

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. <i>CA Cancer J Clin.</i> 2015;65(1):5-29.	Review/Other-Tx	N/A	To provide the expected numbers of new cancer cases and deaths in 2015 nationally and for each state, as well as a comprehensive overview of cancer incidence, mortality, and survival rates and trends using the most current population-based data. The article also estimates the total number of deaths averted nationally during the past 2 decades and by state in 2011 as a result of the continual decline in cancer death rates and present actual number of deaths reported in 2011 by age for the 10 leading causes of death and for the 5 leading causes of cancer death.	Cancer death rates have been continuously declining for the past 2 decades. Overall, the risk of dying from cancer decreased by 22% between 1991 and 2011. Regionally, progress has been most rapid for residents of the Northeast, among whom death rates have declined by 25% to 30%, and slowest in the South, where rates declined by about 15%. Further reductions in cancer death rates can be accelerated by applying existing cancer control knowledge across all segments of the population, with an emphasis on those in the lowest socioeconomic bracket and other disadvantaged populations.	4
2. Dighe S, Blake H, Koh MD, et al. Accuracy of multidetector computed tomography in identifying poor prognostic factors in colonic cancer. <i>Br J Surg.</i> 2010;97(9):1407-1415.	Observational-Dx	84 patients	To validate prospectively the accuracy of MDCT in stratifying patients into good and poor prognostic groups in a multicenter setting.	The accuracy, sensitivity, specificity and PPV of stratification by CT compared with histological examination was 74% (95% CI, 64 to 82), 78% (65 to 87), 67% (49 to 81) and 81% (68 to 89), respectively. Accuracy for detecting malignant lymph nodes and extramural venous invasion was 58% and 70%, respectively. The agreement for predicting prognostic stratification was moderate (kappa = 0.54).	2
3. Dighe S, Swift I, Magill L, et al. Accuracy of radiological staging in identifying high-risk colon cancer patients suitable for neoadjuvant chemotherapy: a multicentre experience. <i>Colorectal Dis.</i> 2012;14(4):438-444.	Experimental-Dx	94 patients	To determine the accuracy of CT staging in identifying patients with high-risk colon cancers who would be considered as candidates for a neoadjuvant therapy trial (FOxTROT) and those at low risk (T1/T2) who would be excluded.	Of 94 patients with radiological and pathological data, 71% were categorized by CT as having a poor prognosis. The sensitivity and specificity of CT in identifying these tumors were 87% (95% CI, 74–94) and 49% (95% CI, 33–65). Sensitivity and specificity for tumor infiltration beyond the muscularis propria (T3/T4 vs T1/T2) were 95% (95% CI, 87–98) and 50% (95% CI, 22–77), respectively. Including all CT-staged T3 and T4 patients in the trial would have increased the proportion eligible for entry to 89% (n = 84) without affecting the false-positive rate of 7%. Some 20% of T3/T4 patients would have been ineligible for FOxTROT because of synchronous metastases.	2

Pretreatment Staging Colorectal Cancer
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4. Dighe S, Purkayastha S, Swift I, et al. Diagnostic precision of CT in local staging of colon cancers: a meta-analysis. <i>Clin Radiol.</i> 2010;65(9):708-719.	Meta-analysis	19 studies	To determine the accuracy of CT in detecting disease with invasion beyond the muscularis propria and malignant lymph nodes.	19 studies fulfilled all the necessary inclusion criteria. The pooled sensitivity, specificity, diagnostic OR for detection of tumor invasion were 86% (95% CI: 78%–92%); 78% (95% CI: 71%–84%); 22.4 (95% CI: 11.9–42.4). Similarly, the values for nodal detection were 70% (95% CI: 63%–73%); 78% (95% CI: 73%–82%); 8.1(95% CI: 4.7–14.1). In the subgroup analysis, the best results were obtained in studies utilizing MDCT.	M
5. Smith NJ, Bees N, Barbachano Y, Norman AR, Swift RI, Brown G. Preoperative computed tomography staging of nonmetastatic colon cancer predicts outcome: implications for clinical trials. <i>Br J Cancer.</i> 2007;96(7):1030-1036.	Observational-Dx	126 CT scans	To determine if clinical outcome could be predicted from radiological features of the primary tumor.	T-stage and nodal status was correctly predicted in only 60% and 62%, respectively. However, interobserver agreement for prognostic group was 79% (kappa=0.59) and 3-year relapse-free survival was 71% and 43% for the CT-predicted 'good' and 'poor' groups, respectively ($P<0.0066$). This compared favorably with 75% vs 43% for histology-predicted prognostic groups. CT is a robust method for stratifying patients preoperatively, with similar accuracy to histopathology for predicting outcome. Recognition of poor prognosis tumors preoperatively may permit investigation into the future use of neo-adjuvant therapy in colon cancer.	2
6. Pricolo VE. Rectal cancer: the good, the bad, and the ugly. <i>Arch Surg.</i> 2011;146(5):544.	Review/Other-Dx	N/A	Comment on rectal cancer.	No results stated in abstract.	4

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<p>7. Middleton PF, Sutherland LM, Maddern GJ. Transanal endoscopic microsurgery: a systematic review. <i>Dis Colon Rectum</i>. 2005;48(2):270-284.</p>	<p>Meta-analysis</p>	<p>3 studies</p>	<p>To systematically review the evidence relating to the safety and efficacy of transanal endoscopic microsurgery, a relatively new technique used to locally excise rectal tumors, compared with existing techniques such as anterior resections and abdominoperineal resections or local excisions.</p>	<p>3 comparative studies (including 1 randomized, controlled trial) and 55 case series were included. The first area of study was the safety and efficacy of adenomas. In the randomized, controlled trial, no difference could be detected in the rate of early complications between transanal endoscopic microsurgery (10.3%) and direct local excision (17%) (RR, 0.61; 95% CI, 0.29–1.29). Transanal endoscopic microsurgery resulted in less local recurrence (6/98; 6%) than direct local excision (20/90; 22%) (RR, 0.28; 95% CI, 0.12–0.66). The 6% rate of local recurrence for transanal endoscopic microsurgery in this trial is consistent with the rates found in case series of transanal endoscopic microsurgery (median, 5%). Second was the safety and efficacy of carcinomas. In the randomized, controlled trial, no difference could be detected in the rate of complications between transanal endoscopic microsurgery and direct local excision (RR for overall early complication rates, 0.56; 95% CI, 0.22–1.42). No differences in survival or local recurrence rate between transanal endoscopic microsurgery and anterior resection could be detected in either the randomized, controlled trial (HR 1.02 for survival) or the nonrandomized, comparative study. There were 2 of 25 (8%) transanal endoscopic microsurgery recurrences in the randomized, controlled trial, but no figures were given for recurrence after anterior resection. In the case series, the median local recurrence rate for transanal endoscopic microsurgery was 8.4%, ranging from 0% to 50%. The third comparison was cost of the procedures. Transanal endoscopic microsurgery had both a lower recurrence rate and a lower cost than local excision or anterior resection for adenomas.</p>	<p>M</p>

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8. Nogue M, Salud A, Vicente P, et al. Addition of bevacizumab to XELOX induction therapy plus concomitant capecitabine-based chemoradiotherapy in magnetic resonance imaging-defined poor-prognosis locally advanced rectal cancer: the AVACROSS study. <i>Oncologist</i> . 2011;16(5):614-620.	Observational-Tx	47 patients	To assess the efficacy and toxicity of adding bevacizumab to induction chemotherapy followed by preoperative bevacizumab-based chemoradiotherapy in patients with locally advanced rectal cancer.	Between July 2007 and July 2008, 47 patients were recruited. Among 45 patients who underwent surgery, pathologic complete response was achieved in 16 patients (36%; 95% CI: 22.29%–51.27%), and an additional 17 patients (38%) had Dworak TRG 3. R0 resection was performed in 44 patients (98%). Most grade 3/4 adverse events occurred during the induction phase and included diarrhea (11%), asthenia (4%), neutropenia (6%), and thrombocytopenia (4%). 11 patients (24%) required surgical re-intervention.	1
9. Velenik V, Ocvirk J, Music M, et al. Neoadjuvant capecitabine, radiotherapy, and bevacizumab (CRAB) in locally advanced rectal cancer: results of an open-label phase II study. <i>Radiat Oncol</i> . 2011;6:105.	Observational-Tx	61 patients	To assess the safety and efficacy of the addition of bevacizumab to capecitabine and concurrent radiotherapy for locally advanced rectal cancer.	61 patients were enrolled (median age 60 years [range 31–80], 64% male). 12 patients (19.7%) had T3N0 tumors, 1 patient T2N1, 19 patients (31.1%) T3N1, 2 patients (3.3%) T2N2, 22 patients (36.1%) T3N2 and 5 patients (8.2%) T4N2. Median tumor distance from the anal verge was 6 cm (range 0–11). Grade 3 adverse events included dermatitis (n = 6, 9.8%), proteinuria (n = 4, 6.5%) and leucocytopenia (n = 3, 4.9%). Radical resection was achieved in 57 patients (95%), and 42 patients (70%) underwent sphincter-preserving surgery. TRG 4 (pathologic complete response) was recorded in 8 patients (13.3%) and TRG 3 in 9 patients (15.0%). T-, N- and overall downstaging rates were 45.2%, 73.8%, and 73.8%, respectively.	2

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<p>10. Boland PM, Fakhri M. The emerging role of neoadjuvant chemotherapy for rectal cancer. <i>J Gastrointest Oncol.</i> 2014;5(5):362-373.</p>	<p>Review/Other-Tx</p>	<p>N/A</p>	<p>To review the emerging role of neoadjuvant chemotherapy for rectal cancer.</p>	<p>Locally advanced rectal cancer remains a substantial public health problem. Historically, the disease has been plagued by high rates of both distant and local recurrences. The standardization of preoperative chemoradiation and transmesorectal excision have greatly lowered the rates of local recurrence. Efforts to improve treatment through use of more effective radiosensitizing therapies have proven unsuccessful in rectal cancer. Presently, due to improved local therapies, distal recurrences represent the dominant problem in this disease. Adjuvant chemotherapy is currently of established benefit in CRC. As such, adjuvant chemotherapy, consisting of fluoropyrimidine and oxaliplatin, represent the standard of care for many patients. However, after preoperative chemoradiotherapy and rectal surgery, the administration of highly effective chemotherapy regimens has proven difficult. For this reason, novel neoadjuvant approaches represent appealing avenues for investigation. Strategies of neoadjuvant chemotherapy alone, neoadjuvant chemotherapy followed by chemoradiation and neoadjuvant chemoradiation followed by chemotherapy are under investigation. Initial encouraging results have been noted, though definitive phase III data is lacking.</p>	<p>4</p>

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11. Glynne-Jones R, Tan D, Goh V. Pelvic MRI for guiding treatment decisions in rectal cancer. <i>Oncology (Williston Park)</i> . 2014;28(8):667-677.	Review/Other-Dx	N/A	To discuss the features that predict local regional and distant metastasis, and review the features that can be imaged on MRI to allow decision making regarding the best neoadjuvant treatment in locally advanced rectal cancer.	Fluoropyrimidine-based chemoradiation is used routinely for locally advanced rectal cancer to shrink the tumor preoperatively, improve lateral surgical clearance at total mesorectal excision, prevent local recurrence, and preserve organ function. In Northern Europe, short-course preoperative radiotherapy is preferred to achieve locoregional control. However, with recent improvements in the quality of surgery, in MRI, and in pathologic reporting, we question whether "routine" chemoradiation or short-course preoperative radiotherapy should be offered indiscriminately for all patients. MRI is considered the optimal modality for locoregional staging and evaluation of the potential for an involved CRM. MRI also provides detailed anatomic information for surgical planning, and may identify poor prognostic features, which influence the way in which the pathologist processes specimens. MRI can predict the likelihood of good/poor tumor response to neoadjuvant chemoradiation and can categorize responders/nonresponders following treatment. Using MRI to define the risk of both local recurrence and metastatic spread allows clinicians to determine which patients might benefit from or safely avoid neoadjuvant treatment.	4
12. Barbaro B, Fiorucci C, Tebala C, et al. Locally advanced rectal cancer: MR imaging in prediction of response after preoperative chemotherapy and radiation therapy. <i>Radiology</i> . 2009;250(3):730-739.	Observational-Dx	53 patients	To prospectively differentiate, at MRI, patients with locally advanced nonmucinous rectal cancer who will respond to long-course chemotherapy and radiation therapy from those who will not respond, with histopathologic results as the reference standard.	Morphologic response assessment with MRI achieved a PPV of 84.2% (32/38) and a NPV of 66.7% (10/15). Volume reduction extent $\geq 70\%$ was significantly different between patients in whom disease was downstaged and those in whom it was not downstaged ($P=.000005$) and showed additional diagnostic value, with an overall accuracy of 86.8% (46/53). Presurgical MRI and histopathologic tumor length did not show a significant difference. MRI accuracy for lymph node (N) stage was 86.8% (46/53) on the basis of morphologic criteria.	2

