K, Heverhagen AE, Klose KJ, Kessler K, Sitter H. Diagnostic accuracy of magnetic resonance imaging: a prospective evaluation of patients with suspected appendicitis (diamond). <i>J Magn Reson Imaging</i> . 35(3):617-23, 2012 Mar.	Observational-Dx	52 patients	To show the effect of standard MRI in patients with suspected appendicitis on negative laparotomy and perforation rate in addition to evaluating the economic impact on hospital resources.	Negative laparotomy and perforation rate were 0% (0/52) and 8% (1/13). Sensitivity and specificity for detecting acute appendicitis were 85% (11/13) and 97% (38/39). In 40% of patients therapy changed due to the MRI. The overall effect on the use of hospital resources was a net saving of euro 2,335.	2
52. Leeuwenburgh MM, Wiarda BM, Jensch S, et al. Accuracy and interobserver agreement between MR-non-expert radiologists and MR-experts in reading MRI for suspected appendicitis. <i>Eur J Radiol</i> . 83(1):103-10, 2014 Jan.	Observational-Dx	230 patients	To compare accuracy and interobserver agreement between radiologists with limited experience in the evaluation of abdominal magnetic resonance imaging (MRI) (non-experts), and radiologists with longer MR reading experience (experts), in reading MRI in patients with suspected appendicitis.	Urgent diagnoses were assigned to 147 of 223 patients; 117 had appendicitis. Sensitivity for appendicitis was 0.89 by MR-non-expert radiologists and 0.97 in MR-expert reading (p=0.01). Specificity was 0.83 for MR-non-experts versus 0.93 for MR-expert reading (p=0.002). MR-experts and MR-non-experts agreed on appendicitis in 89% of cases (kappa 0.78). Accuracy in detecting urgent diagnoses was significantly lower in MR-non-experts compared to MR-expert reading: sensitivity 0.84 versus 0.95 (p<0.001) and specificity 0.71 versus 0.82 (p=0.03), respectively. Agreement on urgent diagnoses was 83% (kappa 0.63).	2

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
53. Leeuwenburgh MM, Wiarda BM, Wiezer MJ, et al. Comparison of imaging strategies with conditional contrast-enhanced CT and unenhanced MR imaging in patients suspected of having appendicitis: a multicenter diagnostic performance study. <i>Radiology</i> . 268(1):135-43, 2013 Jul.	Observational-Dx	230 patients	To compare the diagnostic performance of imaging strategies with magnetic resonance (MR) imaging and computed tomographic (CT) imaging in adult patients suspected of having appendicitis.	Between March and September 2010, 229 US, 115 CT, and 223 MR examinations were performed in 230 patients (median age, 35 years; 40% men). Appendicitis was the final diagnosis in 118 cases. Conditional and immediate MR imaging had sensitivity and specificity comparable to that of conditional CT, which resulted in 3% (three of 118; 95% confidence interval [CI]: 1%, 7%) missed appendicitis, and 8% (10 of 125; 95% CI: 4%, 14%) false-positives. Conditional MR missed appendicitis in 2% (two of 118; 95% CI: 0%, 6%) and generated 10% (13 of 129; 95% CI: 6%, 16%) false-positives. Immediate MR missed 3% (four of 117; 95% CI: 1%, 8%) appendicitis with 6% (seven of 120; 95% CI: 3%, 12%) false-positives. Conditional strategies resulted in more false-positives in women than in men (conditional CT, 17% vs 0%; P = .03; conditional MR, 19% vs 1%; P = .04), whereas immediate MR imaging did not.	2
54. Leeuwenburgh MM, Wiezer MJ, Wiarda BM, et al. Accuracy of MRI compared with ultrasound imaging and selective use of CT to discriminate simple from perforated appendicitis. <i>Br J Surg</i> . 101(1):e147-55, 2014 Jan.	Observational-Dx	230 patients	To estimate the accuracy of magnetic resonance imaging (MRI) in distinguishing between simple and perforated appendicitis, and to compare MRI against ultrasound imaging with selected additional (conditional) use of computed tomography (CT).	MRI was performed in 223 of 230 included patients. Acute appendicitis was the final diagnosis in 118 of 230 patients, of whom 87 had simple and 31 perforated appendicitis. MRI correctly identified 17 of 30 patients with perforated appendicitis (sensitivity 57 (95 per cent confidence interval 39 to 73) per cent), whereas ultrasound imaging with conditional CT identified 15 of 31 (sensitivity 48 (32 to 65) per cent) (P = 0.517). All missed diagnoses of perforated appendicitis were identified as simple acute appendicitis with both imaging protocols. None of the MRI features for perforated appendicitis had a positive predictive value higher than 53 per cent.	2



