American College of Radiology
ACR Appropriateness Criteria®
Imaging of Ductal Carcinoma in Situ (DCIS)

Variant 1: **Adult. Newly diagnosed DCIS. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Digital breast tomosynthesis diagnostic	Usually Appropriate	☢☢
Mammography diagnostic	Usually Appropriate	☢☢
US breast	May Be Appropriate	O
MRI breast without and with IV contrast	May Be Appropriate	O
Mammography with IV contrast	Usually Not Appropriate	☢☢
MRI breast without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET breast dedicated	Usually Not Appropriate	☢☢☢
Sestamibi MBI	Usually Not Appropriate	☢☢☢

Variant 2: **Adult. Newly diagnosed DCIS. No surgical intervention. Active surveillance.**

Procedure	Appropriateness Category	Relative Radiation Level
Digital breast tomosynthesis diagnostic	Usually Appropriate	☢☢
Mammography diagnostic	Usually Appropriate	☢☢
MRI breast without and with IV contrast	May Be Appropriate	O
US breast	Usually Not Appropriate	O
Mammography with IV contrast	Usually Not Appropriate	☢☢
MRI breast without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET breast dedicated	Usually Not Appropriate	☢☢☢
Sestamibi MBI	Usually Not Appropriate	☢☢☢

Variant 3: **Adult. Evaluation for local recurrence in patient with history of breast conservation therapy for DCIS. Routine surveillance.**

Procedure	Appropriateness Category	Relative Radiation Level
Digital breast tomosynthesis diagnostic	Usually Appropriate	☢☢
Digital breast tomosynthesis screening	Usually Appropriate	☢☢
Mammography diagnostic	Usually Appropriate	☢☢
Mammography screening	Usually Appropriate	☢☢
MRI breast without and with IV contrast	May Be Appropriate (Disagreement)	O
US breast	Usually Not Appropriate	O
Mammography with IV contrast	Usually Not Appropriate	☢☢
MRI breast without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET breast dedicated	Usually Not Appropriate	☢☢☢
Sestamibi MBI	Usually Not Appropriate	☢☢☢

Variant 4: **Adult. Evaluation for ipsilateral local recurrence in a patient with history of mastectomy for DCIS. Routine surveillance.**

Procedure	Appropriateness Category	Relative Radiation Level
US breast	Usually Not Appropriate	O
Digital breast tomosynthesis screening	Usually Not Appropriate	☢☢
Mammography screening	Usually Not Appropriate	☢☢
Mammography with IV contrast	Usually Not Appropriate	☢☢
MRI breast without and with IV contrast	Usually Not Appropriate	O
MRI breast without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET breast dedicated	Usually Not Appropriate	☢☢☢
Sestamibi MBI	Usually Not Appropriate	☢☢☢

Variant 5: **Adult. Suspected local recurrence based on symptoms, physical examination, or laboratory value in patient with a history of breast conservation therapy for DCIS. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US breast	Usually Appropriate	O
Digital breast tomosynthesis diagnostic	Usually Appropriate	☢☢
Mammography diagnostic	Usually Appropriate	☢☢
Mammography with IV contrast	Usually Not Appropriate	☢☢
Image-guided core biopsy breast	Usually Not Appropriate	Varies
Image-guided fine needle aspiration breast	Usually Not Appropriate	Varies
MRI breast without and with IV contrast	Usually Not Appropriate	O
MRI breast without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET breast dedicated	Usually Not Appropriate	☢☢☢
Sestamibi MBI	Usually Not Appropriate	☢☢☢

Variant 6: **Adult. Suspected local recurrence based on symptoms, physical examination, or laboratory value in patient with history of mastectomy for DCIS. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US breast	Usually Appropriate	O
Digital breast tomosynthesis diagnostic	Usually Not Appropriate	☢☢
Mammography diagnostic	Usually Not Appropriate	☢☢
Mammography with IV contrast	Usually Not Appropriate	☢☢
Image-guided biopsy chest	Usually Not Appropriate	Varies
Image-guided fine needle aspiration chest	Usually Not Appropriate	Varies
MRI breast without and with IV contrast	Usually Not Appropriate	O
MRI breast without IV contrast	Usually Not Appropriate	O
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢

Variant 7: **Adult. Known DCIS with microinvasion found on prior mammography, ultrasound, or MRI during initial evaluation. Axillary evaluation needed. Next imaging study.**

Procedure	Appropriateness Category	Relative Radiation Level
US axilla	Usually Not Appropriate	O
US-guided core biopsy axillary node	Usually Not Appropriate	O
US-guided fine needle aspiration biopsy axillary node	Usually Not Appropriate	O
Digital breast tomosynthesis diagnostic	Usually Not Appropriate	☢☢
Mammography with IV contrast	Usually Not Appropriate	☢☢
MRI breast without and with IV contrast	Usually Not Appropriate	O
MRI breast without IV contrast	Usually Not Appropriate	O
Lymphoscintigraphy axilla	Usually Not Appropriate	☢☢
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET/CT whole body	Usually Not Appropriate	☢☢☢

Variant 8: **Adult. Known DCIS without microinvasion found on prior mammography, ultrasound, or MRI during initial evaluation. Axillary evaluation needed. Next imaging study.**

Procedure	Appropriateness Category	Relative Radiation Level
US axilla	Usually Not Appropriate	O
US-guided core biopsy axillary node	Usually Not Appropriate	O
US-guided fine needle aspiration biopsy axillary node	Usually Not Appropriate	O
Digital breast tomosynthesis diagnostic	Usually Not Appropriate	☢☢
Mammography with IV contrast	Usually Not Appropriate	☢☢
MRI breast without and with IV contrast	Usually Not Appropriate	O
MRI breast without IV contrast	Usually Not Appropriate	O
Lymphoscintigraphy axilla	Usually Not Appropriate	☢☢
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET/CT whole body	Usually Not Appropriate	☢☢☢

IMAGING OF DUCTAL CARCINOMA IN SITU (DCIS)

Expert Panel on Breast Imaging: Cherie M. Kuzmiak, DO[a]; Richard E. Sharpe Jr., MD, MBA[b]; Alana A. Lewin, MD[c]; Susan P. Weinstein, MD[d]; Victoria Blinder, MD[e]; Elizabeth H. Dibble, MD[f]; Katerina Dodelzon, MD[g]; Basak E. Dogan, MD[h]; Lisa V. Paulis, MD[i]; Jennifer Kay Plichta, MD, MS[j]; Lonie R. Salkowski, MD, PhD, MS[k]; Maryam Sattari, MD, MS[l]; John R. Scheel, MD, PhD, MPH[m]; Priscilla J. Slanetz, MD, MPH.[n]

Summary of Literature Review

Introduction/Background

Ductal carcinoma in situ (DCIS; intraductal carcinoma) is a noninvasive proliferation of cohesive neoplastic epithelial cells confined to the mammary ductal-lobular systems, exhibiting a range of architectural patterns and nuclear grades [1]. DCIS most commonly presents as a mammographically detected clinically occult disease [2,3]. Before the introduction of mammography screening programs, DCIS was uncommon and accounted for 2% to 3% of palpable breast cancers [1]. With improvements in screening mammography, DCIS now accounts for approximately 20% of breast cancer diagnosed in the United States [4]. For people living in the United States, the American Cancer Society (ACS) estimates that 55,720 new cases of DCIS will be diagnosed in 2023 [4]. In addition, the incidence of DCIS is highest among non-Hispanic White (26.6 per 100,000) and Black (26.5 per 100,000) people, however, the incidence of DCIS increased for Black people (1.6%) from 2000 to 2014 whereas it was stable for White people [2]. DCIS has a favorable prognosis with a 10-year overall survival rate of 97.2% to 98.6% [5].

The management of DCIS continues to evolve because of its heterogeneity and low risk of mortality. There are no randomized controlled trials for DCIS comparing breast conserving surgery (BCS) to mastectomy, however, there has been no difference in overall survival between mastectomy and BCS for the treatment of DCIS [6]. Some patients with DCIS detected at core-needle biopsy (CNB) will have possible occult invasive disease that is diagnosed at surgical excision. A meta-analysis reported an overall DCIS upstaging rate to invasive cancer of 25.9% [7]. The cumulative incidence of axillary node metastasis in patients diagnosed preoperatively with DCIS is low (0%-14%) [8-17]. Nodal involvement in these patients is because of undetected invasive disease at the time of CNB [8-18].