Pretreatment Staging Colorectal Cancer
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13. Perez RO, Pereira DD, Proscurshim I, et al. Lymph node size in rectal cancer following neoadjuvant chemoradiation--can we rely on radiologic nodal staging after chemoradiation? <i>Dis Colon Rectum</i> . 2009;52(7):1278-1284.	Observational-Tx	31 patients	To determine the difference in size between metastatic and nonmetastatic nodes and the critical lymph node size after neoadjuvant chemoradiation therapy.	There was a mean of 6.5 lymph nodes per patient and 12 positive nodes of the 201 recovered (6%). 95% of all lymph nodes were <5 mm, whereas 50% of positive lymph nodes were <3 mm. Metastatic lymph nodes were significantly greater in size (5.0 vs 2.5 mm; <i>P</i> =0.02). Lymph nodes >4.5 mm had a greater risk of harboring metastases (<i>P</i> =0.009).	2
14. Halligan S, Altman DG, Taylor SA, et al. CT colonography in the detection of colorectal polyps and cancer: systematic review, meta-analysis, and proposed minimum data set for study level reporting. <i>Radiology</i> . 2005;237(3):893-904.	Meta-analysis	24 studies; 4,181 patients; 2 reviewers	Systematic review and meta-analysis to assess the methodologic quality of available data in published reports of CTC.	Meta-analysis of 2,610 patients, showed high per-patient average sensitivity (93%; 95% CI: 73%, 98%) and specificity (97%; 95% CI: 95%, 99%) for colonography; sensitivity and specificity decreased to 86% (95% CI: 75%, 93%) and 86% (95% CI: 76%, 93%), respectively, when the threshold was lowered to include medium polyps. When polyps of all sizes were included, studies were too heterogeneous in sensitivity (range 45%–97%) and specificity (range 26%–97%) to allow meaningful meta-analysis. Of 150 cancers, 144 were detected (sensitivity 95.9%; 95% CI: 91.4%, 98.5%).	M
15. Kim DH, Pickhardt PJ, Hanson ME, Hinshaw JL. CT colonography: performance and program outcome measures in an older screening population. <i>Radiology</i> . 2010;254(2):493-500.	Observational-Dx	577 patients	To evaluate CTC performance and program outcome measures in an older cohort (65–79 years) of an established large-scale CRC screening program.	With a 6 mm threshold for positivity, the overall referral rate to optical colonoscopy was 15.3% (88/577), leading to 277 polypectomies and the removal of 103 nondiminutive adenomas. For adenomas, the per-patient positivity rates were 10.9% (63/577) and 6.8% (39/577) at the 6- and 10-mm thresholds, respectively. The prevalence of advanced neoplasia was 7.6% (44/577). 54 adenomas met advanced status, and 5 unsuspected cancers were detected. The advanced neoplasias identified were typically large, with a mean size of 21 mm. Potentially important extracolonic findings were seen in 15.4% (89/577) of patients, with a workup rate of 7.8% (45/577). The majority of important extracolonic diagnoses were vascular aneurysms (n = 18). No major complications were encountered.	4

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16. Moawad FJ, Maydonovitch CL, Cullen PA, Barlow DS, Jenson DW, Cash BD. CT colonography may improve colorectal cancer screening compliance. <i>AJR Am J Roentgenol.</i> 2010;195(5):1118-1123.	Review/Other-Dx	250 patients	To assess patient preferences between colonoscopy and CTC in an open access system.	The most common reasons for undergoing CTC included convenience (33.6%), recommendation by referring provider (13.2%), and perceived safety (10.8%). Had CTC not been an available option, 91 of the 250 patients (36%) would have foregone CRC screening. Among the 57 patients who had experienced both procedures, 95% (n = 54) preferred CTC.	4
17. Morrin MM, Farrell RJ, Raptopoulos V, McGee JB, Bleday R, Kruskal JB. Role of virtual computed tomographic colonography in patients with colorectal cancers and obstructing colorectal lesions. <i>Dis Colon Rectum.</i> 2000;43(3):303-311.	Observational-Dx	34 patients	Prospective study to assess the ability of CTC to diagnose colorectal masses, stage CRCs, image the proximal colon in obstructing colorectal lesions, and evaluate the anastomoses in patients with previous colorectal surgery.	CTC can accurately identify all colorectal masses but may overcall stool as masses in poorly prepared colons. CTC has a staging accuracy of 81% for CRC and is superior to barium enema in visualizing colonic segments proximal to obstructing colorectal lesions.	3
18. Lowenthal D, Zeile M, Lim WY, et al. Detection and characterisation of focal liver lesions in colorectal carcinoma patients: comparison of diffusion-weighted and Gd-EOB-DTPA enhanced MR imaging. <i>Eur Radiol.</i> 2011;21(4):832-840.	Observational-Dx	73 patients	To compare DWI and Gd-EOB-DTPA-enhanced MRI for the detection and characterization of focal liver lesions in patients with CRC.	A total of 332 focal liver lesions were evaluated. Detection rates were significantly higher for MR-Late images (94.4% for benign and 100% for malignant lesions) compared with MR-DWI (78.3% and 97.5%) and MR-Dyn images (81.5% and 89.9%). Accuracy was 0.82, 0.76 and 0.89 for MR-DWI, MR-Dyn and MR-Late images while sensitivity was 0.98, 0.87 and 0.95, respectively. For characterization of subcentimeter lesions sensitivity was highest for MR-DWI (0.92). Combined reading of unenhanced and contrast-enhanced images had an identical high accuracy of 0.98.	2

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19. Scharitzer M, Ba-Ssalamah A, Ringl H, et al. Preoperative evaluation of colorectal liver metastases: comparison between gadoxetic acid-enhanced 3.0-T MRI and contrast-enhanced MDCT with histopathological correlation. <i>Eur Radiol.</i> 2013;23(8):2187-2196.	Observational-Dx	38 patients	To compare the diagnostic performance of 64-row MDCT and gadoxetic-acid-enhanced MRI at 3.0 T in patients with colorectal liver metastases in correlation with histopathological findings.	Surgery and histopathological workup revealed 81 colorectal liver metastases in 35 patients and diffuse metastatic involvement in 3 patients. In a lesion-by-lesion analysis, significant sensitivity differences could only be found for reader 1 ($P=0.035$) and reader 3 ($P=0.003$). For segment-based evaluation, MRI was more sensitive only for reader 3 ($P=0.012$). The number of false-positive results ranged from 3 to 12 for MDCT and 8 to 11 for MRI evaluation. In the group of small lesions, the sensitivity differed significantly between both methods ($P=0.003$). In patients with hepatic steatosis, MRI showed a trend toward better performance than MDCT, but without statistical performance.	2
20. Brouquet A, Abdalla EK, Kopetz S, et al. High survival rate after two-stage resection of advanced colorectal liver metastases: response-based selection and complete resection define outcome. <i>J Clin Oncol.</i> 2011;29(8):1083-1090.	Observational-Tx	127 patients	A retrospective study to compare outcomes of patients undergoing at least the first stage of two-stage resection with those of selected nonsurgically treated patients responding to modern chemotherapy.	65 patients underwent the first stage of two-stage resection; 62 patients fulfilled the inclusion criteria for the medical group. Two-stage resection patients had a mean of 6.7 +/- 3.4 colorectal liver metastases with mean size of 4.5 +/- 3.1 cm. Nonsurgical patients had a mean of 5.9 +/- 2.9 colorectal liver metastases with mean size of 5.4 +/- 3.4 cm (not significant). 47 two-stage resection patients (72%) completed the second stage. Progression between stages was the main cause of noncompletion of the second stage (61%). After 50 months median follow-up, the 5-year survival rate was 51% in the two-stage resection group and 15% in the medical group ($P=.005$). In patients who underwent two-stage resection, noncompletion of two-stage resection and major postoperative complications were independently associated with worse survival.	2

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21. Shindoh J, Loyer EM, Kopetz S, et al. Optimal morphologic response to preoperative chemotherapy: an alternate outcome end point before resection of hepatic colorectal metastases. <i>J Clin Oncol.</i> 2012;30(36):4566-4572.	Observational-Tx	209 patients	To confirm the prognostic value of an optimal morphologic response to preoperative chemotherapy in patients undergoing chemotherapy with or without bevacizumab before resection of colorectal liver metastases and to identify predictors of the optimal morphologic response.	An optimal morphologic response was observed in 47% of patients treated with bevacizumab and 12% of patients treated without bevacizumab ($P < .001$). The 3- and 5-year OS rates were higher in the optimal response group (82% and 74%, respectively) compared with the suboptimal response group (60% and 45%, respectively; $P < .001$). On multivariate analysis, suboptimal morphologic response was an independent predictor of worse OS (HR, 2.09; $P = .007$). Receipt of bevacizumab (OR, 6.71; $P < .001$) and largest metastasis before chemotherapy of ≤ 3 cm (OR, 2.12; $P = .025$) were significantly associated with optimal morphologic response. The morphologic response showed no specific correlation with conventional size-based RECIST criteria, and it was superior to RECIST in predicting major pathologic response.	2
22. Chung WS, Kim MJ, Chung YE, et al. Comparison of gadoxetic acid-enhanced dynamic imaging and diffusion-weighted imaging for the preoperative evaluation of colorectal liver metastases. <i>J Magn Reson Imaging.</i> 2011;34(2):345-353.	Observational-Dx	47 patients	To retrospectively compare the diagnostic accuracy for the detection of colorectal liver metastases between gadoxetic acid-enhanced MRI and DWI on 3.0 T system, and then to determine whether a combination of the 2 techniques may improve the diagnostic performance.	A total of 78 confirmed colorectal liver metastases in 42/47 patients was found. Each reader noted higher diagnostic accuracy of combined set of gadoxetic acid-enhanced MRI and DWI than DWI set and gadoxetic acid-enhanced set, without statistical significance. Regardless of the size of colorectal liver metastasis, each reader detected significantly more metastases on combined set than on DWI set, and PPV was significantly higher with DWI set than with gadoxetic acid-enhanced set or with combined set for one reader.	2

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23. Kim YK, Lee MW, Lee WJ, et al. Diagnostic accuracy and sensitivity of diffusion-weighted and of gadoxetic acid-enhanced 3-T MR imaging alone or in combination in the detection of small liver metastasis (≤ 1.5 cm in diameter). <i>Invest Radiol.</i> 2012;47(3):159-166.	Observational-Dx	86 patients	To compare the diagnostic accuracy and sensitivity of combined gadoxetic acid-enhanced MRI and DWI with each imaging approach alone for detecting small hepatic metastases (≤ 1.5 cm).	There was a tendency toward an increased diagnostic accuracy for the combined set (mean, 0.965) compared with that for each image set alone (mean, 0.911 for gadoxetic acid set; 0.926 for DWI set). The combined set showed better sensitivity (mean, 97.47%/95.0%: values on per-lesion/per-patient basis) than each imaging set alone (mean, 90.7%/83.7% for gadoxetic acid set; 91.6%/83.0% for DWI set) ($P < 0.05$) on both per-lesion basis and per-patient basis. All image sets showed similar PPVs.	2
24. Wu LM, Hu J, Gu HY, Hua J, Xu JR. Can diffusion-weighted magnetic resonance imaging (DW-MRI) alone be used as a reliable sequence for the preoperative detection and characterisation of hepatic metastases? A meta-analysis. <i>Eur J Cancer.</i> 2013;49(3):572-584.	Meta-analysis	11 studies	To perform a meta-analysis of all available studies of the diagnostic performance of DWI-MRI in patients with hepatic metastases.	Across 11 studies (537 patients), DWI-MRI sensitivity was 0.87 (95% CI, 0.80, 0.91) and specificity was 0.90 (95% CI, 0.86, 0.93). Overall, likelihood ratio-positive was 8.52 (95% CI, 6.17, 11.77), likelihood ratio-negative was 0.15 (95% CI, 0.10, 0.22) and diagnostic OR was 57.36 (95% CI, 38.29, 85.93). In studies in which both DWI-MRI and contrast-enhanced MRI were performed, the comparison of DWI-MRI performance with that of contrast-enhanced MRI suggested no major differences against these 2 methods ($P > 0.05$). DWI-MRI combined contrast-enhanced MRI had higher sensitivity and specificity than DWI-MRI alone (97% vs 86% and 91% vs 90%, respectively) ($P < 0.05$). The subgroup in which DWI-MRI examinations were performed with a 3.0 T device had higher pooled specificity (0.91, 95% CI, 0.88, 0.95) than the subgroup of DWI-MRI with 1.5 T device (0.81, 95% CI, 0.67, 0.94) ($P < 0.05$). Average lesion size (≤ 1.5 cm vs > 1.5 cm) did not influence the diagnostic accuracy of the test ($P > 0.05$).	M