**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
55. Duke E, Kalb B, Arif-Tiwari H, et al. A Systematic Review and Meta-Analysis of Diagnostic Performance of MRI for Evaluation of Acute Appendicitis. [Review]. AJR Am J Roentgenol. 206(3):508-17, 2016 Mar.	Meta-analysis	30 studies	To determine the accuracy of magnetic resonance imaging (MRI) in the diagnosis of acute appendicitis in the general population and in subsets of pregnant patients and children.	A total of 30 studies that comprised 2665 patients were reviewed. The sensitivity and specificity of MRI for the diagnosis of acute appendicitis are 96% (95% CI, 95-97%) and 96% (95% CI, 95-97%), respectively. In a subgroup of studies that focused solely on pregnant patients, the sensitivity and specificity of MRI were 94% (95% CI, 87-98%) and 97% (95% CI, 96-98%), respectively, whereas in studies that focused on children, sensitivity and specificity were found to be 96% (95% CI, 95-97%) and 96% (95% CI, 94-98%), respectively.	Good
56. Petroianu A, Alberti LR. Accuracy of the new radiographic sign of faecal loading in the cecum for differential diagnosis of acute appendicitis in comparison with other inflammatory diseases of right abdomen: a prospective study. J. med. life. 5(1):85-91, 2012 Feb 22.	Observational-Dx	470 patients	To assess the importance of the new radiographic sign of faecal loading in the cecum for the diagnosis of acute appendicitis, in comparison with other inflammatory diseases, and to verify the maintenance of this radiographic sign after surgical treatment of appendicitis.	The sign of faecal loading in the cecum, characterized by hypo transparency interspersed with multiple small foci of hyper transparent images, was present in 97 patients of Subgroup 1A, in 68 patients of Subgroup 1B, in 19 patients of Group 2, in 12 patients of Group 3 and in 13 patients of Group 4. During the postoperative period the radiographic sign disappeared in 66 of the 68 cases that had presented with the sign. The sensitivity of the radiographic sign for acute appendicitis was 97.05% and its specificity was 85.33%. The positive predictive value for acute appendicitis was 78.94% and its negative predictive value was 98.08%.	3
57. Foley CR, Latimer RG, Rimkus DS. Detection of acute appendicitis by technetium 99 HMPAO scanning. Am Surg. 1992; 58(12):761-765.	Observational-Dx	30 patients	Prospective study to report use of Tc-99 HMPAO scanning in acute appendicitis.	Tc-99 HMPAO study had a sensitivity of 81%, a specificity of 100% and an overall accuracy of 89%. Tc-99 HMPAO WBC scanning is useful in confirming clinical diagnosis of acute appendicitis.	3

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
58. Kontopodis N, Kouraki A, Panagiotakis G, Chatziioannou M, Spiridakis K. Efficacy of preoperative computed tomography imaging to reduce negative appendectomies in patients undergoing surgery for left lower quadrant abdominal pain. <i>G Chir.</i> 35(9-10):223-8, 2014 Sep-Oct.	Observational-Dx	257 patients	To report the experience with preoperative computed tomography (CT)-scan in patients with suspected acute appendicitis.	Groups I,II,III,IV included 12.4%, 18.2%, 54.5% and 14.8% of patients, respectively. The corresponding negative appendectomy rates were 18.7%, 4.3%, 4.2% and 2.6%. Odds ratio of negative appendectomy for patients without CT-scan was 5.2 (95% CI: 1.2-27.7) when there was low clinical probability and 1.6 (95% CI: 0.2-14.2) for high clinical probability.	3
59. Sezer TO, Gulece B, Zalluhoglu N, Gorgun M, Dogan S. Diagnostic value of ultrasonography in appendicitis. <i>Adv. Clin. Exp. Med.</i> 21(5):633-6, 2012 Sep-Oct.	Observational-Dx	91 patients	To determine the diagnostic accuracy of ultrasonography (US) for acute appendicitis.	Ultrasound supported the diagnosis of acute appendicitis in 58 (63.7%) patients. In the US with positive findings, 55 patients (94.8%) had inflamed appendices on histopathology and 5 (8.6%) had normal appendices. The overall sensitivity of ultrasonography was 71.4% and specificity was 78.5%. Positive predictive value (PPV), negative predictive value (NPV) and the diagnostic accuracy of ultrasonography are 94.8%, 33.3%, and 72.5% respectively.	3
60. Hasani SA, Fathi M, Daadpey M, Zare MA, Tavakoli N, Abbasi S. Accuracy of bedside emergency physician performed ultrasound in diagnosing different causes of acute abdominal pain: a prospective study. <i>Clin Imaging.</i> 39(3):476-9, 2015 May-Jun.	Observational-Dx	150 patients	To evaluate the diagnostic accuracy of bedside emergency physician-performed ultrasound study (EPUS) in patients with nontraumatic acute abdominal pain in comparison with their final diagnosis as the gold standard.	Emergency physician who performed bedside ultrasound had 78% diagnostic accuracy. Emergency physicians showed better results in diagnosing some entities (abdominal aortic aneurysm and renal stones) than the others (acute appendicitis, cholelithiasis, and cholecystitis).	2