Factors associated with axillary lymph node positivity in patients diagnosed with DCIS and DCIS with microinvasion on CNB are younger age, larger DCIS lesion size, high histological grade, receptor status, human epidermal growth factor receptor (HER) 2 overexpression, and lymphovascular invasion [19-21]. Randomized trials evaluating radiotherapy (RT) after BCS for DCIS have demonstrated a reduction in ipsilateral breast tumor recurrence rates by 50% to 70% [5,22-24]. Half of the recurrences are invasive cancer and half are DCIS [1]. Other studies have shown that endocrine therapy provides risk reduction in the ipsilateral breast treated with BCS and in the contralateral breast with estrogen receptors (ER)-positive primary tumors [25,26]. The current National Comprehensive Cancer Network (NCCN) treatment guidelines for DCIS are BCS without lymph node sampling, unless the excision is in an anatomic location compromising a future sentinel lymph node (SLN) procedure followed by potential RT. In patients undergoing a total mastectomy, SLN sampling may be performed or omitted. The guidelines also include the potential addition of endocrine therapy for all patients with hormone receptor–positive DCIS [27]. To potentially de-escalate the treatment of patients with DCIS, there are ongoing randomized multicenter trials designed to determine which DCIS lesions are associated with future risk of invasive disease [28-32].

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Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient's care).

Discussion of Procedures by Variant

Variant 1: Adult. Newly diagnosed DCIS. Initial imaging.

It is estimated that 20% to 30% of DCIS will progress to invasive breast cancer if not treated [31]. A retrospective population based study in the United Kingdom of 5.2 million women 50 to 64 years of age who participated in the national breast cancer screening program found a significant negative association between screen-detected DCIS and the rate of invasive interval cancers: for every 3 screen-detected cases of DCIS, 1 fewer invasive interval cancer occurred in the subsequent 3 years [33]. These findings suggest that detection and treatment of DCIS may be worthwhile for the prevention of future invasive disease.

CT Chest With IV Contrast

There is no evidence to support the use of CT chest with intravenous (IV) contrast for initial imaging of newly diagnosed DCIS.

The American Society of Clinical Oncology (ASCO) published Choosing Wisely guidelines advises against routine performance of PET, CT, and radionuclide bone scans in the staging of early breast cancer at low risk for metastasis, given the lack of evidence demonstrating a benefit in asymptomatic individuals with newly identified DCIS, or clinical stage I or II disease, because unnecessary imaging can lead to harm through unnecessary radiation exposure, misdiagnosis, unnecessary invasive procedures, overtreatment, and treatment-related complications [34].

CT Chest Without and With IV Contrast

There is no evidence to support the use of CT chest without and with IV contrast for initial imaging of newly diagnosed DCIS.

The ASCO published Choosing Wisely guidelines advises against routine performance of PET, CT, and radionuclide bone scans in the staging of early breast cancer at low risk for metastasis, given the lack of evidence demonstrating a benefit in asymptomatic individuals with newly identified DCIS, or clinical stage I or II disease, because unnecessary imaging can lead to harm through unnecessary radiation exposure, misdiagnosis, unnecessary invasive procedures, overtreatment, and treatment-related complications [34].

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Digital Breast Tomosynthesis Diagnostic

DCIS presents as mammographically identified suspicious calcifications in approximately 80% of cases [3]. Pure DCIS presents with suspicious calcifications in 73% to 98% of cases, which can be identified mammographically independent of the density of the fibroglandular breast tissue [35-38]. Approximately half of DCIS calcifications will have fine pleomorphic morphologic characteristics and a grouped distribution [3,39]. Microcalcifications associated with high-grade DCIS and DCIS with necrosis appear as fine pleomorphic or fine-linear branching [40]. Mammography findings associated with low and intermediate-grade DCIS include round/punctate calcifications or an asymmetry without calcifications [40-42].

Diagnostic mammography can evaluate lesion size and extent of disease and can be assisted by ultrasound (US). The typical appearance of suspicious calcifications in isolated DCIS may be more commonly assessed as BI-RADS 5, highly suggestive of malignancy with mammography (87%) than with US (33%) [36].

For DCIS, mammographic size demonstrates high correlation with pathologic size [43]. It should be noted that measurement of the DCIS component of malignancies as seen on imaging may differ from estimates reported by pathology [44,45].

A European multicenter retrospective reading study of 7,060 examinations compared digital mammography, digital breast tomosynthesis (DBT), digital mammography plus DBT, and synthetic mammography plus DBT found similar sensitivity in detecting DCIS across all modalities and improvement in specificity of DBT plus 2-D compared with 2-D mammography alone [46].

A recent analysis of 166 breast lesions in 130 patients found similar performance in detecting DCIS across synthetic 2-D mammography, DBT alone, DBT supplemented with US, and contrast-enhanced digital mammography [47].

For detecting high-grade DCIS, the sensitivity of mammography may be lower than for breast MRI. A study of 167 women diagnosed with pure DCIS that had preoperative mammography and breast MRI found that 56% of the DCIS cases were diagnosed by mammography and 92% by breast MRI. Forty-eight percent of the high-grade DCIS lesions were diagnosed on breast MRI and not apparent on mammography [48].

FDG-PET Breast Dedicated

There is no evidence to support the use of fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET breast dedicated for initial imaging of newly diagnosed DCIS.

Limited studies have suggested that FDG-PET dedicated breast may allow for identification of some forms of DCIS, yet there are insufficient data to substantiate routine use of FDG-PET [49,50]. In a study consisting of 139 surgery-confirmed pure DCIS cases (50 high-risk and 89 low-risk DCIS), the reported sensitivity and specificity of dedicated breast PET to differentiate between indolent and potentially aggressive DCIS were 90% (95% confidence interval [CI], 77%-96%) and 92% (95% CI, 84%-97%), respectively [51].

The ASCO published Choosing Wisely guidelines advises against routine performance of PET, CT, and radionuclide bone scans in the staging of early breast cancer at low risk for metastasis, given the lack of evidence demonstrating a benefit in asymptomatic individuals with newly identified DCIS, or clinical stage I or II disease, because unnecessary imaging can lead to harm through unnecessary radiation exposure, misdiagnosis, unnecessary invasive procedures, overtreatment, and treatment-related complications [34].

Mammography Diagnostic

DCIS presents as mammographically identified suspicious calcifications in approximately 80% of cases [3]. Pure DCIS presents with suspicious calcifications in 73% to 98% of cases, which can be identified mammographically independent of the density of the fibroglandular breast tissue [35-38]. Approximately half of DCIS calcifications will have fine pleomorphic morphologic characteristics and a grouped distribution [3,39]. Microcalcifications associated with high-grade DCIS and DCIS with necrosis appear as fine pleomorphic or fine-linear branching [40]. Mammography findings associated with low and intermediate-grade DCIS include round/punctate calcifications or an asymmetry without calcifications [40-42].

Diagnostic mammography can evaluate lesion size and extent of disease and can be assisted by US. The typical appearance of suspicious calcifications in isolated DCIS may be more commonly assessed as BI-RADS 5, highly suggestive of malignancy with mammography (87%) than with US (33%) [36].

Mammography has been demonstrated to be more sensitive in detecting DCIS overall than US. In a prospective study of 111 consecutive women with newly diagnosed breast cancer, 2-D mammography was found to be more sensitive than US in detecting DCIS (55% versus 47%, $P < .01$) [52].

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Mammography With IV Contrast

There is insufficient evidence to support routine use of mammography with IV contrast for initial imaging of newly diagnosed DCIS.

Few studies have evaluated the use of mammography with IV contrast for the evaluation of DCIS. Mammography with IV contrast protocols require performance of a standard 2-D mammogram that should be interpreted in addition to the contrast-enhanced image. The standard 2-D mammogram can detect the microcalcifications often associated with DCIS. DCIS demonstrates varied appearances on mammography with IV contrast, such as enhancement at site of suspicious calcifications, no enhancement at site of suspicious calcifications, and enhancement at a site remote to suspicious calcifications [53,54].

Small studies have demonstrated enhancement of DCIS-associated calcifications seen on mammography with IV contrast ranging from 67% to 84% [55-57]. A review of 95 women found that, although 12 cases of suspicious calcifications were identified, 4 showed no enhancement despite biopsy results demonstrating DCIS and invasive lobular cancer [57]. A review of 94 biopsied lesions found that 16 of 19 (84%) cases of DCIS showed enhancement [55]. A study of 147 women undergoing mammography with IV contrast found that 81% (27 of 33) pure DCIS lesions demonstrated enhancement [56]. These findings suggest that the absence of enhancement is insufficient to exclude DCIS, but the presence of enhancement raises the suspicion for malignancy.

The usefulness of mammography with IV contrast arises from identifying nonmass enhancement or an enhancing mass that suggests malignancy, noting that the absence of enhancement tends to favor benignity or low-grade DCIS [54].

In a small study that included 8 cases of biopsy-proven DCIS, measurements of the digital mammography was found to underestimate tumor size derived by histopathologic findings by 7 mm and mammography with IV contrast overestimated tumor size by 11 mm [58]. Because of technical limitations, mammography with IV contrast may be unable to identify some lesions in the far posterior breast and in the axilla.