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25. Yu MH, Lee JM, Hur BY, et al. Gadoteric acid-enhanced MRI and diffusion-weighted imaging for the detection of colorectal liver metastases after neoadjuvant chemotherapy. <i>Eur Radiol.</i> 2015.	Observational-Dx	77 patients	To investigate the diagnostic performance of gadoteric acid-enhanced MRI including DWI for the detection of colorectal liver metastases after neoadjuvant chemotherapy.	Diagnostic accuracy of gadoteric acid-enhanced MRI in group B was slightly lower than in group A, but a statistically significant difference was not observed (observer 1: A z, 0.926 in group A, 0.905 in group B; observer 2: A z, 0.944 in group A, 0.885 in group B; $P>0.05$). Sensitivity and PPV of group B were comparable to those of group A (observer 1: sensitivity = 93.5% vs 93.6%, PPV = 95.1% vs 86.9%; observer 2: sensitivity = 96.8% vs 91.0%; PPV = 90.0% vs 89.7%; all $P>0.05$).	2
26. Koh DM, Collins DJ, Wallace T, Chau I, Riddell AM. Combining diffusion-weighted MRI with Gd-EOB-DTPA-enhanced MRI improves the detection of colorectal liver metastases. <i>Br J Radiol.</i> 2012;85(1015):980-989.	Review/Other-Dx	N/A	Review applications and challenges of DWI in the body.	DWI derives its image contrast from differences in the motion of water molecules between tissues. Such imaging can be performed quickly without the need for the administration of exogenous contrast medium. The technique yields qualitative and quantitative information that reflects changes at a cellular level and provides unique insights about tumor cellularity and the integrity of cell membranes. Recent advances enable the technique to be widely applied for tumor evaluation in the abdomen and pelvis and have led to the development of whole-body DWI.	4
27. Macera A, Lario C, Petracchini M, et al. Staging of colorectal liver metastases after preoperative chemotherapy. Diffusion-weighted imaging in combination with Gd-EOB-DTPA MRI sequences increases sensitivity and diagnostic accuracy. <i>Eur Radiol.</i> 2013;23(3):739-747.	Observational-Dx	32 patients	To compare the diagnostic accuracy and sensitivity of Gd-EOB-DTPA MRI and DWI alone and in combination for detecting colorectal liver metastases in patients who had undergone preoperative chemotherapy.	Evaluation of image set 1 correctly identified 127/166 lesions (accuracy 76.5%; 95% CI 69.3–82.7) and 106/144 metastases (sensitivity 73.6%, 95% CI 65.6–80.6). Evaluation of image set 2 correctly identified 108/166 (accuracy 65.1%, 95% CI 57.3–72.3) and 87/144 metastases (sensitivity of 60.4%, 95% CI 51.9–68.5). Evaluation of image set 3 correctly identified 148/166 (accuracy 89.2%, 95% CI 83.4–93.4) and 131/144 metastases (sensitivity 91%, 95% CI 85.1–95.1). Differences were statistically significant ($P<0.001$). Notably, similar results were obtained analyzing only small lesions (<1 cm).	2

Pretreatment Staging Colorectal Cancer
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28. American College of Radiology. <i>Manual on Contrast Media</i> . Available at: http://www.acr.org/~media/37D84428BF1D4E1B9A3A2918DA9E27A3.pdf .	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
29. Yimei J, Ren Z, Lu X, Huan Z. A comparison between the reference values of MRI and EUS and their usefulness to surgeons in rectal cancer. <i>Eur Rev Med Pharmacol Sci</i> . 2012;16(15):2069-2077.	Observational-Dx	69 patients received MRI and 60 patients received EUS	To assess the reference value to surgeons of MRI and EUS in local staging of rectal cancer.	EUS had higher sensitivity in T1 ($P=0.044 < 0.05$) and specificity in T2 ($P=0.039 < 0.05$) than MRI. MRI had higher sensitivity in N staging ($P=0.046 < 0.05$) and was more accurate in pT1~4N1~2 ($P < 0.05$) than EUS. Reference values for surgery (comparing appropriate rates of Str.1 with Str.3) of MRI and EUS were 79.7% vs 76.7%, respectively ($P > 0.05$). The actual treatment accuracy (comparing appropriate rates of Str.2 with Str.3) was increased up to 94.2% vs 91.7%, respectively ($P > 0.05$).	3
30. Ju H, Xu D, Li D, Chen G, Shao G. Comparison between endoluminal ultrasonography and spiral computerized tomography for the preoperative local staging of rectal carcinoma. <i>Biosci Trends</i> . 2009;3(2):73-76.	Observational-Dx	78 patients	To compare the efficacy of endoluminal US and spiral CT in preoperative local staging of rectal carcinoma.	For T staging, accuracy was 84.6% for endoluminal US, 70.5% for spiral CT ($P < 0.05$). For N staging, accuracy was 64.1% for endoluminal US, 61.5% for spiral CT ($P > 0.05$). Endoluminal US is superior to spiral CT in judging tumor infiltrate depth, but neither could provide satisfactory assessments of lymph node metastases.	3
31. Jurgensen C, Teubner A, Habeck JO, Diener F, Scherubl H, Stolzel U. Staging of rectal cancer by EUS: depth of infiltration in T3 cancers is important. <i>Gastrointest Endosc</i> . 2011;73(2):325-328.	Observational-Dx	83 patients	To assess the accuracy of T and N staging by EUS with attention to infiltration depth as provided by EUS.	Accuracy of T staging and N status was 76% and 63%, respectively. Overstaging by EUS was more common in minimally invasive T3 by EUS (uT3) (8 of 16 [50%]) compared with advanced uT3 tumors (1 of 24 [4%]) ($P = .01$). Accuracy of EUS discrimination between T1/2 and T3/4 in rectal cancer for all but minimally invasive uT3 rectal tumors was 88%.	3

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
32. Badger SA, Devlin PB, Neilly PJ, Gilliland R. Preoperative staging of rectal carcinoma by endorectal ultrasound: is there a learning curve? <i>Int J Colorectal Dis.</i> 2007;22(10):1261-1268.	Observational-Dx	95 patients	To determine if a learning curve exists in preoperative staging of rectal cancer since the accuracy in the assessment of disease staging may be dependent on operator experience.	Overall accuracy for T staging was 71.6%. No improvement with experience was noted ($P>0.05$). For T staging, EUS tended to overstage more frequently than understage (24.2% vs 4.2%). The sensitivity, specificity, PPV and NPV of uT3 staging were 96.6%, 33.3%, 70.4% and 85.7%, respectively. Overall accuracy of uN staging was 68.8%. EUS tended to overstage nodal disease more frequently than understage (16.1% vs 15.1%). Sensitivity, specificity, PPV and NPV were calculated for US-detected nodal disease (73.2%, 62.2%, 74.5% and 60.5%, respectively). Nodal staging accuracy improved from 50% after assessment of 10 cases to 77% after 30 cases were examined. EUS is an accurate method for staging rectal cancer preoperatively.	3

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
33. Fernandez-Esparrach G, Ayuso-Colella JR, Sendino O, et al. EUS and magnetic resonance imaging in the staging of rectal cancer: a prospective and comparative study. <i>Gastrointest Endosc.</i> 2011;74(2):347-354.	Observational-Dx	90 patients	To prospectively compare the performance of EUS and MRI in the locoregional staging of rectal cancer in a large series of patients.	90 patients (54 men and 36 women with a mean age of 68 +/- 12 years; range 33–87 years) constitute the final sample of this study. Most of the tumors were stages T2-T3 (85%; 95% CI, 77%–92%). 20 of them (22%; 95% CI, 14%–32%) were stenotic and 24 (27%; 95% CI, 18%–37%) had polypoid morphology. The accuracy of T staging was very similar for EUS and MRI for stage T2 (76%; 95% CI, 65%–84% and 77%; 95% CI, 67%–85%, respectively; <i>P</i> =not significant) and stage T3 (76%; 95% CI, 65%–84% and 83%, 95% CI, 73%–90%, respectively; <i>P</i> =not significant). MRI was not able to visualize any T1 tumor, whereas EUS understaged all T4 tumors. The univariate analysis showed that the polypoid morphology of the tumor inversely correlated with T staging on MRI. The accuracy of MRI for N staging was higher than that of EUS, although the difference did not reach statistical significance (79%; 95% CI, 65%–88% and 65%; 95% CI, 51%–78%, respectively). When performing the univariate analysis to assess the reasons for this difference, the presence of a stenotic tumor was the only parameter significantly related to a poorer performance of EUS in N staging.	1
34. Ashraf S, Hompes R, Slater A, et al. A critical appraisal of endorectal ultrasound and transanal endoscopic microsurgery and decision-making in early rectal cancer. <i>Colorectal Dis.</i> 2012;14(7):821-826.	Observational-Dx	494 patients	To report its accuracy and impact for patients entered on the UK transanal endoscopic microsurgery database.	EUS was performed in 165/494 patients who underwent transanal endoscopic microsurgery for rectal cancer. It inaccurately staged rectal cancer in 44.8% of tumors: 32.7% were understaged and 12.1% were overstaged. There was no significant difference in the depth of transanal endoscopic microsurgery excision or R1 rate between the patients who underwent EUS before transanal endoscopic microsurgery and those who did not (<i>P</i> =0.73).	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
35. Lin S, Luo G, Gao X, et al. Application of endoscopic sonography in preoperative staging of rectal cancer: six-year experience. <i>J Ultrasound Med.</i> 2011;30(8):1051-1057.	Observational-Dx	192 patients	To evaluate our experience with the application of EUS in preoperative staging of rectal cancer.	The accuracy of overall T staging was 86.5%, and for T1, T2, T3, and T4, the accuracy rates were 86.7%, 94.0%, 86.2%, and 65.5%, respectively. The accuracy of T staging for ulcerated lesions was significantly lower than that for nonulcerated lesions ($P=.013$). The accuracy of T staging between nontraversable stenotic lesions and traversable lesions was also significantly different ($P=.002$). The accuracy of N staging was 77.8%, and the specificity and sensitivity were 85.6% and 74.2%, respectively.	3
36. Ravizza D, Tamayo D, Fiori G, et al. Linear array ultrasonography to stage rectal neoplasias suitable for local treatment. <i>Dig Liver Dis.</i> 2011;43(8):636-641.	Observational-Dx	92 patients with 92 neoplasias	To evaluate the diagnostic accuracy of EUS in the staging of neoplasias suitable for local treatment.	The sensitivity, specificity, overall accuracy rate, PPV, and NPV of EUS for pT0-1 were 86%, 95.6%, 91.3%, 94.9% and 88.7%. Those for nodal involvement were 45.4%, 95.5%, 83%, 76.9% and 84%, with 3 false positive results and 12 false negative. For combined pT0-1 and pN0, EUS showed an 87.5% sensitivity, 95.9% specificity, 92% overall accuracy rate, 94.9% PPV and 90.2% NPV.	3
37. Low G, Tho LM, Leen E, et al. The role of imaging in the pre-operative staging and post-operative follow-up of rectal cancer. <i>Surgeon.</i> 2008;6(4):222-231.	Review/Other-Dx	N/A	Review role of imaging in the preoperative staging and postoperative follow-up of rectal cancer.	EUS is useful for T staging and CT for detecting metastases. PET/CT has been a major recent development. It has superior utility in detecting recurrent disease, including when conventional imaging is negative, detects occult metastases and may significantly enhance ability to deliver accurate radiotherapy. Imaging has also opened up avenues for guided therapies aimed at ablating liver metastases. Radiofrequency ablation, in particular, is being used successfully and can improve survival of stage 4 patients.	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
38. Landmann RG, Wong WD, Hoepfl J, et al. Limitations of early rectal cancer nodal staging may explain failure after local excision. <i>Dis Colon Rectum</i> . 2007;50(10):1520-1525.	Observational-Dx	938 consecutive patients had EUS; 134 treated with radical resection, without neoadjuvant therapy	To examine the accuracy of EUS in determining nodal stage based on depth of penetration of the primary lesion (T stage).	Overall accuracy of EUS nodal staging was 70%, with a 16% false-positive rate and 14% false-negative rate.	3
39. Moriya Y, Sugihara K, Akasu T, Fujita S. Importance of extended lymphadenectomy with lateral node dissection for advanced lower rectal cancer. <i>World J Surg</i> . 1997;21(7):728-732.	Review/Other-Tx	448 patients	To review patients with advanced lower rectal cancer who underwent curative wide lymphadenectomy with autonomic nerve preservation with respect to surgical techniques, operative burdens, node status, survival rate, and mode of recurrence.	Operative time and blood loss in patients who underwent lateral dissection were much greater than those encountered with conventional resection. According to the direction of lymphatic spread in patients with Dukes C disease, the incidence of upward spread was 94% and lateral spread 27%. The overall incidence of lateral metastasis was 14%. The overall 5-year survival was 70%. According to the Dukes classification, the 5-year survival rates were 92% for Dukes A, 79% for Dukes B, and 55% for Dukes C, whereas it was 43% in patients with lateral node metastasis. An analysis of the survival rate was carried out with regard to the number of node metastases, direction of lymphatic spread, and autonomic nerve preservation. The overall incidence of local recurrence was 9.3% and amounted to 16.0% in patients with Dukes C disease. The case of advanced lower rectal cancer was characterized by positive lymph nodes or circular lesions around the circumference (both diagnosed by endorectal US). We recommend extended lymphadenectomy with lateral node dissection, as it preserves the autonomic nerve.	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
40. Kim SH, Lee JM, Lee MW, Kim GH, Han JK, Choi BI. Diagnostic accuracy of 3.0-Tesla rectal magnetic resonance imaging in preoperative local staging of primary rectal cancer. <i>Invest Radiol.</i> 2008;43(8):587-593.	Observational-Dx	42 patients, 2 blinded reviewers	To retrospectively evaluate the diagnostic accuracy of 3.0-T rectal MRI in the preoperative local staging of primary rectal cancer.	Diagnostic accuracy (AUC, Az) for determining perirectal extension was for reviewer 1, 0.860 (95% CI, 0.72–0.95) and for reviewer 2, 0.853 (0.71–0.94), respectively. The Az for determination of regional lymph node involvement was for reviewer 1, 0.902 (0.77–0.97) and for reviewer 2, 0.843 (0.70–0.94), respectively. Interobserver agreement included, respectively, good, and moderate agreement for perirectal extension, and regional lymph node involvement (kappa = 0.662 and 0.522, respectively). 3.0-T rectal MRI can provide accurate information of perirectal extension and regional lymph node involvement in the preoperative local staging of primary rectal cancer.	4
41. Sani F, Foresti M, Parmiggiani A, et al. 3-T MRI with phased-array surface coil in the local staging of rectal cancer. <i>Radiol Med.</i> 2011;116(3):375-388.	Observational-Dx	30 patients	To evaluate the diagnostic accuracy of surface-coil 3T MRI in the preoperative study of patients with rectal cancer.	In the patients who underwent MRI before and after radiotherapy (group 1), the diagnostic accuracy of 3T MRI was 88% for T2, 94% for T3 and 88% for T4 cancers. In those who underwent surgical treatment without preoperative radiotherapy (group 2), the diagnostic accuracy was 90% for T2, 87% for T3 and 87% for T4 cancers.	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
42. Wong EM, Leung JL, Cheng CS, Lee JC, Li MK, Chung CC. Effect of endorectal coils on staging of rectal cancers by magnetic resonance imaging. <i>Hong Kong Med J.</i> 2010;16(6):421-426.	Observational-Dx	50 patients; 13 examinations in patients having endorectal coil, 2 blinded reviewers	Retrospective study to compare the use of endorectal plus phased-array coils with use of phased-array coil alone with respect to the accuracy of MRI for detecting mesorectal involvement of rectal cancer.	Overall accuracy of MRI in detecting mesorectal tumor involvement was 80%. Subgroup analysis showed higher accuracy in the group with endorectal coils than in those with phased-array coils alone. Over-detection of mesorectal involvement was noted in 12% of the cases, with lower rate being observed in patients with endorectal coils. Under-detection of mesorectal tumor involvement was only noted in the group without endorectal coils. With the use of endorectal coils, the sensitivity reached 100% and the specificity increased to 86%. Use of endorectal coil in staging MRI of the rectum improves diagnostic accuracy. Whenever feasible, endorectal coil use is therefore recommendable to enhance diagnostic accuracy. The study results substantiate the understanding of staging by MRI of rectal cancer in the local Chinese population.	2
43. Karatag O, Karatag GY, Ozkurt H, et al. The ability of phased-array MRI in preoperative staging of primary rectal cancer: correlation with histopathological results. <i>Diagn Interv Radiol.</i> 2012;18(1):20-26.	Observational-Dx	24 patients	To evaluate the accuracy of phased-array MRI for preoperative local tumor staging in primary rectal cancer and emphasized the importance of the preoperative differentiation of T2 tumors from T3 tumors so the appropriate treatment can be applied.	Histopathological examination of the tumors revealed adenocarcinoma. When the tumors were staged, there was 1 patient with a pT1 tumor, 6 patients with pT2 tumors, and 17 patients with pT3 tumors. Using MRI, 4 patients with pT2 were overstaged as T3, and 1 patient with pT3 was overstaged as T4. In the remaining cases (1 pT1, 2 pT2, and 16 pT3), MRI correctly assessed the stage of transmural invasion. The accuracy of T staging and metastatic lymph node detection with MRI was calculated as 79.2% and 58.5%, respectively.	3
44. Maas M, Lambregts DM, Lahaye MJ, et al. T-staging of rectal cancer: accuracy of 3.0 Tesla MRI compared with 1.5 Tesla. <i>Abdom Imaging.</i> 2012;37(3):475-481.	Observational-Dx	13 patients	To determine whether 3T-MRI compared with 1.5T-MRI improves the accuracy for the discrimination between T1-2 and borderline T3 rectal tumors and to evaluate reproducibility.	7 patients had pT1-2 tumors and 6 had pT3 tumors. AUCs ranged from 0.66 to 0.87 at 1.5T vs 0.52-0.82 at 3T. Mean overstaging rate was 43% at 1.5T and 57% at 3T ($P=0.23$). Inter-observer agreement was kappa 0.50-0.71 at 1.5T vs 0.15-0.68 at 3T. Intra-observer agreement was kappa 0.71 at 1.5T and 0.76 at 3T.	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
45. Al-Sukhni E, Milot L, Fruitman M, et al. Diagnostic accuracy of MRI for assessment of T category, lymph node metastases, and circumferential resection margin involvement in patients with rectal cancer: a systematic review and meta-analysis. <i>Ann Surg Oncol.</i> 2012;19(7):2212-2223.	Meta-analysis	21 studies	To determine the accuracy of phased array MRI for T category (T1-2 vs T3-4), lymph node metastases, and CRM (CRM) involvement in primary rectal cancer.	Twenty-one studies were included in the analysis. There was notable heterogeneity among studies. MRI specificity was significantly higher for CRM involvement [94%, 95% CI (CI) 88–97] than for T category (75%, 95% CI 68–80) and lymph nodes (71%, 95% CI 59–81). There was no significant difference in sensitivity between the 3 elements as a result of wide overlapping CIs. Diagnostic OR was significantly higher for CRM (56.1, 95% CI 15.3–205.8) than for lymph nodes (8.3, 95% CI 4.6–14.7) but did not differ significantly from T category (20.4, 95% CI 11.1–37.3).	M