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
61. Ramalingam V, LeBedis C, Kelly JR, Uyeda J, Soto JA, Anderson SW. Evaluation of a sequential multi-modality imaging algorithm for the diagnosis of acute appendicitis in the pregnant female. EMERG. RADIOL.. 22(2):125-32, 2015 Apr.	Observational-Dx	127 patients	To evaluate the performance of a sequential multi-modality imaging algorithm for diagnosing acute appendicitis in pregnancy.	Of the 125 patients with inconclusive ultrasound (US) examinations, 103 underwent magnetic resonance imaging (MRI), of which eight (6.2 %) demonstrated findings of acute appendicitis. Of the 103 patients that received MRI, nine (8.7 %) underwent computed tomography (CT). One patient had a CT performed directly after an inconclusive US exam. No additional cases of appendicitis were detected with CT. The sensitivity and specificity of US alone was 12.5 and 99.2 %, respectively; MRI was 100 and 93.6 %; the sequential multi-modality algorithm including US, CT, and MRI was 100 and 98.3 %.	3
62. Hirsch L, Yogev Y, Ashwal E, From A, Ben-Haroush A, Peled Y. The impact of pregnancy on the accuracy and delay in diagnosis of acute appendicitis. J Matern Fetal Neonatal Med. 27(13):1357-60, 2014 Sep.	Observational-Dx	1618 patients	To determine the accuracy and the delay in diagnosis of presumed acute appendicitis in pregnancy.	Out of 1618 women who underwent appendectomy during the study period, 81 (4.2%) were pregnant who were compared to 243 age-matched non-pregnant women. There was a significantly shorter interval between admission to the hospital and surgery and shorter surgery length (10.2 versus 15.7 h, 1.2 +/- 0.4 versus 1.4 +/- 0.5 h, respectively, p < 0.001) in the pregnant group with similar rates of negative appendectomy (19.8% versus 21.8%, respectively, p = 0.86). The positive and negative predictive values of ultrasonography (US) for the diagnosis of acute appendicitis were 88.2% and 100%, and 92.9% and 57.1%, among the pregnant and the non-pregnant group, respectively. In multivariate analysis, early gestational age was found to be independently associated with higher rate of accurate US results (OR = 0.92, 95% CI 0.85-0.99, p = 0.39).	3