MRI Breast Without and With IV Contrast

DCIS typically presents on MRI breast with IV contrast as nonmass enhancement, mass, or focus [59-62]. Morphology of DCIS on breast MRI is significantly correlated with enhancement kinetics, with nonmass enhancement more likely demonstrating medium and persistent kinetics, and foci or masses demonstrating rapid and plateau or washout kinetics [59,63]. DCIS lesions <1.5 cm are more likely to have rapid initial enhancement (P = .004) [59]. Both calcified and noncalcified DCIS demonstrate similar appearances on breast MRI [59]. Several important shifts in breast MRI have increased the sensitivity of breast MRI in detecting DCIS to 85% to 92%, including a shift to high temporal from high spatial imaging, evolution from primarily interpreting diagnostic studies to screening of high-risk patients, and an increased understanding of nonmass enhancement [48,64-66].

Contrast-enhanced breast MRI can identify most pure DCIS lesions, may identify multifocal or multicentric disease, and can predict upgrade to invasive cancer [67,68]. A study of 51 patients with biopsy proven DCIS who underwent breast MRI with IV contrast found that MRI depicted 88% of DCIS lesions, predicted upgrade to invasive disease in 82% of cases, and predicted multicentricity in 90% of cases [68]. Contrast-enhanced breast MRI may also be useful in identifying patients with high-grade DCIS, particularly those that could be mammographically occult [48,69]. For detecting high-grade DCIS, the sensitivity of mammography may be lower than for breast MRI. A study of 167 women diagnosed with pure DCIS who had preoperative mammography and breast MRI found that 56% of the DCIS cases were diagnosed by mammography, 92% by breast MRI, and 48% of high-grade DCIS lesions were diagnosed on breast MRI and not apparent on mammography [48].

Breast MRI may be useful for patients with newly diagnosed DCIS by detecting additional areas of ipsilateral or contralateral breast DCIS, by more accurately estimating lesion size, and by predicting upgrade to invasive cancer [67]. A secondary analyses of a multicenter prospective clinical trial from the Eastern Cooperative Oncology Group-American College of Radiology Imaging Network (ECOG-ACRIN) Cancer Research group of 339 women with DCIS diagnosed with conventional imaging (mammography and US) confirmed via CNB who underwent MRI found that MRI showed nonmass enhancement in 58% patients. MRI exams showed larger median tumor size than mammograms and yielded an additional cancer detection rate of 6.2% (16 additional ipsilateral malignant lesions found and 5 contralateral malignant lesions detected) with a false-positive rate of 14.2% [67].

Because mammography has been reported to underestimate the extent of DCIS, breast MRI may be especially useful for evaluating patients with DCIS [58]. When used in conjunction with mammography, breast MRI has the potential to guide clinical management of DCIS, however, long-term clinical outcome data are lacking [67,68,70,71].

Although breast MRI does increase the detection of breast cancer, long-term outcome data do not support the routine use of breast MRI for evaluating patients with newly diagnosed DCIS [72]. Data on MRI use shows conflicting results and may indicate that some populations may benefit, but not all routinely. A trial of 63 patients undergoing MRI after a diagnosis of DCIS found 34.8% of cases had MRI results that accurately predicted pathologic size, whereas in 65.2% of cases, MRI overestimated disease by a mean of 1.97 cm overall, and overestimated by a mean of 3.2 cm in patients with MRI tumor size >2 cm. There was no significant difference in mastectomy rates between the MRI and non-MRI group, and in patients undergoing BCS, there were fewer positive margins in the MRI versus the non-MRI group (P = .41) [73]. A meta-analysis of 9 studies of 1,077 women with DCIS who had undergone preoperative breast MRI and 2,175 who did not find that preoperative breast MRI was not associated with improvement in surgical outcomes. Specifically, preoperative breast MRI was not associated with improvement in rate of re-excision and was associated with significantly increased odds of having initial mastectomy (odds ratio 1.72, P = .0012) [71]. Although tumor size was not reported in the meta-analysis, the authors indicated that they perceived that size at MRI did not correlate well with exact tumor size measurement at pathology suggesting that some patients who were converted to initial mastectomy based on MRI findings may have done so based on overestimates of tumor size [71,73].

MRI Breast Without IV Contrast

There is no evidence to support the use of MRI breast without IV contrast for initial imaging of newly diagnosed DCIS.

Sestamibi MBI

Currently, there is insufficient evidence to support the use of sestamibi molecular breast imaging (MBI) for initial imaging of newly diagnosed DCIS; however, there is developing data from small studies and the science is evolving.

The sensitivity of MBI in detecting DCIS may be similar to mammography and breast MRI. A meta-analysis of 19 studies evaluating MBI used as an adjunct to mammography found a pooled sensitivity of 88% for detecting DCIS, similar to mammography and breast MRI [74]. In a retrospective study of 33 patients, the pattern of uptake for DCIS lesions at MBI correlated well with mammography, with MBI demonstrating improved assessment of local disease extent [75].

Regarding use of MBI to evaluate for residual disease, MBI may show similar disease extent as breast MRI before neoadjuvant chemotherapy (NAC), and MBI may be an alternative to breast MRI [76]. Defining the extent of residual disease compared with pathologic evaluation also was limited after NAC for both breast MRI and MBI. A study of patients after NAC found that 56 women had residual invasive disease or DCIS, and post–NAC findings were positive in 82% of MRI patients and 59% of MBI examinations, yielding false-negative rates of 18% by MRI and 41% by MBI [76]. Neither breast MRI nor MBI showed sufficient accuracy after NAC in predicting breast pathologic complete response to obviate tissue diagnosis to assess for residual invasive disease [76].

US Breast

Diagnostic mammography, and possibly US, are often used to evaluate tumor size and extent of disease during the initial diagnostic workup and before pathological diagnosis. DCIS may present on US as a mass, nonmass lesion, or ductal dilatation. US most commonly demonstrates pure DCIS lesions (86%), including 13% of cases of clinically and mammographically occult pure DCIS [77]. Approximately 6% to 23% of DCIS lesions are not detected by mammography, some of which could be identified with US and/or breast MRI [35,61,78].

DCIS with microcalcifications on mammography demonstrate US findings in 80% of cases, most commonly heterogeneous hyper- or isoechoic parenchyma with intralesional microcalcifications and without posterior acoustic features [77]. DCIS without microcalcifications on mammography has shown positive US findings in 98% of cases, most commonly masses with round or oval shape, microlobulated margins, parallel orientation, heterogeneous mild hypoechogenicity, and posterior acoustic features [77]. Ductal dilatation and intralesional cystic foci were present in 18% and 24% of pure DCIS, respectively [77].

In an analysis of 809 DCIS lesions surgically treated across 16 institutions, 705 (87%) were seen by US, with the most common US imaging findings of DCIS being nonmass abnormalities (64%), such as hypoechoic areas in the mammary gland (49%) and ductal abnormalities (10%), followed by masses (36%) [79].

Given the increased awareness of the limited sensitivity of screening mammography for women with dense breasts, whole breast screening US has emerged as a supplemental screening tool [80]. This section was previously described in the ACR Appropriateness Criteria® topic on "Supplemental Breast Cancer Screening Based on Breast Density" [81].

The increasing use of breast US in screening has resulted in DCIS being detected by US alone. In this clinical scenario, DCIS commonly presents as cystic or solid localized lesions, often of low grade [82].

The incremental cancer detection of US appears to be maintained after patients undergo tomosynthesis. A trial of 3,231 women found that screening US identified 3.4 per 1,000 cancers after patients underwent tomosynthesis, with 4% of these lesions being DCIS [83]. A trial of 7,146 paired tomosynthesis and US examinations found a supplemental cancer detection rate after tomosynthesis of 2.4 per 1,000 (positive predictive value 19.8%), with 4% of these lesions being DCIS [84].

US has demonstrated a lower sensitivity than breast MRI for the detection of DCIS ($P < .001$) and a lower sensitivity for the detection of DCIS compared to invasive carcinoma [52].

Variant 2: Adult. Newly diagnosed DCIS. No surgical intervention. Active surveillance.

It is estimated that 20% to 30% of DCIS will progress to invasive breast cancer if not treated [31]. Predicting which patients will progress to invasive cancer is limited by a lack of natural history data for DCIS. Consequently, active surveillance as an alternative management strategy to de-escalate treatment and to reduce overtreatment in patients with newly diagnosed low-risk DCIS is under evaluation. Instead of upfront surgery and possible RT, patients undergo close mammographic follow-up and may receive the potential addition of endocrine therapy for hormone receptor–positive DCIS. To potentially de-escalate the treatment of patients with low-risk DCIS, there are ongoing randomized multicenter trials designed to determine the risk of enrolling patients with possible occult invasive disease and how to identify those lesions that will progress to invasive disease [29-32]. Patients of screening-age with DCIS detected as asymptomatic calcifications without associated invasive cancer and those with low or low and intermediate nuclear grade DCIS are eligible for the trials [29-32]. All patients who undergo active surveillance are at risk of progression to invasive cancer. Close imaging surveillance (mammography every 6-12 months) is designed to detect progression to invasive cancer as soon as possible and not affect patient prognosis [2]. The results of these prospective active surveillance DCIS trials will not be available for 10 to 20 years [85].