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
46. Rafaelsen SR, Vagn-Hansen C, Sorensen T, Ploen J, Jakobsen A. Transrectal ultrasound and magnetic resonance imaging measurement of extramural tumor spread in rectal cancer. <i>World J Gastroenterol.</i> 2012;18(36):5021-5026.	Observational-Dx	86 consecutive patients	To evaluate the agreement between TRUS and MRI in classification of \geq T3 rectal tumors.	TRUS found 51 patients to have an early \geq T3 tumor and 35 to have an advanced tumor, whereas MRI categorized 48 as early \geq T3 tumors and 38 as advanced tumors. No patients with tumors classified as advanced by TRUS were found to be early on MRI. The kappa value in classifying early vs advanced T3 rectal tumors was 0.93 (95% CI: 0.85–1.00). We found a kappa value of 0.74 (95% CI: 0.63–0.86) for the total sub-classification between the 2 methods. The mean maximal tumor outgrowth measured by TRUS, 5.5 mm +/- 5.63 mm and on MRI, 6.3 mm +/- 6.18 mm, $P=0.004$. In 19 of the 86 patients the following CT scan or surgery revealed distant metastases; of the 51 patients in the US ab group 3 (5.9%) had metastases, whereas 16 (45.7%) of 35 in the cd group harbored distant metastases, $P=0.00002$. The OR of having distant metastases in the US cd group compared to the ab group was 13.5 (95% CI: 3.5–51.6), $P=0.00002$. The mean maximal US measured outgrowth was 4.3 mm (95% CI: 3.2–5.5 mm) in patients without distant metastases, while the mean maximal outgrowth was 9.5 mm (95% CI: 6.2–12.8 mm) in the patients with metastases, $P=0.00004$. Using the MRI classification 3 (6.3%) of 48 in the MRI ab group had distant metastases, while 16 (42.1%) of the 38 in the MRI cd group, $P=0.00004$. The MRI OR was 10.9 (95% CI: 2.9–41.4), $P=0.00008$. The mean maximal MRI measured outgrowth was 4.9 mm (95% CI: 3.7–6.1 mm) in patients without distant metastases, while the mean maximal outgrowth was 11.5 mm (95% CI: 7.8–15.2 mm) in the patients with metastases, $P=0.000006$.	2

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
47. Phang PT, Gollub MJ, Loh BD, et al. Accuracy of endorectal ultrasound for measurement of the closest predicted radial mesorectal margin for rectal cancer. <i>Dis Colon Rectum</i> . 2012;55(1):59-64.	Observational-Dx	52 patients	To assess EUS identification of mesorectal margins and the measurement of the closest predicted radial tumor-mesorectal margin.	52 patients were studied with an average rectal cancer distance to the anal verge of 6.8 cm. Interobserver correlation coefficients of EUS mesorectal dimensions ranged from 0.47 to 0.53 ($P<0.01$). MRI and EUS measurements of the closest predicted radial mesorectal margin were correlated $r = 0.56$ ($P<0.0001$). MRI and EUS determination of margin involvement agreed in 81% of cases.	2
48. Li JC, Liu SY, Lo AW, et al. The learning curve for endorectal ultrasonography in rectal cancer staging. <i>Surg Endosc</i> . 2010;24(12):3054-3059.	Observational-Dx	50 patients	To prospectively analyze results of EUS staging for rectal cancer, aiming to determine its accuracy and to define the learning curve of the procedure.	In the 26-month study period, 50 patients (36 males) with median age of 67 years (range 47–89 years) underwent EUS staging. The overall accuracy rates of uT and uN staging were 86 and 66%. For uT staging, 10% of tumors were overstaged and 4% were understaged. For uN staging, 22% of patients were overstaged and 12% were understaged. With experience accumulation from early group to late group, accuracy improvement was observed in uN staging (52 vs 80%, $P=0.037$), while the accuracy rate remained consistently high in uT staging (84 vs 88%, $P=1.0$).	3
49. Del Vescovo R, Trodella LE, Sansoni I, et al. MR imaging of rectal cancer before and after chemoradiation therapy. <i>Radiol Med</i> . 2012;117(7):1125-1138.	Observational-Dx	39 patients	To determine the diagnostic accuracy of MRI in patients with rectal carcinoma by comparing post-chemoradiation MRI with pathological specimens.	Following neoadjuvant chemoradiation therapy, the analysis of MRIs showed 23 (59%) patients with a rectal disease staged $\leq T2$ and 16 (41%) with a disease staged $>T2$. Post-treatment histological staging (TNM) revealed 13 patients with a disease $>T2$ and 26 patients with a disease $\leq T2$. Cohen's kappa to measure concordance between post-chemoradiation MRI staging and histological response showed 83.6% concordance for disease confined to the serosa ($\leq T3$): concordance was 97.22% for disease $\leq N1$ and 33.33% for disease $>N1$.	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
50. Engelen SM, Maas M, Lahaye MJ, et al. Modern multidisciplinary treatment of rectal cancer based on staging with magnetic resonance imaging leads to excellent local control, but distant control remains a challenge. <i>Eur J Cancer</i> . 2013;49(10):2311-2320.	Observational-Tx	296 patients	To evaluate whether a differentiated treatment of primary rectal cancer based on MRI can reduce the number of incomplete resections and local recurrences and improve recurrence-free and OS.	Overall 228 patients underwent treatment with curative intent: 49 with surgery only, 86 with 5 x 5 Gy and surgery and 93 with chemoradiation and surgery. The number of complete resections (margin >1 mm) was 218 (95.6%). At a median follow-up of 41 months the 3-year local recurrence rate, DFS rate and OS rate is 2.2%, 80% and 84.5%, respectively.	1
51. Extramural depth of tumor invasion at thin-section MR in patients with rectal cancer: results of the MERCURY study. <i>Radiology</i> . 2007;243(1):132-139.	Observational-Dx	679 consecutive patients	To prospectively evaluate the accuracy of MRI in depicting the extramural depth of tumor invasion in patients who have rectal cancer, with histopathologic results as the reference standard. Study performed by Magnetic Resonance Imaging and Rectal Cancer European Equivalence (MERCURY) Study Group, which is a multicenter multidisciplinary collaboration.	Tumor extramural depth measurements obtained at both MRI and histopathologic analysis were available for 295 (95%) of 311 patients after primary surgery. Mean tumor extramural depths were 2.80 mm +/- 4.60 (standard deviation) and 2.81 mm +/- 4.28 at MRI and histopathologic analysis, respectively. The mean difference between the MR-derived and histopathologically derived tumor extramural depths was -0.05 mm +/- 3.85 (95% CI, -0.49 mm, 0.40 mm). Therefore, MRI and histopathologic assessments of tumor spread were considered equivalent to within 0.5 mm. Demonstration of accurate measurement of the depth of extramural tumor spread in the MERCURY Study enabled accurate preoperative prognostication.	1