**Right Lower Quadrant Pain-Suspected Appendicitis  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
63. Segev L, Segev Y, Rayman S, Nissan A, Sadot E. The diagnostic performance of ultrasound for acute appendicitis in pregnant and young nonpregnant women: A case-control study. <i>Int J Surg.</i> 34:81-85, 2016 Oct.	Observational-Dx	586 patients	To compare the diagnostic performance of ultrasound in pregnant and young nonpregnant women with suspected acute appendicitis.	Of 586 young women treated for appendicitis during the study periods (92 pregnant, 494 non-pregnant), 200 underwent preoperative ultrasound [67 pregnant, and 133 nonpregnant young women]. The pregnant and nonpregnant groups were comparable in age and presenting symptoms. There was no significant difference in the predictive performance of ultrasound between the two groups (AUC 0.76 and 0.73 respectively, $p = 0.78$ ) or within the pregnant group, by trimester [first ( $n = 23$ ), AUC 0.73; second ( $n = 32$ ), AUC 0.67; third ( $n = 12$ ), AUC 0.86; $p = 0.4$ ]. Ultrasound had a positive predictive value of 0.94 in the pregnant group and 0.91 in the nonpregnant group; corresponding negative predictive values were 0.40 and 0.43.	3
64. Lehnert BE, Gross JA, Linnau KF, Moshiri M. Utility of ultrasound for evaluating the appendix during the second and third trimester of pregnancy. <i>EMERG. RADIOL.</i> 19(4):293-9, 2012 Aug.	Observational-Dx	99 consecutive pregnant women	To retrospectively evaluate the right lower quadrant USs in women presenting during the second or third trimester of pregnancy for the frequency of appendix visualization and accuracy in diagnosing appendicitis.	The appendix was not visualized in 97% (96/99) of right lower quadrant US examinations. Of the 3 studies in which the appendix was visualized, 2 were considered positive for appendicitis and 1 was considered negative. 8 patients in this group ultimately underwent appendectomy, including the 2 patients with positive right lower quadrant USs, and appendicitis confirmed at pathology in 7 of these cases (87.5%). Right lower quadrant US successfully demonstrated an abnormal appendix in 28.7% (2 of 7) of surgically confirmed cases; however, this technique did not detect appendicitis in 71% (5 of 7) of patients with surgically proven disease due to nonvisualization of the appendix.	3

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
65. Burke LM, Bashir MR, Miller FH, et al. Magnetic resonance imaging of acute appendicitis in pregnancy: a 5-year multiinstitutional study. <i>Am J Obstet Gynecol.</i> 213(5):693.e1-6, 2015 Nov.	Observational-Dx	714 pregnant women	To determine the diagnostic performance of magnetic resonance imaging (MRI) in the diagnosis of acute appendicitis during pregnancy in a multiinstitutional study.	Of the cases that were evaluated, 9.3% (66/709) had MRI findings of acute appendicitis. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive values were 96.8%, 99.2%, 99.0%, 92.4%, and 99.7%, respectively. There was no statistically significant difference between centers that were included in the study (pair-wise probability values ranged from 0.12-0.99).	3
66. Theilen LH, Mellnick VM, Longman RE, et al. Utility of magnetic resonance imaging for suspected appendicitis in pregnant women. <i>Am J Obstet Gynecol.</i> 212(3):345.e1-6, 2015 Mar.	Observational-Dx	171 pregnant women	To estimate the rate and risk of appendix nonvisualization and alternative diagnoses made with magnetic resonance imaging (MRI) for suspected appendicitis in pregnant women.	Over the 5-year period, 171 pregnant women underwent MRI for suspected appendicitis. The rate of nonvisualization was 30.9% (n = 53). Of the remaining 118 women with a visualized appendix, 18 women had imaging findings that were consistent with appendicitis and underwent appendectomy. Twelve cases of appendicitis were confirmed on pathologic evaluation (66.7%). Women with nonvisualization of the appendix on MRI were more likely to be beyond the first trimester (odds ratio, 2.1; 95% confidence interval, 1.0-4.5). Seventy-four women had disease diagnosed on MRI (43.3%). In the group of 43 women who had a nondiagnostic ultrasound scanning before the MRI, the rate of subsequent diagnostic MRI was 65% (n = 28).	3
67. Konrad J, Grand D, Lourenco A. MRI: first-line imaging modality for pregnant patients with suspected appendicitis. <i>Abdom Imaging.</i> 40(8):3359-64, 2015 Oct.	Observational-Dx	117 patients	To evaluate the sensitivity, specificity, and accuracy of ultrasound (US) as compared to magnetic resonance imaging (MRI) in pregnant patients with suspected appendicitis for visualization of the appendix, accuracy at diagnosing acute appendicitis, the ability of each modality to identify alternate diagnoses of pain and whether gestational age (GA) has an association with appendix identification rates.	The appendix was visualized in 7% (8/117) of US exams and in 80% (91/114) of MRI exams. Alternate etiologies of pathology were determined in 3% (3/117) of US exams and 12% (14/114) of MRI exams. The sensitivity and specificity of MRI for acute appendicitis were both 100% and 98%, respectively, as compared to 18% and 99%, respectively, with US. GA did not affect MRI or ultrasound visualization rates of the appendix.	3