CT Chest With IV Contrast

There is no evidence to support the use of CT of the chest with IV contrast in active surveillance in patients with newly diagnosed DCIS.

CT Chest Without and With IV Contrast

There is no evidence to support the use of CT of the chest without and with IV contrast in active surveillance in patients with newly diagnosed DCIS.

CT Chest Without IV Contrast

There is no evidence to support the use of CT of the chest without IV contrast in active surveillance in patients with newly diagnosed DCIS.

Digital Breast Tomosynthesis Diagnostic

In a retrospective study consisting of 29 patients with DCIS who underwent active surveillance [86], the 29 patients were divided into 2 groups. Group 1 consisted of 22 (75.9%) nontrial active surveillance patients who refused surgery or were not surgical candidates, and of those patients 16 (72.7%) received hormonal therapy (9 letrozole, 7 tamoxifen) and 6 (27.3%) did not. In Group 1, 86% (19/22) of the patients presented with calcifications on

diagnostic mammography with a mean long-axis length of 3.4 cm (range 0.3-8.0 cm). Two of the DCIS cases were detected on high-risk screening MRI that presented as clumped morphologies and multiple or regional distributions. Group 2 consisted of 7 (24.1%) patients who were enrolled in a trial of letrozole and deferred surgical excision for 6 to 12 months. In Group 2, all patients presented with calcifications and the mean long-axis length was 4.7 cm (range 2.6-10.4 cm). The authors reported that the imaging follow-up in Group 1 was nonstandardized, but all patients underwent at least a yearly 2-D mammography with a directed US (50%, 11/22) or an MRI (55%, 12/22) performed at the discretion of the surgical oncologist or radiologist [86]. In Group 2, all patients were scheduled for mammography and MRI according to the study protocol [87]. The median follow-up for Group 1 was 2.7 years (range 0.6-13.9 years). Of the patients in Group 1, 15 (68%) had stable imaging, whereas 7 (32%) patients underwent additional biopsies that yielded invasive ductal carcinoma in 2 patients after 3.9 and 3.6 years who developed increasing calcifications and new masses, respectively. On surgical excision, 1 (14%) patient in Group 2 was upstaged to DCIS with microinvasion, whereas the other 6 patients had only DCIS on final pathology. Between the patients in both groups with mammographic calcifications (n = 26), there was no progression to invasive disease among those with stable (50%, 13/26) or decreased (19%, 5/26) calcifications [86].

A total of 79 patients were enrolled in a phase II single-arm multicenter cooperative-group (CALGB 40903) trial conducted in postmenopausal patients diagnosed with ER-positive DCIS without invasion and treated with letrozole 2.5 mg/day for 6 months before surgery [87]. Mammography (digital 2-view bilateral mammograms for each breast with additional images as deemed necessary by the breast radiologist) was obtained at baseline and repeated after 6 months or within 4 weeks before surgical excision. Assessment of mammographic disease was based exclusively on total extent of calcifications (patients with a mass associated with DCIS were excluded from the trial). As part of the study protocol, contrast-enhanced bilateral breast MRI was also obtained at baseline and repeated after 3 months and 6 months. The results demonstrated that, in 54 patients with both baseline and 6-month mammograms, the median reduction in extent of disease was 5.0 mm (14.5%; interquartile range 10.8; $P = .007$). In 67 patients with data from all MRI study time points, the baseline MRI volumes ranged from 0.004 to 26.3 cm^3. Median reductions from baseline MRI volume (1.4 cm^3) were 0.6 cm^3 (61.0%) at 3 months ($P < .001$) and 0.8 cm^3 (71.7%) at 6 months ($P < .001$) [88]. Of the 59 patients who underwent surgery per study protocol, 50 (85%) patients had residual DCIS, invasive cancer was detected in 6 (10%) patients, and 9 (15%) patients had pathologic complete response on final pathology [88]. There was no significant correlation observed between baseline mammographic maximum extent and pathologic DCIS size or between baseline MRI maximum diameter and pathologic DCIS size. However, significant correlation was observed between 6-month MRI maximum diameter and pathologic DCIS size ($P = .001$) [88].

FDG-PET Breast Dedicated

There is no evidence to support the use of dedicated FDG-PET of the breast in active surveillance in patients with newly diagnosed DCIS.

Mammography Diagnostic

In a retrospective study consisting of 29 patients with DCIS who underwent active surveillance [86], the 29 patients were divided into 2 groups. Group 1 consisted of 22 (75.9%) nontrial active surveillance patients who refused surgery or were not surgical candidates, and of those patients 16 (72.7%) received hormonal therapy (9 letrozole, 7 tamoxifen) and 6 (27.3%) did not. In Group 1, 86% (19/22) of the patients presented with calcifications on diagnostic mammography with a mean long-axis length of 3.4 cm (range 0.3-8.0 cm). Two of the DCIS cases were detected on high-risk screening MRI that presented as clumped morphologies and multiple or regional distributions. Group 2 consisted of 7 (24.1%) patients who were enrolled in a trial of letrozole and deferred surgical excision for 6 to 12 months. In Group 2, all patients presented with calcifications and the mean long-axis length was 4.7 cm (range 2.6-10.4 cm). The authors reported that the imaging follow-up in Group 1 was nonstandardized, but all patients underwent at least a yearly 2-D mammography with a directed US (50%, 11/22) or an MRI (55%, 12/22) performed at the discretion of the surgical oncologist or radiologist [86]. In Group 2, all patients were scheduled for mammography and MRI according to the study protocol [87]. The median follow-up for Group 1 was 2.7 years (range 0.6-13.9 years). Of the patients in Group 1, 15 (68%) had stable imaging, whereas 7 (32%) patients underwent additional biopsies that yielded invasive ductal carcinoma in 2 patients after 3.9 and 3.6 years who developed increasing calcifications and new masses, respectively. On surgical excision, 1 (14%) patient in Group 2 was upstaged to DCIS with microinvasion, whereas the other 6 patients had only DCIS on final pathology. Between the patients in both groups with mammographic calcifications (n = 26), there was no progression to invasive disease among those with stable (50%, 13/26) or decreased (19%, 5/26) calcifications [86].

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Mammography With IV Contrast
There is no evidence to support the use of mammography with IV contrast in active surveillance in patients with newly diagnosed DCIS.

MRI Breast Without and With IV Contrast
There is limited evidence to support the use of breast MRI without and with IV contrast in active surveillance in patients with newly diagnosed DCIS.

A total of 79 patients were enrolled in a phase II single-arm multicenter cooperative-group (CALGB 40903) trial conducted in postmenopausal patients diagnosed with ER-positive DCIS without invasion and treated with letrozole 2.5 mg/day for 6 months before surgery [87]. Mammography (digital 2-view bilateral mammograms for each breast with additional images as deemed necessary by the breast radiologist) was obtained at baseline and repeated after 6 months or within 4 weeks before surgical excision. Assessment of mammographic disease was based exclusively on total extent of calcifications (patients with a mass associated with DCIS were excluded from the trial). As part of the study protocol, contrast-enhanced bilateral breast MRI was also obtained at baseline and repeated after 3 months and 6 months. The results demonstrated that, in 54 patients with both baseline and 6-month mammograms, the median reduction in extent of disease was 5.0 mm (14.5%; interquartile range 10.8; $P = .007$). In 67 patients with data from all MRI study time points, the baseline MRI volumes ranged from 0.004 to 26.3 cm^3. Median reductions from baseline MRI volume (1.4 cm^3) were 0.6 cm^3 (61.0%) at 3 months ($P < .001$) and 0.8 cm^3 (71.7%) at 6 months ($P < .001$) [88]. Of the 59 patients who underwent surgery per study protocol, 50 (85%) patients had residual DCIS, invasive cancer was detected in 6 (10%) patients, and 9 (15%) patients had pathologic complete response on final pathology [88]. There was no significant correlation observed between baseline mammographic maximum extent and pathologic DCIS size or between baseline MRI maximum diameter and pathologic DCIS size. However, significant correlation was observed between 6-month MRI maximum diameter and pathologic DCIS size ($P = .001$) [88].

Because mammography has been reported to underestimate the extent of DCIS, breast MRI may be especially useful for evaluating patients with DCIS [58]. When used in conjunction with mammography, breast MRI has the potential to guide clinical management of DCIS, however, long-term clinical outcome data are lacking [67,68,70,71].

MRI Breast Without IV Contrast
There is no evidence to support the use of breast MRI without IV contrast in active surveillance in patients with newly diagnosed DCIS.

Sestamibi MBI
There is no evidence to support the use of sestamibi MBI in active surveillance in patients with newly diagnosed DCIS.

US Breast
There is no evidence to support the use of US breast in active surveillance in patients with newly diagnosed DCIS.

Variant 3: Adult. Evaluation for local recurrence in patient with history of breast conservation therapy for DCIS. Routine surveillance.