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
52. Kim SH, Lee JM, Park HS, Eun HW, Han JK, Choi BI. Accuracy of MRI for predicting the circumferential resection margin, mesorectal fascia invasion, and tumor response to neoadjuvant chemoradiotherapy for locally advanced rectal cancer. <i>J Magn Reson Imaging</i> . 2009;29(5):1093-1101.	Observational-Dx	65 consecutive patients, 2 independent reviewers	Retrospective blinded study to evaluate the diagnostic accuracy of MRI for predicting the CRM, mesorectal fascia invasion, and the tumor response to neoadjuvant chemoradiotherapy for locally advanced rectal cancer.	The measured CRM was not significantly different from the reference standard (mean difference, -1.4 mm; 95% limits of agreement, -8.3–5.4 mm; interclass correlation coefficient, 0.82). The diagnostic accuracy (A(z)) for determining mesorectal fascia invasion was 0.890 for reviewer 1 (95% CI, 0.788–0.954) and 0.829 for reviewer 2 (95% CI, 0.715–0.911). The A(z) for predicting complete or near-complete regression was 0.791 for reviewer 1 (95% CI, 0.672-0.882) and 0.735 for reviewer 2 (95% CI, 0.611–0.837). MRI provides accurate information regarding the CRM of locally advanced rectal cancer after neoadjuvant chemoradiotherapy; it also shows relatively high accuracy for predicting mesorectal fascia invasion and moderate accuracy for assessing tumor response.	2
53. Wieder HA, Rosenberg R, Lordick F, et al. Rectal cancer: MR imaging before neoadjuvant chemotherapy and radiation therapy for prediction of tumor-free circumferential resection margins and long-term survival. <i>Radiology</i> . 2007;243(3):744-751.	Observational-Dx	68 patients, 2 reviewers	To retrospectively evaluate the prognostic importance of involvement of the CRM predicted by using MRI before neoadjuvant treatment in patients with rectal cancer.	MRI led to accurate prediction of a histologically involved CRM (sensitivity, 100%; specificity, 88%). The rates for local recurrence (group 1, 33%; group 2, 5%; group 3, 6%; $P < .02$) and 5-year OS (group 1, 39%; group 2, 70%; group 3, 90%; $P < .001$) differed significantly among the predefined groups. The distance to the mesorectal fascia was an independent prognostic parameter in multivariate analysis ($P < .001$), and histopathologic response to treatment provided no additional information. Prediction of the tumor-free CRM assessed with MRI before initiation of neoadjuvant chemotherapy and radiation therapy proved to be a prognostic factor in rectal cancer.	3
54. Purkayastha S, Tekkis PP, Athanasiou T, Tilney HS, Darzi AW, Heriot AG. Diagnostic precision of magnetic resonance imaging for preoperative prediction of the circumferential margin involvement in patients with rectal cancer. <i>Colorectal Dis</i> . 2007;9(5):402-411.	Meta-analysis	9 studies evaluating 529 patients	Meta-analysis comparing MRI with histology after total mesorectal excision. To evaluate the diagnostic precision of MRI for the preoperative evaluation of circumferential margin involvement in patients with rectal cancer.	MRI can accurately predict circumferential margin involvement preoperatively for rectal cancer in single units.	M

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
55. Videhult P, Smedh K, Lundin P, Kraaz W. Magnetic resonance imaging for preoperative staging of rectal cancer in clinical practice: high accuracy in predicting circumferential margin with clinical benefit. <i>Colorectal Dis.</i> 2007;9(5):412-419.	Observational-Dx	91 patients, 5 observers	Retrospective study to determine agreement between staging of rectal cancer made by MRI and histopathological examination and the influence of MRI on choice of radiotherapy and surgical procedure.	MRI predicted CRM with high accuracy in rectal cancer. MRI could be used as a clinical guidance with high reliability.	3
56. Chang GJ, You YN, Park IJ, et al. Pretreatment high-resolution rectal MRI and treatment response to neoadjuvant chemoradiation. <i>Dis Colon Rectum.</i> 2012;55(4):371-377.	Observational-Dx	62 patients	To evaluate the ability of pretreatment rectal MRI to classify tumor response to neoadjuvant chemoradiation.	Tumor response was good in 25 (40.3%) and poor in 37 (59.7%). Median interval from MRI to surgery was 7.9 weeks (interquartile range, 7.0–9.0). MRI tumor depth was <1 mm in 10 (16.9%), 1 to 5 mm in 30 (50.8%), and >5 mm in 21 (33.9%). Lymph node status was positive in 40 (61.5%), and vascular invasion was present in 16 (25.8%). Tumor response was associated with MRI tumor depth ($P=0.001$), MRI lymph node status ($P<0.001$) and vascular invasion ($P=0.009$). Multivariate regression indicated >5 mm MRI tumor depth (OR = 0.08; 95% CI = 0.01–0.93; $P=0.04$) and MRI lymph node positivity (OR = 0.12; 95% CI = 0.03–0.53; $P=0.005$) were less likely to achieve a good response to neoadjuvant chemoradiotherapy.	2
57. Hunter CJ, Garant A, Vuong T, et al. Adverse features on rectal MRI identify a high-risk group that may benefit from more intensive preoperative staging and treatment. <i>Ann Surg Oncol.</i> 2012;19(4):1199-1205.	Review/Other-Dx	236 patients	To determine the incidence of synchronous metastatic disease according to MRI risk features.	Imaging data were available for 230 (97.5%) of 236 patients. Incidence of confirmed distant metastases was significantly greater in the MRI high-risk group, with 28 (20.7%) of 135 (95% CI, 14.8–28.3), vs the low-risk group, with 4 (4.2%) of 95 (95% CI, 1.7–10.3) (OR 6.0, 95% CI, 2.0–17.6, $P<0.001$).	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
58. Patel UB, Taylor F, Blomqvist L, et al. Magnetic resonance imaging-detected tumor response for locally advanced rectal cancer predicts survival outcomes: MERCURY experience. <i>J Clin Oncol.</i> 2011;29(28):3753-3760.	Observational-Dx	111 patients	To assess MRI and pathologic staging after neoadjuvant therapy for rectal cancer in a prospectively enrolled, multicenter study.	On multivariate analysis, the MRI-assessed TRG HRs were independently significant for survival (HR, 4.40; 95% CI, 1.65 to 11.7) and DFS (DFS; HR, 3.28; 95% CI, 1.22 to 8.80). 5-year survival for poor MRI-assessed TRG was 27% vs 72% ($P=.001$), and DFS for poor MRI-assessed TRG was 31% vs 64% ($P=.007$). Preoperative MRI-predicted CRM independently predicted local recurrence (LR; HR, 4.25; 95% CI, 1.45 to 12.51). 5-year survival for poor post-treatment pathologic T stage (ypT) was 39% vs 76% ($P=.001$); DFS for the same was 38% vs 84% ($P=.001$); and LR for the same was 27% vs 6% ($P=.018$). The 5-year survival for involved path CRM was 30% vs 59% ($P=.001$); DFS, 28 vs 62% ($P=.02$); and LR, 56% vs 10% ($P=.001$). Pathology node status did not predict outcomes.	2
59. Shihab OC, Taylor F, Salerno G, et al. MRI predictive factors for long-term outcomes of low rectal tumours. <i>Ann Surg Oncol.</i> 2011;18(12):3278-3284.	Observational-Dx	101 patients	To analyze the prognostic values of preoperative, pretreatment factors (MRI low rectal stage, tumor position, MRI-predicted margin involvement), preoperative post-treatment factors (MRI-measured TRG and MRI-predicted margin involvement), and postoperative factors (pathological CRM involvement, pathological T- and N-stage and operation performed).	On univariate analysis, advanced MRI low rectal tumor stage correlated with greater incidence of recurrence ($P=0.013$) and death ($P=0.029$) compared with earlier stage tumors. Good MRI TRG score (good response to preoperative therapy) correlated with significantly reduced tumor recurrence rates ($P=0.008$) and increased survival ($P=0.008$) vs the poor MRI TRG score group. On multivariate analysis, good MRI TRG score was associated with reduced recurrence ($P=0.003$) but not survival rates.	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
60. Strassburg J, Ruppert R, Ptok H, et al. MRI-based indications for neoadjuvant radiochemotherapy in rectal carcinoma: interim results of a prospective multicenter observational study. <i>Ann Surg Oncol.</i> 2011;18(10):2790-2799.	Observational-Tx	230 patients	To evaluate the use of CRM status in preoperative MRI as an indication for neoadjuvant radiochemotherapy in rectal carcinoma patients.	Of 230 patients that met the inclusion criteria, 96 (41.7%) received a long course of neoadjuvant radiochemotherapy and 134 (58.3%) were primarily operated on. The pathologically CRM was positive in 13/230 (5.7%) (primarily operated on, 2/134 [1.5%]; after neoadjuvant radiochemotherapy, 11/96 [11%]). In 1 of 134 (0.7%), the MRI CRM was falsely negative. Patients at participating centers varied in terms of preoperative stage but not in pathologically CRM positivity (0%–13%, $P=.340$). The plane of surgery was mesorectal (good) in 209/230 (90.9%), intramesorectal (moderate) in 16/230 (7%), and the muscularis propria plane (poor) in 2.2% (5/230).	2
61. Taylor FG, Quirke P, Heald RJ, et al. Preoperative high-resolution magnetic resonance imaging can identify good prognosis stage I, II, and III rectal cancer best managed by surgery alone: a prospective, multicenter, European study. <i>Ann Surg.</i> 2011;253(4):711-719.	Review/Other-Dx	374 patients	To assess local recurrence, DFS, and OS in MRI-predicted good prognosis tumors treated by surgery alone.	Of 374 patients followed up in the MERCURY study, 122 (33%) were defined as "good prognosis" stage III or less on MRI. OS and DFS for all patients with MRI "good prognosis" stage I, II and III disease at 5 years was 68% and 85%, respectively. The local recurrence rate for this series of patients predicted to have a good prognosis tumor on MRI was 3%.	4
62. Kim DJ, Kim JH, Ryu YH, Jeon TJ, Yu JS, Chung JJ. Nodal staging of rectal cancer: high-resolution pelvic MRI versus (1)(8)F-FDGPET/CT. <i>J Comput Assist Tomogr.</i> 2011;35(5):531-534.	Observational-Dx	30 patients	To compare high-resolution pelvic MRI with PET/CT for the preoperative assessment of nodal staging in rectal cancer.	The accuracies of nodal status prediction from MRI and PET/CT were 83% and 70%, respectively. MRI had a sensitivity of 94% and a specificity of 67%, whereas PET/CT had a sensitivity of 61% and a specificity of 83%. A combination of MRI and PET/CT revealed a sensitivity of 94%, a specificity of 83%, and an accuracy of 90%.	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
63. Mizukami Y, Ueda S, Mizumoto A, et al. Diffusion-weighted magnetic resonance imaging for detecting lymph node metastasis of rectal cancer. <i>World J Surg.</i> 2011;35(4):895-899.	Observational-Dx	129 patients	To study the accuracy of lymph node staging by DWI + conventional MRI.	59 (46%) patients had metastatic lymph nodes on histopathologic examinations. 220 (18%) of 1,250 lymph nodes were pathologically positive for tumor metastasis. The overall patient-based sensitivity, specificity, PPV, NPV, and accuracy of DWI + conventional MRI were 93%, 81%, 81%, 93%, and 87%, respectively. Corresponding values of CT were 73%, 79%, 74%, 77%, and 76%, respectively. The overall node-based sensitivity, specificity, PPV, NPV, and accuracy of DWI + conventional MRI were 97%, 81%, 52%, 99%, and 84%, respectively. Corresponding values of CT were 86%, 80%, 48%, 96%, and 81%, respectively.	3
64. Koh DM, George C, Temple L, et al. Diagnostic accuracy of nodal enhancement pattern of rectal cancer at MRI enhanced with ultrasmall superparamagnetic iron oxide: findings in pathologically matched mesorectal lymph nodes. <i>AJR Am J Roentgenol.</i> 2010;194(6):W505-513.	Observational-Dx	25 patients	To evaluate the diagnostic accuracy of the pattern of nodal enhancement at MRI enhanced with ultrasmall superparamagnetic iron oxide in the nodal classification of rectal cancer in pathologically matched mesorectal lymph nodes.	After surgery, radiologic-pathologic comparison of 126 mesorectal nodes (116 benign, 10 malignant) was possible. Use of morphologic criteria resulted in an average sensitivity of 65% (95% CI, 35%–88%); specificity, 75% (67%–83%); PPV, 19% (8%–34%); and NPV, 96% (91%–99%). Use of ultrasmall superparamagnetic iron oxide criteria resulted in an average sensitivity of 65% (95% CI, 35%–88%); specificity, 93% (87%–96%); PPV, 43% (21%–67%); and NPV, 97% (92%–99%). Use of ultrasmall superparamagnetic iron oxide MRI improved diagnostic specificity for both observers ($P<0.01$). Interobserver agreement was fair for morphologic criteria ($\kappa = 0.39$) but good for ultrasmall superparamagnetic iron oxide criteria ($\kappa = 0.68$).	2
65. Lambregts DM, Beets GL, Maas M, et al. Accuracy of gadofosveset-enhanced MRI for nodal staging and restaging in rectal cancer. <i>Ann Surg.</i> 2011;253(3):539-545.	Observational-Dx	68 patients	To prospectively assess the accuracy of gadofosveset-enhanced MRI for nodal staging and restaging in rectal cancer.	For the experienced reader, sensitivity, specificity, and AUC improved from 76%, 82% and 0.84 on standard MRI to 80%, 97% and 0.96 on gadofosveset-MRI ($P<0.001$). For the junior reader results improved from 69%, 85%, and 0.85 on standard MRI to 70%, 95%, and 0.93 on gadofosveset-MRI ($P=0.03$). Interobserver agreement was good on both standard MRI ($\kappa = 0.73$) and gadofosveset-MRI ($\kappa = 0.71$).	2