**Right Lower Quadrant Pain-Suspected Appendicitis**  
**EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
68. Rapp EJ, Naim F, Kadivar K, Davarpanah A, Cornfeld D. Integrating MR imaging into the clinical workup of pregnant patients suspected of having appendicitis is associated with a lower negative laparotomy rate: single-institution study. <i>Radiology</i> . 267(1):137-44, 2013 Apr.	Observational-Dx	187 patients	To determine if integrating magnetic resonance (MR) imaging into the workup of right lower quadrant pain in pregnant patients was associated with improved outcomes as measured by the negative laparotomy rate (NLR) and the perforation rate (PR).	MR imaging was introduced into the clinical workup in 2004. From 1996 to 2003, the NLR for pregnant patients was 55% (17 of 31), and the PR was 21% (three of 14). From 2004 to 2011, the NLR was 29% (15 of 51), and the PR was 26% (nine of 35). The 47% decline in the NLR ([55%-29%]/55%) was statistically significant (P = .02). The change in PR was not significant (P > .99). The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of MR imaging in the diagnosis of appendicitis were 89% (17 of 19), 97% (187 of 193), 74% (17 of 23), and 99% (187 of 189), respectively.	3
69. American College of Radiology. Manual on Contrast Media. Available at: <a href="https://www.acr.org/Clinical-Resources/Contrast-Manual">https://www.acr.org/Clinical-Resources/Contrast-Manual</a> .	Review/Other-Dx	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	4
70. Stewart D, Grewal N, Choi R, Waxman K. The use of tagged white blood cell scans to diagnose appendicitis in pregnant patients. <i>Am Surg</i> . 72(10):894-6, 2006 Oct.	Observational-Dx	13 patients	A retrospective review of all patients who were pregnant and underwent a nuclear medicine study as part of their evaluation was performed.	There was no relationship between the results of Tc-99m tagged WBC scans and the presence of appendicitis (P=0.538). The sensitivity of the Tc-99m tagged WBC scans was 50 %; specificity was 73 %. The data suggest that Tc-99m tagged WBC scans in pregnancy is not reliable in evaluating for appendicitis.	3
71. American College of Radiology. ACR–SPR Practice Parameter for the Safe and Optimal Performance of Fetal Magnetic Resonance Imaging (MRI). Available at: <a href="https://www.acr.org/-/media/ACR/Files/Practice-Parameters/mr-fetal.pdf">https://www.acr.org/-/media/ACR/Files/Practice-Parameters/mr-fetal.pdf</a>	Review/Other-Dx	N/A	To promote safe and optimal performance of fetal magnetic resonance imaging (MRI).	N/A	4

**Right Lower Quadrant Pain-Suspected Appendicitis  
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
72. American College of Radiology. ACR-SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation. Available at: <a href="https://www.acr.org/-/media/ACR/Files/Practice-Parameters/pregnant-pts.pdf">https://www.acr.org/-/media/ACR/Files/Practice-Parameters/pregnant-pts.pdf</a>	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4
73. American College of Radiology. ACR-ACOG-AIUM-SRU Practice Parameter for the Performance of Obstetrical Ultrasound. Available at: <a href="https://www.acr.org/-/media/ACR/Files/Practice-Parameters/us-ob.pdf">https://www.acr.org/-/media/ACR/Files/Practice-Parameters/us-ob.pdf</a>	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4
74. Expert Panel on MR Safety, Kanal E, Barkovich AJ, et al. ACR guidance document on MR safe practices: 2013. J Magn Reson Imaging. 37(3):501-30, 2013 Mar.	Review/Other-Dx	N/A	Guidance document on MR safety practices to help guide MR practitioners regarding MR safety issues and provide a basis for them to develop and implement their own MR policies and practices.	N/A	4
75. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: <a href="https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf">https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf</a> .	Review/Other-Dx	N/A	Guidance document on exposure of patients to ionizing radiation.	No results stated in abstract.	4

## Evidence Table Key

### Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
  - a. The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
  - b. The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
  - c. The study is an expert opinion or consensus document.
- Meta-analysis
  - a. *Good quality* – the study design, methods, analysis, and results are valid and the conclusion is supported.
  - b. *Inadequate quality* – the study design, analysis, and results lack the methodological rigor to be considered a good meta-analysis study.

## Abbreviations Key

Dx = Diagnostic

Tx = Treatment