The aim of surveillance is to detect local recurrence and/or second breast cancers before symptoms develop. A retrospective review of 513 women treated for DCIS with BCS and whole-breast RT found that 8% subsequently developed an ipsilateral breast tumor recurrence (mean time to recurrence was 4.5 years), with 91% exclusively diagnosed on mammography, 6% diagnosed by both palpation and mammography, and 3% diagnosed as Paget's disease on physical examination [89]. In this study, 75% of recurrences presented mammographically as microcalcifications, and 80% of the patients who presented initially with microcalcifications had a subsequent recurrence manifested by microcalcifications [89]. In 94%, the recurrent tumor calcifications had a morphology similar to the initial DCIS [89]. Recurrences were overwhelmingly minimal cancers (91%) and presented as pure DCIS (53%), DCIS with microinvasion (19%), invasive ductal carcinoma (9%), invasive lobular carcinoma (6%), and DCIS with invasive cancer (13%), of which 53% were stage 0 and 47% were stage 1 [89]. The mean time to recurrence for all patients was 4.5 years, similar for noninvasive and invasive second cancers (3.8 and 5.2 years, respectively, $P = .14$) [89].

A retrospective review of 162 women with DCIS treated with breast-conserving therapy found 20% of patients had a pathologically proven carcinoma in the treated breast, with median interval from diagnosis of the original DCIS to local recurrence of 26 months (range 6-168 months) [90]. Recurrences were detected solely by mammography in 17 (85%) of 20 patients, by mammography and physical examination in 2 (10%) patients, and solely by physical examination in 1 (5%) patient [90]. Eighteen (90%) local recurrence contained calcifications and 18 (90%) involved the lumpectomy quadrant. The mammographic pattern and calcification morphology were the same in 11 (79%) of 14 DCIS and 9 (82%) of 11 DCIS, respectively [90]. Local recurrence after breast-conserving therapy for DCIS invariably contained DCIS, and 35% of recurrences also contained invasive carcinoma [90].

A study of 9,191 women diagnosed with and treated for DCIS in England and followed for over 9 years found that 7% developed DCIS or invasive malignancy in the ipsilateral and 5% in the contralateral breast [91]. For patients with recurrent cancer, invasive disease was more common than DCIS both for ipsilateral and contralateral recurrent events [91].

The annual risk of developing an invasive recurrence is estimated at 0.86% (ipsilateral 0.53%, contralateral 0.30%) [92]. Patients may have a significantly higher risk of developing ipsilateral invasive cancer if DCIS was treated with wide local excision compared to mastectomy (0.69% versus 0.22%, $P < .0001$) [92].

For women with DCIS and second cancer events, the recurrences were essentially split between in situ (52%) and invasive (48%) disease and ipsilateral (52%) and contralateral (48%) location, noting that ipsilateral recurrences were more common among women treated with BCS without RT (82%) [93].

The risk of recurrence after BCS for DCIS is low. Approximately 13% of patients receiving RT for DCIS developed ipsilateral recurrence at 10 years, and 28% of patients treated by lumpectomy alone [94]. The annualized recurrence rate for DCIS across several large trials with an average follow up of 4 to 11 years varied from 2% to 4.6% for those treated with surgery and 1.4% to 2.5% for those treated with surgery and RT [95]. Results from meta-analysis studies demonstrate an association between high-grade DCIS having an increased risk of ipsilateral recurrence compared to low-grade DCIS [96,97].

Long-term survival is improved by early detection of local recurrence of breast cancer, so evaluation for local recurrence in patients with a history of breast conservation therapy is advised [98].

CT Chest With IV Contrast

There is no evidence to support the use of CT chest with IV contrast for routine surveillance evaluation for local recurrence in patients with a history of breast conservation therapy for DCIS.

CT Chest Without and With IV Contrast

There is no evidence to support the use of CT chest without and with IV contrast for routine surveillance evaluation for local recurrence in patients with a history of breast conservation therapy for DCIS.

CT Chest Without IV Contrast

There is no evidence to support the use of CT chest without IV contrast for routine surveillance evaluation for local recurrence in patients with a history of breast conservation therapy for DCIS.

Digital Breast Tomosynthesis Diagnostic

This section was previously described in the ACR Appropriateness Criteria® topic on "Imaging After Breast Surgery" [99]. NCCN and American Society of Radiology Oncology (ASTRO) guidelines advise surveillance/imaging follow-up of postsurgical DCIS, which includes mammography every 12 months with the first mammogram occurring 6 to 12 months after breast conservation therapy [27]. Patients treated with breast-conserving therapy should have their first posttreatment mammogram no earlier than 6 months after definitive RT. Subsequent mammograms should be obtained every 6 to 12 months for surveillance of abnormalities. The ASCO Practice Guidelines for Breast Cancer Follow-Up and Management After Primary Treatment advise that mammography should be performed yearly if stability of mammographic findings is achieved after completion of locoregional therapy [100,101].

For this clinical scenario, annual mammography is a helpful surveillance imaging test because it is associated with a reduction of mortality compared to patients who do not undergo annual mammography [102,103]. For patients with a personal history of breast cancer, the most common presentation of a recurrent or second breast cancer is an abnormal mammogram in an otherwise asymptomatic patient [99,104-106]. Mammography detects approximately 91% to 97% of cases of recurrent DCIS after BCS and can be used for the routine surveillance for local recurrence in a patient with a history of breast conservation therapy for DCIS [89]. Of these, 75% of cases of recurrent DCIS presented mammographically as microcalcifications, and 80% of the patients whose initial DCIS presented with microcalcifications will have a recurrence manifested by microcalcifications [89]. In 94%, the recurrent tumor calcifications had a morphology similar to the initial DCIS [89]. In 60% to 90% of cases, recurrences are in the same quadrant [89,90].

The ACR Practice Parameter for the Performance of Screening and Diagnostic Mammography provides guidance for patients with a history of breast cancer [107]. Surveyed radiologists varied on their recommendation of diagnostic versus screening mammography for patients treated with breast conservation therapy with most (79%) recommending at least 1 diagnostic mammogram, 49% recommending diagnostic mammography up to 2 years, and 33% recommending diagnostic mammography from for 2 to 5 years [108].

Digital Breast Tomosynthesis Screening

This section was previously described in the ACR Appropriateness Criteria® topic on "Imaging After Breast Surgery" [99]. NCCN and ASTRO guidelines advise surveillance/imaging follow-up of postsurgical DCIS, which includes mammography every 12 months with the first mammogram occurring 6 to 12 months after breast conservation therapy [27]. Patients treated with breast-conserving therapy should have their first posttreatment mammogram no earlier than 6 months after definitive RT. Subsequent mammograms should be obtained every 6 to 12 months for surveillance of abnormalities. The ASCO Practice Guidelines for Breast Cancer Follow-Up and Management After Primary Treatment advise that mammography should be performed yearly if stability of mammographic findings is achieved after completion of locoregional therapy [100,101].

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The addition of DBT to 2-D digital mammography or 2-D synthetic images in the surveillance of patients with breast cancer history has been shown to reduce recall rates and indeterminate findings and no significant change in cancer detection rate [109-111].

FDG-PET Breast Dedicated

There is no evidence to support the use of FDG-PET breast dedicated for routine surveillance evaluation for local recurrence in patients with a history of breast conservation therapy for DCIS.

Mammography Diagnostic

This section was previously described in the ACR Appropriateness Criteria® topic on "Imaging After Breast Surgery" [99]. NCCN and ASTRO guidelines advise surveillance/imaging follow-up of postsurgical DCIS, which includes mammography every 12 months with the first mammogram occurring 6 to 12 months after breast conservation therapy [27]. Patients treated with breast-conserving therapy should have their first posttreatment mammogram no earlier than 6 months after definitive RT. Subsequent mammograms should be obtained every 6 to 12 months for surveillance of abnormalities. The ASCO Practice Guidelines for Breast Cancer Follow-Up and Management After Primary Treatment advise that mammography should be performed yearly if stability of mammographic findings is achieved after completion of locoregional therapy [100,101].

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The ACR Practice Parameter for the Performance of Screening and Diagnostic Mammography provides guidance for patients with a history of breast cancer [107]. Surveyed radiologists varied on their recommendation of diagnostic versus screening mammography for patients treated with breast conservation therapy with most (79%) recommending at least 1 diagnostic mammogram, 49% recommending diagnostic mammography up to 2 years, and 33% recommending diagnostic mammography from for 2 to 5 years [108].

For patients with invasive breast cancer, there is limited data to support more frequent imaging of the ipsilateral breast, with a study suggesting diagnosis of second cancer at a lower stage, but this could have been to less than expected compliance of the annual surveillance group [113]. The addition of DBT to 2-D digital mammography or 2-D synthetic images in the surveillance of patients with breast cancer history has been shown to reduce recall rates and indeterminate findings and no significant change in cancer detection rate [109-111].