* See Last Page for Key

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
66. Bernini A, Deen KI, Madoff RD, Wong WD. Preoperative adjuvant radiation with chemotherapy for rectal cancer: its impact on stage of disease and the role of endorectal ultrasound. <i>Ann Surg Oncol</i> . 1996;3(2):131-135.	Observational-Dx	43 patients	To assess the impact of preoperative adjuvant therapy in patients judged by EUS to have extramural invasion of rectal cancer and/or regional lymph node involvement.	Downstaging was seen in 23 (53%) patients with wall invasion and in 23 (72%) of 32 patients with lymph node involvement. Overall, downstaging was achieved in 30 (70%). PPV of US after irradiation were 72% and 56% for wall penetration and lymph node status, respectively. NPV of US after irradiation were 100% and 82%, respectively.	3
67. Farouk R, Nelson H, Radice E, Mercill S, Gunderson L. Accuracy of computed tomography in determining resectability for locally advanced primary or recurrent colorectal cancers. <i>Am J Surg</i> . 1998;175(4):283-287.	Observational-Dx	84 patients	To determine the accuracy of CT in determining tumor resectability in patients with locally advanced primary (T4) or locally recurrent CRC.	At surgery, disease was confined to the pelvis in 63 patients, the abdomen in 7 and both the pelvis and abdomen in 14. CT correctly identified tumor in 87% of patients, with 89% and 80% accuracies for pelvic and abdominal disease, respectively. CT is generally reliable at identifying disease as being confined to one region, and for predicting the need for adjacent organ resection. It is less discriminating for predicting local tumor resectability.	1
68. Bhattacharjya S, Bhattacharjya T, Baber S, Tibballs JM, Watkinson AF, Davidson BR. Prospective study of contrast-enhanced computed tomography, computed tomography during arteriportography, and magnetic resonance imaging for staging colorectal liver metastases for liver resection. <i>Br J Surg</i> . 2004;91(10):1361-1369.	Observational-Dx	120 patients	Prospective study to compare the value of contrast-enhanced helical CT, CT during arteriportography, and contrast-enhanced MRI for staging patients with colorectal liver metastases.	The sensitivity and specificity were 73.0% and 96.5% for CT, 87.1% and 89.3% for CT arteriportography, and 81.9% and 93.2% for MRI. PPV were 89.7%, 87.5% and 87.5%, respectively. The diagnostic accuracy of spiral CT, MRI and CT arteriportography was similar. Combining modalities did not improve accuracy.	3
69. Ahmetoglu A, Cansu A, Baki D, et al. MDCT with multiplanar reconstruction in the preoperative local staging of rectal tumor. <i>Abdom Imaging</i> . 2011;36(1):31-37.	Observational-Dx	37 patients	To evaluate the accuracy of MDCT with multiplanar reconstruction in the preoperative local staging of rectal tumor.	Overall accuracy was 86% in T staging, 84% in N staging, 89% in International Union Against Cancer (UICC) Staging, and 94.5% in the prediction of mesorectal fascia involvement.	3
70. Anderson EM, Betts M, Slater A. The value of true axial imaging for CT staging of colonic cancer. <i>Eur Radiol</i> . 2011;21(6):1286-1292.	Observational-Dx	50 consecutive datasets	To assess the effect of true axial CT on the accuracy of staging of colonic cancers.	The overall accuracy for tumor staging was 56% for reader 1, 48% for reader 2 and 64% for reader 3 for standard axial CT. This improved to 72% ($P=0.012$), 66% ($P=0.012$) and 80% ($P=0.021$) when the true axial images were added. For nodal staging, overall accuracy improved from 56% to 70% ($P=0.065$) for reader 1, 58% to 76% ($P=0.012$) for reader 2 and 60% to 76% ($P=0.021$) for reader 3 between reads.	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
71. da Fonte AC, Chojniak R, de Oliveira Ferreira F, Pinto PN, dos Santos Neto PJ, Bitencourt AG. Inclusion of computed tomographic colonography on pre-operative CT for patients with colorectal cancer. <i>Eur J Radiol.</i> 2012;81(3):e298-303.	Observational-Dx	25 patients	To evaluate the impact of the inclusion of CTC involving fecal tagging and no laxatives on the CT study routinely used in staging patients with CRC.	All exams were well-tolerated, and only one had unsatisfactory quality. CTC identified all the carcinomas and had an overall accuracy of 80%, 60.1% and 100% for the evaluation of tumor depth, lymph nodes and metastases respectively. CTC identified all polyps >9 mm. Following CTC, changes to surgical plans were observed in 20.8% of the cases, all with incomplete optical colonoscopies.	3
72. Duman M, Tas S, Mecit EA, et al. Preoperative local staging of colorectal cancer patients with MDCT. <i>Hepatogastroenterology.</i> 2012;59(116):1108-1112.	Observational-Dx	73 patients	To evaluate tumor invasion (T staging) and lymph node metastasis (N staging) of CRC preoperatively by using MDCT and to compare with the histopathological findings.	In this study, the best accuracy results had been acquired for T1 and T2 tumors as 90.4% and 73.9%, respectively. For both histopathologically staged N0 and N1 patients, the accuracy results were 61.6%. The distant metastases were not detected in this study.	2
73. Stabile Ianora AA, Moschetta M, Pedote P, Scardapane A, Angelelli G. Preoperative local staging of colosigmoideal cancer: air versus water multidetector-row CT colonography. <i>Radiol Med.</i> 2012;117(2):254-267.	Experimental-Dx	70 patients	To evaluate the diagnostic accuracy of MDCT performed with 2 different hypodense endoluminal contrast agents for the preoperative staging of colosigmoideal cancer.	The overall diagnostic accuracy of MDCT was 68.6% for water and 62.8% for air colonography. In the evaluation of the T parameter, the accuracy values were 88.6% for water and 80% for air colonography. In staging of the N parameter, the accuracy values were 77.1% and 74.3% for water and air MDCT colonography, respectively.	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
74. Manfredi S, Lepage C, Hatem C, Coatmeur O, Faivre J, Bouvier AM. Epidemiology and management of liver metastases from colorectal cancer. <i>Ann Surg.</i> 2006;244(2):254-259.	Review/Other-Dx	13,463 patients	To report on the incidence, treatment, and prognosis of synchronous and metachronous liver metastases.	The proportion of patients with synchronous liver metastases was 14.5%. Age-standardized incidence rates were 7.6 per 100,000 in males, 3.7 per 100,000 in females. The 5-year cumulative metachronous liver metastasis rate was 14.5%. It was 3.7% for TNM stage I tumors, 13.3% for stage II, and 30.4% for stage III ($P<0.001$). The risk of liver metastasis was also associated to gross features. Resection for cure was performed in 6.3% of synchronous liver metastases and 16.9% of metachronous liver metastases. Age, presence of another site of recurrence, and period of diagnosis were independent factors associated with the performance of a resection for cure. The 1- and 5-year survival rates were 34.8% and 3.3% for synchronous liver metastases. Their corresponding rates were, respectively, 37.6% and 6.1% for metachronous liver metastases.	4
75. Alberts SR, Poston GJ. Treatment advances in liver-limited metastatic colorectal cancer. <i>Clin Colorectal Cancer.</i> 2011;10(4):258-265.	Review/Other-Dx	N/A	A review to discuss the advances made in management of patients with liver-limited metastatic disease.	Over the last several decades advances in the management and treatment of patients with liver metastases from CRC has changed a disease with a dismal prognosis to one with a potential for cure in some patients. Advances have been made through coordinated management of patients by surgeons, medical oncologists, radiologists, and other health care professionals coupled with advances in treatment options. Although these advances have clearly impacted patient outcomes, it is clear that the benefit of traditional surgical approaches and the use of cytotoxic chemotherapy are reaching a plateau. Continued research to develop new and more active therapies, including targeted or biologic agents, is needed.	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
76. Cance WG, Cohen AM, Enker WE, Sigurdson ER. Predictive value of a negative computed tomographic scan in 100 patients with rectal carcinoma. <i>Dis Colon Rectum</i> . 1991;34(9):748-751.	Observational-Dx	100 patients	To evaluate the ability of a CT scan to predict accurately the absence of either periaortic nodal metastases or liver metastases in a group of patients with rectal carcinoma.	64 patients (64%) had stage T3 or T4 tumors. 10 patients had unsuspected distant metastases for an overall NPV of 90%. 7 patients had small liver metastases, and 3 had periaortic nodal metastases. 6 of the patients with liver metastases had them completely resected at the original laparotomy. The predictive value of the CT scan diminished in the patients who were selected to receive full-dose preoperative radiation therapy and had a mean delay of 12 weeks between CT scan and laparotomy. The preoperative carcinoembryonic antigen levels were of no value in predicting the presence of distant metastases.	3
77. Valls C, Andia E, Sanchez A, et al. Hepatic metastases from colorectal cancer: preoperative detection and assessment of resectability with helical CT. <i>Radiology</i> . 2001;218(1):55-60.	Experimental-Dx	157 patients	To prospectively evaluate helical CT in the preoperative detection of hepatic metastases and assessment of resectability with surgical, IOUS, and histopathologic correlation.	IOUS, palpation, and histopathologic examination revealed 290 liver metastases; helical CT correctly depicted 247. Helical CT results were the following: overall detection rate, 85.1% (95% CI: 80.8%, 89.3%); PPV, 96.1% (95% CI: 92.9%, 98.1%); and false-positive rate, 3.9% (10/257 findings; 95% CI: 1.9%, 7.1%). False-positive findings were related to hemangioendothelioma, hemangioma, hepatic peliosis, biliary adenoma, centrilobar hemorrhage, biliary hamartoma, periportal fibrosis, and normal liver parenchyma. Curative resection was performed in 112 instances with a resectability rate of 94.1%. 4-year patient survival rate was 58.6%.	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
78. Numminen K, Isoniemi H, Halavaara J, et al. Preoperative assessment of focal liver lesions: multidetector computed tomography challenges magnetic resonance imaging. <i>Acta Radiol.</i> 2005;46(1):9-15.	Observational-Dx	31 patients	To investigate prospectively MDCT and MRI in the preoperative assessment of focal liver lesions.	At surgery, IOUS and palpation revealed 45 solid liver lesions. From these, preoperative MDCT detected 43 (96%) and MRI 35 (78%) deposits. MDCT performed statistically better than MRI in lesion detection ($P=0.008$). Assessment of lesion vascular proximity was correctly determined by MDCT in 98% of patients and by MRI in 87%. Statistical difference was found ($P=0.002$). IOUS and palpation changed the preoperative surgical plan as a result of extrahepatic disease in 8/31 (26%) cases. In MDCT as well in MRI extrahepatic involvement was suspected in 2 cases.	3
79. Onishi H, Murakami T, Kim T, et al. Hepatic metastases: detection with multi-detector row CT, SPIO-enhanced MR imaging, and both techniques combined. <i>Radiology.</i> 2006;239(1):131-138.	Observational-Dx	38 patients	To retrospectively compare the accuracy in detection of hepatic metastases among contrast material-enhanced MDCT alone, superparamagnetic iron oxide-enhanced MRI alone, and a combination of contrast-enhanced CT and superparamagnetic iron oxide-enhanced MRI.	The mean AUC curve for the combined approach (0.70) was significantly higher than that for superparamagnetic iron oxide-enhanced MRI alone (0.58, $P<.05$, Fisher protected least significant difference test), and there was no significant difference between each of them and that for contrast-enhanced CT alone (0.66). For all lesions, the mean sensitivity of combined imaging (0.59) was significantly higher than that of CT (0.48) or MRI (0.43) alone ($P<.05$, Fisher protected least significant difference test and generalized estimating equations). For all lesions, the mean PPVs were 0.82, 0.89, and 0.81, for combined MRI and CT, CT alone, and MRI alone, respectively.	2
80. Soyer P, Pocard M, Boudiaf M, et al. Detection of hypovascular hepatic metastases at triple-phase helical CT: sensitivity of phases and comparison with surgical and histopathologic findings. <i>Radiology.</i> 2004;231(2):413-420.	Experimental-Dx	32 patients with 59 hepatic metastases	To compare the respective sensitivities of unenhanced, arterial-dominant, and portal-dominant phase helical CT in the preoperative depiction of hypovascular hepatic metastases by using IOUS and histopathologic findings as the standard of reference.	Among 59 hepatic metastases, unenhanced, arterial-dominant, and portal-dominant phase helical CT imaging depicted 39 (66.1%; 95% CI: 53.3%, 76.8%), 44 (74.5%; 95% CI: 62.2%, 83.9%), and 54 (91.5%; 95% CI: 81.6%, 96.3%) metastases, respectively. Portal-dominant phase imaging depicted significantly more hypovascular hepatic metastases than did unenhanced ($P<.001$) or arterial-dominant ($P<.01$) phase imaging (Wilcoxon test).	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