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For this clinical scenario, annual mammography is a helpful surveillance imaging test because it is associated with a reduction of mortality compared to women who do not undergo annual mammography [102,103]. For patients with a personal history of breast cancer, the most common presentation of a recurrent or second breast cancer is an abnormal mammogram in an otherwise asymptomatic patient [99,104-106]. Mammography detects approximately 91% to 97% of cases of recurrent DCIS after BCS and can be used for the routine surveillance for local recurrence in a patient with history of breast conservation therapy for DCIS [89]. Of these, 75% of cases of recurrent DCIS presented mammographically as microcalcifications, and 80% of the patients whose initial DCIS presented with microcalcifications will have a recurrence manifested by microcalcifications [89]. In 94%, the recurrent tumor

calcifications had a morphology similar to the initial DCIS [89]. In 60% to 90% of cases, recurrences are in the same quadrant [89,90].

The ACR Practice Parameter for the Performance of Screening and Diagnostic Mammography provides guidance for patients with a history of breast cancer [107]. Surveyed radiologists varied on their recommendation of diagnostic versus screening mammography for patients treated with breast conservation therapy with most (79%) recommending at least 1 diagnostic mammogram, 49% recommending diagnostic mammography up to 2 years, and 33% recommending diagnostic mammography from for 2 to 5 years [108].

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Mammography With IV Contrast
There is insufficient evidence to support routine use of mammography with IV contrast for routine surveillance evaluation for local recurrence in patients with a history of breast conservation therapy for DCIS.

Mammography with IV contrast performs a low-energy mammogram equivalent to a mammogram without IV contrast, which can identify most cases of recurrent DCIS after BCS. However, only a few studies have evaluated the use of mammography with IV contrast for the routine evaluation for local recurrence in patients with history of breast conservation therapy for DCIS.

MRI Breast Without and With IV Contrast
There is insufficient literature to support the routine use of MRI breast without and with IV contrast in this clinical scenario. However, high-risk patients who have undergone breast conservation therapy for DCIS may benefit from MRI high-risk surveillance of the breast, see the ACR Practice Parameter for the Performance of Contrast-Enhanced Magnetic Resonance Imaging (MRI) of the Breast [114].

MRI Breast Without IV Contrast
There is no evidence to support the use of MRI breast without IV contrast for routine surveillance evaluation for local recurrence in patients with history of breast conservation therapy for DCIS.

Sestamibi MBI
There is no evidence to support the use of sestamibi MBI for routine surveillance evaluation for local recurrence in patients with a history of breast conservation therapy for DCIS.

US Breast
There is no evidence to support the routine use of breast US for routine surveillance evaluation for local recurrence in patients with history of breast conservation therapy for DCIS.

Variant 4: Adult. Evaluation for ipsilateral local recurrence in a patient with history of mastectomy for DCIS. Routine surveillance.

All forms of mastectomy leave residual breast tissue, and the amount of residual breast tissue can be variable. In a retrospective study using breast MRI that evaluated residual breast tissue after mastectomy in 367 women who had undergone therapeutic or prophylactic mastectomy with reconstruction, for a total of 501 cases, residual breast tissue was identified in 29.9% of the cases: 21.3% of the therapeutic mastectomy cases and 51% of the nipple-sparing mastectomy cases [115]. A prospective study evaluating the amount of residual breast tissue in 160 cases, either curative (n = 109) or risk-reducing (n = 51) indication, with predetermined biopsies from the skin envelope, demonstrated residual breast tissue was detected in 82 (51.3%) mastectomies, and the median residual breast tissue per breast was 7.1% [116]. Residual breast tissue especially behind the nipple is a frequent finding for nipple-sparing mastectomy [116].

The rates of locoregional recurrence after mastectomy for DCIS range from 1% to 3% after 10 years [117-120]. Most local recurrences are invasive breast cancer detected clinically as a chest wall mass [117,120]. Recurrences have been reported to be associated with younger age, higher grade DCIS with necrosis, and multifocal or multicentric disease [117,120].

Locoregional recurrence is often detected clinically after mastectomy. For this reason, ASCO recommends frequent clinical surveillance with physical examination and history every 3 to 12 months for the first 5 years after mastectomy, followed by annual clinical examination in subsequent years [100].

CT Chest With IV Contrast
In asymptomatic patients with a history of mastectomy for DCIS, there is no evidence to support the use of CT chest with IV contrast for evaluation of local recurrence.

ASCO, NCCN, and European Socitey for Medical Oncology (ESMO) all recommend against the use of CT imaging [100,121,122] to screen for local recurrence after mastectomy.

CT Chest Without and With IV Contrast
In asymptomatic patients with a history of mastectomy for DCIS, there is no evidence to support the use of CT chest without and with IV contrast for evaluation of local recurrence.

ASCO, NCCN, and ESMO all recommend against the use of CT imaging [100,121,122] to screen for local recurrence after mastectomy.

CT Chest Without IV Contrast
In asymptomatic patients with a history of mastectomy for DCIS, there is no evidence to support the use of CT chest without IV contrast for evaluation of local recurrence.

ASCO, NCCN, and ESMO all recommend against the use of CT imaging [100,121,122] to screen for local recurrence after mastectomy.

Digital Breast Tomosynthesis Screening
There is no evidence to support the use of DBT to evaluate for local recurrence after mastectomy.

FDG-PET Breast Dedicated
There is no evidence to support the use of dedicated breast FDG-PET to evaluate for local recurrence after mastectomy.

Mammography Screening
There is no evidence to support the use of mammography screening to evaluate for local recurrence after mastectomy.

Mammography With IV Contrast
There is no evidence to support the use of mammography with IV contrast to evaluate for local recurrence after mastectomy.

MRI Breast Without and With IV Contrast
There is insufficient literature to support the use of breast MRI to evaluate for local recurrence after mastectomy. A single, retrospective study consisting of 402 asymptomatic mastectomy cases that underwent MRI, the cancer detection rate in the asymptomatic mastectomy side was 10/1,000. The reported sensitivity, specificity, positive predictive value, and negative predictive value of surveillance MRI was 66.7%, 99.2%, 57.1%, and 99.5%, respectively [123]. None of the recurrences were in the 33% patients who underwent mastectomy for DCIS [123].

ASCO, NCCN, and ESMO all recommend against the use of MRI [100,121,122] to screen for local recurrence after mastectomy.

MRI Breast Without IV Contrast
There is no evidence to support the use of breast MRI without IV contrast to evaluate for local recurrence after mastectomy.

ASCO, NCCN, and ESMO all recommend against the use of MRI [100,121,122] to screen for local recurrence after mastectomy.

Sestamibi MBI
There is no evidence to support the use of sestamibi MBI to evaluate for local recurrence after mastectomy.

US Breast
There is insufficient literature to support the use of US to evaluate for local recurrence after mastectomy.

One study consisting of 1,180 consecutive US screenings were performed for mastectomy sites and ipsilateral axillary fossae in 468 asymptomatic patients who had undergone mastectomy for breast cancer. Of the 468 patients, 19 (4.1%) had "suspicious for malignant nodules"; of these lesions, 10 (52.6%) were malignant. The sensitivity and specificity were 90.9% and 98.0%, respectively. The biopsy positive predictive value was 52.6%. The cancer detection rates with US screening of the mastectomy site and ipsilateral axillary fossae were 2.1%. The US features most common of occult recurrence at the mastectomy sites were irregular shape, not circumscribed, and hypoechoic mass with intratumoral vascularity. In addition, the authors reported that most recurrences were within the deep muscle layer [124].

Variant 5: Adult. Suspected local recurrence based on symptoms, physical examination, or laboratory value in patient with a history of breast conservation therapy for DCIS. Initial imaging.

Patients with a history of breast conservation therapy for DCIS are at risk of subsequent development of DCIS and invasive breast cancer. A study of 9,191 women diagnosed with and treated for DCIS in England and followed for over 9 years found that 7% developed DCIS or invasive malignancy in the ipsilateral and 5% in the contralateral breast [91]. For patients with recurrent cancer, invasive disease was more common than DCIS both for ipsilateral and contralateral recurrent events [91].

The annual risk of developing an invasive recurrence is estimated at 0.86% (ipsilateral 0.53%, contralateral 0.30%) [92]. Patients may have a significantly higher risk of developing ipsilateral invasive cancer if DCIS was treated with wide local excision compared to mastectomy (0.69% versus 0.22%, $P < .0001$) [92].

Although there is limited data to describe the clinical presentations of patients with suspected local recurrence after a history of breast conservation therapy for DCIS, the clinical presentation is likely to be similar to the initial presentations of symptomatic DCIS or invasive cancer, such as palpable lump, spontaneous nipple discharge from a single duct, Paget's disease, and palpable thickening [42].

CT Chest With IV Contrast

There is no evidence to support the use of CT chest with IV contrast for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

CT Chest Without and With IV Contrast

There is no evidence to support the use of CT chest without and with IV contrast for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

CT Chest Without IV Contrast

There is no evidence to support the use of CT chest without IV contrast for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

Digital Breast Tomosynthesis Diagnostic

The conventional workup usually involves an overview examination evaluating both breasts, commonly performed as a diagnostic bilateral mammogram or DBT examination, followed by US for more focused evaluation of the area of concern, when applicable. This topic was previously described in the ACR Appropriateness Criteria® topics on "Palpable Breast Masses" [125] and "Breast Pain" [126].

Palpable DCIS is visible on mammography in approximately 81% of cases; compared with ER-positive noncalcified DCIS, ER-negative noncalcified DCIS is less likely to be visible on mammography [42].

The typical appearance of suspicious calcifications in isolated DCIS may be more commonly assessed as BI-RADS 5 (highly suggestive of malignancy) on mammography (87%) compared to on US (33%) [36]. Compared to invasive breast cancer, mammographic size of DCIS demonstrates high correlation with pathologic size [43]. It should be noted that measurement of the DCIS component of malignancies as seen on imaging may differ from estimates reported by pathology because pathology measurements may not include the DCIS components seen on tomosynthesis and mammography [44,45].

FDG-PET Breast Dedicated
There is no evidence to support the use of FDG-PET breast dedicated for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

Image-Guided Core Biopsy Breast
There is no evidence to support the use of image-guided core biopsy breast for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

If suspicious lesions are identified on mammography and US, image-guided CNB can be beneficial over fine-needle aspiration (FNA) [127].

Image-Guided Fine Needle Aspiration Breast
There is no evidence to support the use of image-guided FNA breast for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

If suspicious lesions are identified on mammography and US, image-guided CNB can be beneficial over FNA [127].

Mammography Diagnostic
The conventional workup usually involves an overview examination evaluating both breasts, commonly performed as a diagnostic bilateral mammogram or DBT examination, followed by US for more focused evaluation of the area of concern, when applicable. This topic was previously described in the ACR Appropriateness Criteria® topics on "Palpable Breast Masses" [125] and "Breast Pain" [126].

Diagnostic mammography is highly accurate in identifying local recurrence in patients with a history of breast conservation therapy for DCIS. A meta-analysis of 9 studies evaluating the diagnostic accuracy of surveillance mammography for detecting ipsilateral breast tumor recurrence and metachronous contralateral breast cancer in patients previously treated for primary breast cancer found the sensitivity of mammography for routine surveillance ranged from 64% to 67% and specificity ranged from 85% to 97%, but was lower, 50% to 83% and 57% to 75%, respectively for patients undergoing nonsurveillance imaging after having a test suspicious for recurrence. Authors noted that although mammography is associated with high sensitivity and specificity, MRI is the most accurate test for detecting ipsilateral breast tumor recurrence and metachronous contralateral breast cancer in women previously treated for primary breast cancer [128].

Mammography With IV Contrast
There is insufficient evidence to support routine use of mammography with IV contrast for initial imaging in setting of suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

MRI Breast Without and With IV Contrast
Although MRI does have a higher sensitivity for malignancy than diagnostic mammography, evidence does not support the use of MRI in cases of a palpable breast mass without corresponding suspicious finding on mammography or US [129-131].

DCIS typically presents on MRI breast with IV contrast as nonmass enhancement (60%) but may also be seen as a mass (31%) or focus (9%) [59]. Morphology of DCIS on breast MRI is significantly correlated with enhancement kinetics, with nonmass enhancement more likely demonstrating medium and persistent kinetics, and foci or masses demonstrating rapid and plateau or washout kinetics ($P < .05$) [59]. DCIS lesions <1.5 cm are more likely to have rapid initial enhancement ($P = .004$) [59]. Both calcified and noncalcified DCIS demonstrate similar appearances on breast MRI [59].

Because mammography has been reported to underestimate the extent of DCIS, breast MRI may be especially useful for evaluating patients with DCIS [58].

MRI Breast Without IV Contrast
There is no evidence to support the use of MRI breast without IV contrast for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

Sestamibi MBI
There is no evidence to support the use of sestamibi MBI for initial imaging for suspected local recurrence based on symptoms, physical examination, or laboratory value in patients with history of breast conservation therapy for DCIS.

US Breast
Diagnostic mammography, and possibly US, are often used to evaluate tumor size and extent of disease during the diagnostic workup of a clinically suspicious finding and prior to pathological diagnosis. US breast demonstrates a high sensitivity in evaluating palpable clinical findings and can identify masses, nonmass lesions, or ductal dilatation associated with recurrent cancer. The sensitivity and specificity of US breast may vary widely in the evaluation of the postoperative breast. A meta-analysis of 9 studies evaluating the diagnostic accuracy of US breast for detecting ipsilateral breast tumor recurrence and metachronous contralateral breast cancer in patients previously treated for primary breast cancer found the sensitivity of US breast to range from 43% to 87% and specificity from 31% to 73% for patients undergoing nonsurveillance imaging after having a test suspicious for recurrence [128].

Variant 6: Adult. Suspected local recurrence based on symptoms, physical examination, or laboratory value in patient with history of mastectomy for DCIS. Initial imaging.

All forms of mastectomy leave residual breast tissue, and the amount of residual breast tissue can be variable. In a retrospective study using breast MRI that evaluated residual breast tissue after mastectomy in 367 women who had undergone therapeutic or prophylactic mastectomy with reconstruction, for a total of 501 cases, residual breast tissue was identified in 29.9% of the cases: 21.3% of the therapeutic mastectomy cases and 51% of the nipple-sparing mastectomy cases [115]. A prospective study evaluating the amount of residual breast tissue in 160 cases, either curative (n = 109) or risk-reducing (n = 51) indication with predetermined biopsies from the skin envelope, demonstrated residual breast tissue was detected in 82 (51.3%) mastectomies, and the median residual breast tissue per breast was 7.1% [116]. Residual breast tissue especially behind the nipple is a frequent finding for nipple-sparing mastectomy [116].

The rates of locoregional recurrence after mastectomy for DCIS range from 1% to 3% after 10 years [117-120]. Most local recurrences are invasive breast cancer detected clinically as a chest wall mass [117,120]. Recurrences have been reported to be associated with younger age, higher grade DCIS with necrosis, and multifocal or multicentric disease [117,120].

CT Chest With IV Contrast
There is no evidence to support the use of CT chest with IV contrast as the initial imaging test for evaluation of suspected local recurrence in a patient with history of mastectomy for DCIS.

CT Chest Without and With IV Contrast
There is no evidence to support the use of CT chest without and with IV contrast as the initial imaging test for evaluation of suspected local recurrence in a patient with history of mastectomy for DCIS.

CT Chest Without IV Contrast
There is no evidence to support the use of CT chest without IV contrast as the initial imaging test for evaluation of suspected local recurrence in a patient with history of mastectomy for DCIS.

Digital Breast Tomosynthesis Diagnostic
There is no evidence to support the use of DBT to evaluate suspected local recurrence in the setting of mastectomy unless the local recurrence suspected is in the axillary region or the patient has a history of breast reconstruction.

FDG-PET/CT Skull Base to Mid-Thigh
There is no evidence to support the use of FDG-PET/CT as the intial imaging test for evaluation of suspected local recurrence in the setting of mastectomy.

Image-Guided Biopsy Chest
There is no relevant literature to support US-guided sampling as the initial imaging test for suspected local recurrence in a patient with a history of mastectomy for DCIS.

US-guided biopsy is usually the next study performed when chest wall imaging is suspicious for local recurrence. US-guided biopsy is a minimally invasive procedure to obtain tissue for pathologic confirmation. US-guided CNB has increasing replaced FNA [132]. Pooled analysis show that the sensitivity of CNB is higher than that of FNA (87% versus 74%) and the specificity of CNB is similar to that of FNA cytology (98% versus 96%) [132]. However,

a negative result does not exclude carcinoma. The reported false-negative rate for US-guided sampling is ≤2% [133].

Image-Guided Fine Needle Aspiration Chest
There is no relevant literature to support US-guided sampling as the initial imaging test for suspected local recurrence in a patient with a history of mastectomy for DCIS.

US-guided biopsy is usually the next study performed when chest wall imaging is suspicious for local recurrence. US-guided biopsy is a minimally invasive procedure to obtain tissue for pathologic confirmation. US-guided CNB has increasing replaced FNA [132]. Pooled analysis show that the sensitivity of CNB is higher than that of FNA (87% versus 74%) and the specificity of CNB is similar to that of FNA cytology (98% versus 96%) [132]. However, a negative result does not exclude carcinoma. The reported false-negative rate for US-guided sampling is ≤2% [133].

Mammography Diagnostic
There is no evidence to support the use of diagnostic mammography to evaluate suspected local recurrence in the setting of mastectomy unless the local recurrence suspected is in the axillary region or the patient has a history of breast reconstruction.

Mammography With IV Contrast
There is no evidence to support the use of mammography with IV contrast to evaluate suspected local recurrence in the setting of mastectomy unless the local recurrence suspected is in the axillary region or the patient has a history of breast reconstruction.