81. Kulemann V, Schima W, Tamandl D, et al. Preoperative detection of colorectal liver metastases in fatty liver: MDCT or MRI? <i>Eur J Radiol.</i> 2011;79(2):e1-6.	Observational-Dx	20 patients	To compare the diagnostic value of MDCT and MRI in the preoperative detection of colorectal liver metastases in diffuse fatty infiltration of the liver, associated with neoadjuvant chemotherapy.	Overall, 51 metastases were found by histopathology of the resected liver segments/lobes. The size of the metastases ranged from 0.4 to 13 cm, with 18 (35%) being up to 1cm in diameter. In the overall rating, MDCT detected 33/51 lesions (65%), and MRI 45/51 (88%). For lesions up to 1 cm, MDCT detected only 2/18 (11%) and MRI 12/18 (66%). One false positive lesion was detected by MDCT. Statistical analysis showed that MRI is markedly superior to MDCT, with a statistically significant difference ($P<.001$), particularly for the detection of small lesions (≤ 1 cm; $P<.004$). There was no significant difference between the 2 modalities in the detection of lesions >1 cm.	2
82. van Kessel CS, van Leeuwen MS, van den Bosch MA, et al. Accuracy of multislice liver CT and MRI for preoperative assessment of colorectal liver metastases after neoadjuvant chemotherapy. <i>Dig Surg.</i> 2011;28(1):36-43.	Observational-Dx	79 lesions in 15 patients	To determine the best imaging modality for preoperative detection, characterization and measurement of colorectal liver metastases after neoadjuvant chemotherapy.	Lesion detection rate was similar for multislice-CT and MRI (76% and 80%, respectively, $P=0.648$). Lesion characterization was significantly superior ($P=0.021$) at MRI (89%, kappa 0.747, $P=0.001$) compared to multislice-CT (77%, kappa 0.235, $P=0.005$). Interobserver variability for diameter measurement was not significant at MRI ($P=0.909$ [95% CI; -1.245 to 1.395]), but significant at multislice-CT ($P=0.028$ [95% CI; -3.349 to -2.007]). Differences in diameter measurement were independent of observer ($P=0.131$), and no statistical effect from imaging modality on diameter measurement was observed ($P=0.095$).	3
83. Kronawitter U, Kemeny NE, Heelan R, Fata F, Fong Y. Evaluation of chest computed tomography in the staging of patients with potentially resectable liver metastases from colorectal carcinoma. <i>Cancer.</i> 1999;86(2):229-235.	Observational-Dx	202 patients	Retrospective analysis to determine whether CT of the chest was necessary in patients with negative chest radiograph.	For routine preoperative workup, majority of lesions appearing on chest CT scans of patients with negative chest radiographs were not malignant. The positive yield of CT-guided workup was 10/202 patients (5%).	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
84. Christoffersen MW, Bulut O, Jess P. The diagnostic value of indeterminate lung lesions on staging chest computed tomographies in patients with colorectal cancer. <i>Dan Med Bull.</i> 2010;57(1):A4093.	Observational-Dx	131 consecutive patients	To evaluate the significance of such indeterminate lung findings in staging CT scans.	In 8 of the 22 patients (36%) lesions progressed. In 1 patient, the lesion turned out to be a primary lung cancer, in another a lymphoma. In the last 6 patients (27%), the lesions developed into CRC lung metastases within a median period of 15 months. These results were significantly different from those obtained in patients who had a normal CT, among whom only 6% developed lung malignancies in the follow-up period ($P<0.0001$). The development of lung metastases was significantly related to positive nodal status at operation and elevated carcinoembryonic antigen level at follow-up ($P<0.05$).	4
85. Grossmann I, Avenarius JK, Mastboom WJ, Klaase JM. Preoperative staging with chest CT in patients with colorectal carcinoma: not as a routine procedure. <i>Ann Surg Oncol.</i> 2010;17(8):2045-2050.	Review/Other-Dx	200 patients	To analyze the outcome and clinical benefit of routine staging with chest CT after inclusion of a consecutive series of 200 patients with CRC.	Synchronous metastases were present in 60 patients (30%). Staging chest CT revealed pulmonary metastases in 6 patients, with 1 false positive finding. In 50 patients indeterminate lesions were seen on chest CT (25%). These were diagnosed during follow-up as true metastases (n = 8), bronchus carcinoma (n = 2), benign lesions (n = 25), and remaining unknown (n = 15). Ultimately, synchronous pulmonary metastases were diagnosed in 13 patients (7%), in 6 patients confined to the lung (3%). In none of the patients the treatment plan for the primary tumor was changed based on the staging chest CT.	4
86. Choi DJ, Kwak JM, Kim J, Woo SU, Kim SH. Preoperative chest computerized tomography in patients with locally advanced mid or lower rectal cancer: its role in staging and impact on treatment strategy. <i>J Surg Oncol.</i> 2010;102(6):588-592.	Review/Other-Dx	103 patients	To evaluate the role of chest CT on preoperative staging in rectal cancer patients and to assess the impact on treatment strategy.	9 patients (8.7%) had pulmonary metastases detected on CT. Chest radiograph did not reveal any pulmonary metastatic lesions in 4 of the 9 patients. Of these 4, treatment was changed in 3 patients because of these findings. 40 (38.8%) patients had indeterminate nodules on chest CT. Of these, 37 patients had follow-up CTs and 4 patients (10.8%) showed interval changes that were confirmed as pulmonary metastasis.	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
87. McQueen AS, Scott J. CT staging of colorectal cancer: what do you find in the chest? <i>Clin Radiol.</i> 2012;67(4):352-358.	Review/Other-Dx	514 patients	To clarify the chest CT findings in patients with a new diagnosis of colorectal adenocarcinoma.	514 out of 568 (90.5%) CRC patients underwent complete CT staging. 31 patients (6%) had lung metastases, of which 4 (0.8%) were isolated. 353 (68.7%) had no evidence of pulmonary metastases, but 130 (25.3%) had indeterminate lung nodules. The indeterminate lung nodules of 12 patients were subsequently confirmed as metastases on follow-up. A major nonmetastatic finding (pulmonary embolism or synchronous primary malignancy) was found in 15/514 patients (3%).	4
88. Kirke R, Rajesh A, Verma R, Bankart MJ. Rectal cancer: incidence of pulmonary metastases on thoracic CT and correlation with T staging. <i>J Comput Assist Tomogr.</i> 2007;31(4):569-571.	Review/Other-Dx	56 consecutive patients, 2 reviewers	To evaluate the incidence of pulmonary metastases detected on thoracic CT in patients with rectal cancer and assess the association between the incidence of pulmonary metastases and the stage of the rectal tumor.	10 (17.9%) of 56 patients had evidence of pulmonary metastases on CT. Of the 56 patients, there were 3 patients with stage T1, 24 with T2, 26 with T3, and 3 with stage T4 tumors. Of these 10 patients, 1 had a stage T2 tumor, 7 had T3, and 2 had stage T4 tumors. Statistical analysis using exact logistic regression showed the odds of getting lung metastases is an increasing function of tumor grade. High incidence of lung metastases in patients with rectal cancer, and thoracic CT should be performed as part of a staging protocol in all patients before any form of treatment is planned. There is a higher incidence of lung metastases with higher T stage.	4
89. Berger-Kulemann V, Schima W, Baroud S, et al. Gadoxetic acid-enhanced 3.0 T MR imaging versus multidetector-row CT in the detection of colorectal metastases in fatty liver using intraoperative ultrasound and histopathology as a standard of reference. <i>Eur J Surg Oncol.</i> 2012;38(8):670-676.	Observational-Dx	23 patients	To compare the diagnostic value of gadoxetic acid-enhanced MRI at 3.0 T with 64-row MDCT in the detection of colorectal liver metastases in diffuse fatty infiltration of the liver after neoadjuvant chemotherapy.	Overall, 68 metastases (range, 0.4–6 cm; 31/68 metastases [46%] ≤1 cm) were found at histology. MDCT detected 49/68 lesions (72%), and MRI 66/68 (97%, $P<0.001$). For lesions ≤1 cm, MDCT detected only 13/31 (41.9%) and MRI 29/31 (93%, $P<0.001$). 8 false-positive lesions were detected by MDCT, 7 small lesions by MRI. There was no statistically significant difference between the 2 modalities in the detection of lesions >1 cm ($P=0.250$). IOUS detected all metastases and revealed two false-positive diagnoses.	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
90. Hammerstingl R, Huppertz A, Breuer J, et al. Diagnostic efficacy of gadoxetic acid (Primovist)-enhanced MRI and spiral CT for a therapeutic strategy: comparison with intraoperative and histopathologic findings in focal liver lesions. <i>Eur Radiol.</i> 2008;18(3):457-467.	Observational-Dx	169 patients	To evaluate the diagnostic efficacy of MRI using the new liver-specific contrast agent gadoxetic acid (Gd-EOB-DTPA, Primovist), as opposed to contrast-enhanced biphasic spiral CT, in the diagnosis of focal liver lesions, compared with a standard of reference.	Data sets were evaluated on-site (14 investigators) and off-site (3 independent blinded readers). Gd-EOB-DTPA was well tolerated. 302 lesions were detected in 131 patients valid for analysis by standard of reference. The frequency of correctly detected lesions was significantly higher on Gd-EOB-DTPA-enhanced MRI compared with CT in the clinical evaluation [10.44%; 95% CI: 4.88, 16.0]. In the blinded reading there was a trend towards Gd-EOB-DTPA-enhanced MRI, not reaching statistical significance (2.14%; 95% CI: -4.32, 8.6). However, the highest rate of correctly detected lesions with a diameter below 1 cm was achieved by Gd-EOB-DTPA-enhanced MRI. Differential diagnosis was superior for Gd-EOB-DTPA-enhanced MRI (82.1%) vs CT (71.0%). A change in surgical therapy was documented in 19/131 patients (14.5%) post Gd-EOB-DTPA-enhanced MRI. Gd-EOB-DTPA-enhanced MRI was superior in the diagnosis and therapeutic management of focal liver lesions compared with CT.	2
91. Kim YK, Park G, Kim CS, Yu HC, Han YM. Diagnostic efficacy of gadoxetic acid-enhanced MRI for the detection and characterisation of liver metastases: comparison with multidetector-row CT. <i>Br J Radiol.</i> 2012;85(1013):539-547.	Observational-Dx	67 patients	To compare the diagnostic performance of gadoxetic acid-enhanced MRI and 16-slice MDCT with respect to their abilities to detect hepatic metastases and differentiate hepatic metastases from hepatic cysts and hemangiomas.	For both observers, the Az values of gadoxetic acid-enhanced MRI (mean, 0.982 and 0.981) were significantly higher than the Az values of MDCT (mean, 0.839 and 0.892) ($P < 0.05$) for the detection of metastases and for the differentiation of metastases from hemangiomas and cysts. Sensitivities of gadoxetic acid-enhanced MRI with regard to the detection and characterization of liver metastases (mean, 96.9% and 96.0%) were significantly higher than those of MDCT (mean, 78.7% and 75.0%) ($P < 0.05$).	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
92. Knowles B, Welsh FK, Chandrakumaran K, John TG, Rees M. Detailed liver-specific imaging prior to pre-operative chemotherapy for colorectal liver metastases reduces intra-hepatic recurrence and the need for a repeat hepatectomy. <i>HPB (Oxford)</i> . 2012;14(5):298-309.	Review/Other-Dx	242 patients	Retrospective review of a prospective database to determine whether liver-specific MRI prior to preoperative chemotherapy affects intra-hepatic recurrence and long-term outcome after hepatectomy.	A liver-specific MRI pre-chemotherapy changed the staging in 56% of patients. At a median (range) follow-up of 55 (6–94) months, there was a higher incidence of intra-hepatic recurrence at a new site in the non-PCI group (65% vs 48% in the PCI group, $P=0.041$) and an increased rate of recurrence in patients with the same number of lesions pre- and post-chemotherapy [HR 2.02, 1:10–3.37, $P=0.024$]. The non-PCI group underwent more repeat hepatectomies than the PCI group (24.7% vs 13%, $P=0.034$), achieving similar long-term survival.	4
93. Kim SH, Lee JM, Hong SH, et al. Locally advanced rectal cancer: added value of diffusion-weighted MR imaging in the evaluation of tumor response to neoadjuvant chemo- and radiation therapy. <i>Radiology</i> . 2009;253(1):116-125.	Observational-Dx	40 patients	To investigate the added value of DWI-MRI in the evaluation of complete response to neoadjuvant combined chemotherapy and radiation therapy in patients with locally advanced rectal cancer.	Diagnostic accuracy (AUC [A(z)]) in the evaluation of complete response was significantly improved after additional review of DWI-MRIs for both reviewers: For reviewer 1, A(z) improved from 0.676 to 0.876 ($P=.005$), whereas for reviewer 2, A(z) improved from 0.658 to 0.815 ($P=.036$). Mean ADC ($[1.62 \pm 0.36] \times 10^{-3}$) mm ² /sec (standard deviation) of the complete response group (n = 11) was significantly higher than that ($[1.04 \pm 0.24] \times 10^{-3}$) mm ² /sec of the non-CR group (n = 29) ($P<.0001$).	2
94. Koh DM, Collins DJ. Diffusion-weighted MRI in the body: applications and challenges in oncology. <i>AJR Am J Roentgenol</i> . 2007;188(6):1622-1635.	Observational-Dx	72 patients	To compare the diagnostic accuracy of Gd-EOB-DTPA-enhanced MRI, DWI-MRI and a combination of both techniques for the detection of colorectal hepatic metastases.	417 lesions (310 metastases, 107 benign) were found in 72 patients. For both readers, diagnostic accuracy using the combined image set was higher [AUC (Az)=0.96, 0.97] than Gd-EOB-DTPA image set (Az=0.86, 0.89) or DWI-MRI image set (Az=0.93, 0.92). Using combined image set improved identification of liver metastases compared with Gd-EOB-DTPA image set ($P<0.001$) or DWI-MRI image set ($P<0.001$). There was very good interobserver agreement for lesion classification ($\kappa=0.81-0.88$).	2

**Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
95. Sugita R, Ito K, Fujita N, Takahashi S. Diffusion-weighted MRI in abdominal oncology: clinical applications. <i>World J Gastroenterol.</i> 2010;16(7):832-836.	Review/Other-Dx	N/A	Review clinical applications of DWI-MRI in abdominal oncology.	DWI can be used for pretreatment tumor detection, characterization including predicting tumor response to therapy, monitoring tumor response during therapy and follow-up study after treatment to detect possible tumor recurrence.	4
96. Mainenti PP, Iodice D, Segreto S, et al. Colorectal cancer and 18FDG-PET/CT: what about adding the T to the N parameter in loco-regional staging? <i>World J Gastroenterol.</i> 2011;17(11):1427-1433.	Observational-Dx	34 patients	To evaluate whether FDG-PET/CT may be an accurate technique in the assessment of the T stage in patients with CRC.	35/37 (94.6%) adenocarcinomas were identified and correctly located on PET/CT images. PET/CT correctly staged the T of 33/35 lesions identified showing an accuracy of 94.3% (95% CI: 87%–100%). All T1, T3 and T4 lesions were correctly staged, while two T2 neoplasms were overstated as T3.	3
97. Kinner S, Antoch G, Bockisch A, Veit-Haibach P. Whole-body PET/CT-colonography: a possible new concept for colorectal cancer staging. <i>Abdom Imaging.</i> 2007;32(5):606-612.	Observational-Dx	55 patients	To develop and evaluate a combined whole-body PET/CT-colonography protocol for dedicated CRC staging in routine clinical use.	All examinations were fully diagnostic and well tolerated by the patients. PET/CT-colonography showed highly accurate results for overall TNM-evaluation and was significantly more accurate than CT-colonography alone.	3

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
98. Veit-Haibach P, Kuehle CA, Beyer T, et al. Diagnostic accuracy of colorectal cancer staging with whole-body PET/CT colonography. <i>Jama</i> . 2006;296(21):2590-2600.	Observational-Dx	47 patients	To determine the staging accuracy of whole-body PET/CT colonography compared with the staging accuracies of CT followed by PET (CT + PET) and CT alone and to evaluate the effect of PET/CT colonography on therapy planning compared with conventional staging (CT of the abdomen and thorax and optical colonoscopy).	Of the 47 patients with a total of 50 lesions, the overall TNM stage was correctly determined for 37 lesions with PET/CT colonography (74%; 95% CI, 60%–85%), 32 lesions with CT + PET (64%; 95% CI, 49%–77%), and 26 lesions with CT alone with a 0.7-cm node threshold (52%; 95% CI, 37%–66%). Compared with optimized abdominal CT staging alone, PET/CT colonography was significantly more accurate in defining TNM stage (difference, 22%; 95% CI, 9%–36%; $P=0.003$), which was mainly based on a more accurate definition of the T-stage. Differences were not detected for defining N-stage between PET/CT colonography and CT alone with a threshold of 0.7 cm for malignant nodes but were detected with a threshold of 1 cm. Differences were not detected in defining M-stage separately or when comparing the accuracies of PET/CT colonography with CT + PET. PET/CT colonography affected consecutive therapy decisions in 4 patients (9%; 95% CI, 2.4%–20.4%) compared with conventional staging (CT alone and colonoscopy).	2
99. Ramos E, Valls C, Martinez L, et al. Preoperative staging of patients with liver metastases of colorectal carcinoma. Does PET/CT really add something to multidetector CT? <i>Ann Surg Oncol</i> . 2011;18(9):2654-2661.	Observational-Dx	97 patients	To determine prospectively whether the systematic use of PET/CT associated with conventional techniques could improve the accuracy of staging in patients with liver metastases of CRC.	In a lesion-by-lesion analysis of the hepatic staging, the sensitivity of MDCT/RM was superior to PET/CT (89.2 vs 55%, $P<0.001$). On the extrahepatic staging, PET/CT was superior to MDCT/MR only for the detection of locoregional recurrence ($P=0.03$) and recurrence in uncommon sites ($P=0.016$). New findings in PET/CT resulted in a change in therapeutic strategy in 17 patients. However, additional information was correct only in eight cases and wrong in nine patients.	2

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
100. Shin SS, Jeong YY, Min JJ, Kim HR, Chung TW, Kang HK. Preoperative staging of colorectal cancer: CT vs. integrated FDG PET/CT. <i>Abdom Imaging</i> . 2008;33(3):270-277.	Review/Other-Dx	N/A	To discuss the role, relative advantages and limitations of CT and PET/CT in the preoperative staging of CRC.	With the advance of CT technology, CT has still relative advantages over PET/CT with respect to local extent of primary tumor and regional lymph node metastases. The most significant additional information provided by PET/CT relates to the accurate detection of distant metastases. At present, routine evaluation of patients with suspicious CRC by PET/CT seems not to be necessary. But, it should be performed on selected patients who have suggestive but inconclusive metastatic lesions with CT. In addition, PET/CT with dedicated CT protocols, such as contrast enhanced PET/CT and PET/CT colonography, may replace the diagnostic CT for the preoperative staging of CRC.	4
101. Briggs RH, Chowdhury FU, Lodge JP, Scarsbrook AF. Clinical impact of FDG PET-CT in patients with potentially operable metastatic colorectal cancer. <i>Clin Radiol</i> . 2011;66(12):1167-1174.	Observational-Dx	102 patients	To assess the clinical impact of FDG-PET/CT in patients with potentially resectable metastatic CRC.	Of 102 patients (mean age 67 years, range 27–85 years), 94 had liver, 5 had isolated lung, and 3 had limited peritoneal metastases. In 31 patients (30%) PET/CT had a major impact on subsequent management, by correctly clarifying indeterminate lesions on conventional imaging as inoperable metastatic disease in 16 patients, detecting previously unsuspected metastatic disease in 9 patients, identifying occult second primary tumors in 3 patients, and correctly down-staging 3 patients. PET/CT had a minor impact in 12 patients (12%), no impact in 49 cases (48%), and a potentially negative impact in 10 cases (10%). Following PET/CT, 36 (35%) patients were no longer considered for surgery. Of those remaining operative 45 of 66 (68%) underwent potentially curative metastatic surgery. In this cohort PET/CT saved 16 futile laparotomies.	4

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
102. Eglinton T, Luck A, Bartholomeusz D, Varghese R, Lawrence M. Positron-emission tomography/computed tomography (PET/CT) in the initial staging of primary rectal cancer. <i>Colorectal Dis.</i> 2010;12(7):667-673.	Observational-Dx	20 patients	To assess the role of FDG-PET/CT in the initial staging of primary rectal adenocarcinoma.	PET/CT correctly identified the primary tumor in all 20 patients. Comparing PET/CT with conventional staging modalities, there were 11 discordant or incidental findings in 9 patients (45%). This resulted in a potential change in stage in 30% (4 patients downstaged and 2 upstaged). PET/CT suggested additional neoplastic pathology in 3 patients and excluded the same in 2 patients. The incidental neoplastic findings were of minor clinical significance and 1 was eventually deemed false positive. While PET/CT resulted in potential management changes in 5 patients (25%), no changes in surgical management occurred. When tumors were grouped according to conventional stage, PET/CT resulted in fewer changes in stage in stage I (0%), compared with stages II to IV (43%) ($P=0.08$).	2
103. Llamas-Elvira JM, Rodriguez-Fernandez A, Gutierrez-Sainz J, et al. Fluorine-18 fluorodeoxyglucose PET in the preoperative staging of colorectal cancer. <i>Eur J Nucl Med Mol Imaging.</i> 2007;34(6):859-867.	Observational-Dx	104 patients	To evaluate the utility of FDG-PET in the initial staging of patients with CRC in comparison with conventional staging methods and to determine its impact on therapeutic management.	In 14 patients, surgery was contraindicated by FDG-PET owing to the extent of disease (only 6/14 suspected by CT). FDG-PET revealed 4 synchronous tumors. For N staging, both procedures showed a relatively high specificity but a low diagnostic accuracy (PET 56%, CT 60%) and sensitivity (PET 21%, CT 25%). For M assessment, diagnostic accuracy was 92% for FDG-PET and 87% for CT. FDG-PET results led to modification of the therapy approach in 50% of patients with unresectable disease. FDG-PET findings were important, revealing unknown disease in 19.2%, changing the staging in 13.46% and modifying the scope of surgery in 11.54% (with a change in the therapeutic approach in 17.85% of those patients with rectal cancer).	2

Pretreatment Staging Colorectal Cancer
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
104. Spatz J, Holl G, Sciuk J, Anthuber M, Arnholdt HM, Markl B. Neoadjuvant chemotherapy affects staging of colorectal liver metastasis--a comparison of PET, CT and intraoperative ultrasound. <i>Int J Colorectal Dis.</i> 2011;26(2):165-171.	Observational-Dx	34 patients	To evaluate the effects of neoadjuvant chemotherapy on the efficacy of PET, PET/CT, CT and IOUS in the detection of liver metastasis.	A total of 109 liver segments were resected, of which 50 showed no metastatic involvement (45.9%). For patients without systemic chemotherapy, sensitivities for PET, CT/MRI and IOUS were 92%, 64% and 100% respectively as compared with 63%, 65% and 94% for patients after neoadjuvant chemotherapy in a segment-based analysis. For PET, SUVs were decreased by 3.9 in 10 patients after chemotherapy whereas lesion diameters were similar (3.0 vs 3.2 cm). Additional metastases were detected by IOUS in 7 patients resulting in a change of operative procedure in 20.6%.	3
105. Capirci C, Rubello D, Pasini F, et al. The role of dual-time combined 18-fluorodeoxyglucose positron emission tomography and computed tomography in the staging and restaging workup of locally advanced rectal cancer, treated with preoperative chemoradiation therapy and radical surgery. <i>Int J Radiat Oncol Biol Phys.</i> 2009;74(5):1461-1469.	Observational-Dx	87 consecutive patients enrolled, 2 reviewers	To evaluate the possible role of dual time sequential FDG-PET scans in the staging and restaging workup of locally advanced rectal cancer.	6 of 87 patients were excluded due to protocol deviation. Following chemoradiation therapy, 40/81 patients (49%) were classified as responders according to Mandard's criteria (TRG1-2). The mean pre-chemoradiation therapy SUV(max) was significantly higher than post-chemoradiation therapy (15.8 vs 5.9; $P<0.001$). The mean response index was significantly higher in responders than in nonresponder patients (71.3% vs 38%; $P=0.0038$). Using a response index cut-off of 65% for defining response to therapy, the following parameters have been obtained: 84.5% sensitivity, 80% specificity, 81.4% PPV, 84.2% NPV, and 81% overall accuracy.	2

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.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

AUC = Area under the receiver operating characteristic curve

CI = Confidence interval

CRC = Colorectal cancer

CRM = Circumferential resection margin

CT = Computed tomography

CTC = Computed tomography colonography

DFS = Disease-free survival

DWI = Diffusion-weighted imaging

EUS = Endoscopic ultrasound

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

Gd-EOB-DTPA = Gadolinium-ethoxybenzyl-diethylenetriamine pentaacetic acid

HR = Hazard ratio

IOUS = Intraoperative ultrasound

MDCT = Multidetector computed tomography

MRI = Magnetic resonance imaging

NPV = Negative predictive value

OR = Odds ratio

OS = Overall survival

PET = Positron emission tomography

PPV = Positive predictive value

ROC = Receiver-operator characteristic

RR = Relative risk

SUV = Standardized uptake value

TRG = Tumor regression grade

TRUS = Transrectal ultrasound

US = Ultrasound