MRI Breast Without and With IV Contrast
There is no evidence to support the use of breast MRI without and with IV contrast as the initial imaging test for evaluation of suspected recurrence in a patient with history of mastectomy for DCIS.

Although MRI does have a higher sensitivity for malignancy than diagnostic mammography, evidence does not support the use of MRI in cases of a palpable breast mass without corresponding suspicious finding on mammography or US [129-131].

MRI Breast Without IV Contrast
There is no evidence to support the use of breast MRI without IV in evaluating the suspected local recurrence in the setting of mastectomy.

US Breast
If there are symptoms suggesting a local recurrence such as a palpable mass or focal pain, US is used after diagnostic mammography (if warranted) for a full evaluation, This section was previously described in the ACR Appropriateness Criteria® topics on "Palpable Breast Masses" [125] and "Breast Pain" [126].

Variant 7: Adult. Known DCIS with microinvasion found on prior mammography, ultrasound, or MRI during initial evaluation. Axillary evaluation needed. Next imaging study.

DCIS with microinvasion is an uncommon pathologic entity accounting for approximately 1% of all breast cancer cases [12,134,135]. Microinvasive breast cancer is defined as malignant cells invading beyond the cellular basement membrane into adjacent breast tissue with no invasive focus >1 mm in the greatest dimension, and it is considered a subset of T1 disease in the AJCC staging system [136]. Because DCIS with microinvasion is uncommon and reported to have a low nodal involvement and a good prognosis, there is no expert consensus on evaluation of the axilla in these patients [12,19,135,137].

CT Chest With IV Contrast
There is no evidence to support the use of CT chest with IV contrast in axillary evaluation of DCIS with microinvasion.

CT Chest Without and With IV Contrast
There is no evidence to support the use of CT chest without and with IV contrast in axillary evaluation of DCIS with microinvasion.

CT Chest Without IV Contrast
There is no evidence to support the use of CT chest without IV contrast in axillary evaluation of DCIS with microinvasion.

Digital Breast Tomosynthesis Diagnostic
There is no evidence to support the use of DBT in axillary evaluation of DCIS with microinvasion.

FDG-PET/CT Whole Body
There is no evidence to support the use of FDG-PET/CT whole body in axillary evaluation of DCIS with microinvasion.

Lymphoscintigraphy Axilla
There is no evidence to support the use of axillary lymphoscintigraphy in axillary evaluation of DCIS with microinvasion.

Mammography With IV Contrast
There is no evidence to support the use of mammography with IV contrast in axillary evaluation of DCIS with microinvasion.

MRI Breast Without and With IV Contrast
There is no evidence to support the use of breast MRI without and with IV contrast in axillary evaluation of DCIS with microinvasion.

MRI Breast Without IV Contrast
There is no evidence to support the use of breast MRI without IV contrast in axillary evaluation of DCIS with microinvasion.

US Axilla
There is no evidence to support the use of US in axillary evaluation of DCIS with microinvasion.

US-Guided Core Biopsy Axillary Node
There is no relevant literature to support US-guided sampling for axillary lymph node evaluation in axillary evaluation of DCIS with microinvasion.

US-Guided Fine Needle Aspiration Biopsy Axillary Node
There is no relevant literature to support US-guided sampling for axillary lymph node evaluation in axillary evaluation of DCIS with microinvasion.

Variant 8: Adult. Known DCIS without microinvasion found on prior mammography, ultrasound, or MRI during initial evaluation. Axillary evaluation needed. Next imaging study.

Lymph node evaluation is important for breast cancer staging and management. It has evolved from axillary lymph node dissection to SLN biopsy. In patients diagnosed with DCIS undergoing SLNB during breast surgery (BCS or mastectomy), the incidence of nodal involvement is low (0%-14%) with most reported as micrometastases or isolated tumor cells [8-17].The clinical significance of these metastases is unknown [18]. The NCCN and ASCO currently recommend that complete axillary lymph node dissection should not be performed in the absence of evidence of invasive cancer or proven axillary metastatic disease in patients with apparent pure DCIS [121,138]. However, a small proportion of patients with apparent pure DCIS will be found to have invasive cancer at the time of their definitive surgical procedure. Therefore, the performance of a SLN procedure should be considered if the patient with apparent pure DCIS is to be treated with mastectomy or with excision in an anatomic location compromising the performance of a future SLN procedure [121].

CT Chest With IV Contrast
There is no evidence to support the use of CT chest with IV contrast in axillary evaluation of DCIS without microinvasion.

CT Chest Without and With IV Contrast
There is no evidence to support the use of CT of the chest without and with IV contrast in axillary evaluation of DCIS without microinvasion.

CT Chest Without IV Contrast
There is no evidence to support CT of the chest without IV contrast in axillary evaluation of DCIS without microinvasion.

Digital Breast Tomosynthesis Diagnostic
There is no evidence to support DBT in axillary evaluation of DCIS without microinvasion.

FDG-PET/CT Whole Body
There is no evidence to support FDG-PET/CT of the whole body in axillary evaluation of DCIS without microinvasion.

Lymphoscintigraphy Axilla
There is no evidence to support the use of axillary lymphoscintigraphy in axillary evaluation of DCIS without microinvasion.

Mammography With IV Contrast
There is no evidence to support mammography with IV contrast in axillary evaluation of DCIS without microinvasion.

MRI Breast Without and With IV Contrast
There is limited evidence to support breast MRI without and with IV contrast in axillary evaluation of DCIS without microinvasion. A study consisting of 682 patients with DCIS with or without preoperative breast MRI evaluation and who underwent breast surgery were recruited from a single institution. Of those, 386 patients had complete imaging and pathologic information. The results demonstrated that contrast-enhanced breast MRI had a 53.8% sensitivity, 77.8% specificity, 14.9% positive predictive value, 95.9% negative predictive value, and 76.2% accuracy to predict axillary lymph node metastasis in preoperative DCIS patients. In addition, in MRI node-negative breast cancer patients with an MRI tumor size <3 cm, the negative predictive value was 96.4%, and all these false-negative cases were N1 [139].

MRI Breast Without IV Contrast
There is no evidence to support noncontract breast MRI in axillary evaluation of DCIS without microinvasion.

US Axilla
There is no evidence to support US in axillary evaluation of DCIS without microinvasion.

US-Guided Core Biopsy Axillary Node
There is no evidence to support US-guided sampling for axillary lymph node evaluation of DCIS without microinvasion.

US-Guided Fine Needle Aspiration Biopsy Axillary Node
There is no evidence to support US-guided sampling for axillary lymph node evaluation of DCIS without microinvasion.

Summary of Highlights
This is a summary of the key recommendations from the variant tables. Refer to the complete narrative document for more information.

- **Variant 1**: For initial imaging of a patient with newly diagnosed DCIS, diagnostic mammography and/or DBT are the recommended studies in order to evaluate tumor size and extent of disease in the breast. Breast US and breast MRI are complementary and may be appropriate in combination with diagnostic mammography/DBT to further delineate tumor size and extent of disease. Breast US can also be used as guidance for biopsy.
- **Variant 2**: For imaging of a patient with newly diagnosed DCIS who is not undergoing surgical intervention (active surveillance), diagnostic mammography and/or DBT are the recommended studies to monitor tumor size and extent in the breast. Breast MRI may be appropriate in combination with diagnostic mammography/DBT to delineate tumor size, extent, and monitor response to nonsurgical therapy.
- **Variant 3**: For routine surveillance imaging for evaluation of local recurrence in a patient with a history of breast conservation therapy for DCIS, annual mammography (screening or diagnostic) and/or DBT (screening or diagnostic) are the recommended imaging studies. Breast MRI may be appropriate, depending on risk factors.
- **Variant 4**: In a patient with a history of mastectomy for DCIS, routine imaging surveillance for ipsilateral recurrence is usually not appropriate.
- **Variant 5**: For initial imaging of a patient with suspected local recurrence based on symptoms, physical examination, or laboratory value in patient with history of breast conservation therapy for DCIS, diagnostic mammography and/or DBT are the recommended studies in order to evaluate tumor size and extent of disease

in the breast. Breast US is usually appropriate in combination with diagnostic mammography/DBT to further delineate tumor size and extent of disease and as guidance for biopsy.

- **Variant 6**: For initial imaging of a patient with suspected local ipsilateral recurrence based on symptoms, physical examination, or laboratory value in a patient with a history of mastectomy for DCIS, US is the recommended study to evaluate tumor size and extent.
- **Variants 7 and 8**: Imaging is not indicated to evaluate the axilla in patients with known DCIS with or without microinvasion.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

Gender Equality and Inclusivity Clause

The ACR acknowledges the limitations in applying inclusive language when citing research studies that pre-dates the use of the current understanding of language inclusive of diversity in sex, intersex, gender and gender-diverse people. The data variables regarding sex and gender used in the cited literature will not be changed. However, this guideline will use the terminology and definitions as proposed by the National Institutes of Health [140].

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional

information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document [141].

Relative Radiation Level Designations		
Relative Radiation Level*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

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