

**American College of Radiology  
ACR Appropriateness Criteria®**

**Monitoring Response to Neoadjuvant Systemic Therapy for Breast Cancer**

**Variant 1: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known breast cancer. Initial determination of tumor size and extent within the breast prior to neoadjuvant chemotherapy. Initial imaging.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
Mammography diagnostic	Usually appropriate	Strong	☼☼ 0.1-1mSv		9	9	0	0	0	0	1	0	1	2	11

References	Study Quality
27 (16733676)	4
26 (31639053)	3
25 (30964425)	3
24 (23255766)	3
23 (23620367)	2
22 (23345348)	2
21 (23844366)	3
20 (25188431)	3
19 (24896197)	3
18 (23969151)	2
17 (25313245)	2
16 (23901124)	3
15 (16142441)	3
14 (14533601)	3
13 (15865110)	3
12 (11720669)	2
11 (14652148)	2



23 (23620367)	2
22 (23345348)	2
21 (23844366)	3
20 (25188431)	3
19 (24896197)	3
18 (23969151)	2
17 (25313245)	2
16 (23901124)	3
15 (16142441)	3
14 (14533601)	3
13 (15865110)	3
12 (11720669)	2
11 (14652148)	2
10 (15486214)	3

Sestamibi MBI	Usually not appropriate	Limited	☼☼☼ 1-10 mSv		2	2	6	6	2	1	0	0	0	0	0	0	
		References	Study Quality														
		40 (31166752)	3														
		39 (24152645)	2														
MRI breast without IV contrast	Usually not appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	1	1	11	2	2	0	0	0	0	0	0	0	
		References	Study Quality														
		38 (29742918)	3														
FDG-PET/CT skull base to mid-thigh	Usually not appropriate	Strong	☼☼☼☼ 10-30 mSv	☼☼☼☼ 3-10 mSv [ped]	1	1	12	3	0	0	0	0	0	0	0	0	
		References	Study Quality														
		29 (19075273)	2														
		28 (16897427)	2														

**Variant 2: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known breast cancer. Imaging of the breast after initiation or completion of neoadjuvant chemotherapy. Initial imaging.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
MRI breast without and with IV contrast	Usually appropriate	Strong	0.0 mSv	0.0 mSv [ped]	9	9	0	0	0	0	0	0	1	1	13

References	Study Quality
93 (20851939)	2
92 (22566277)	3
91 (18384182)	2
90 (24535214)	2
89 (21127880)	2
88 (21929557)	3
87 (30179110)	1
86 (31026118)	2
85 (15522553)	2
84 (18000804)	2
83 (17851879)	2
82 (23463090)	3
81 (26357493)	2
80 (12558665)	4
79 (15024602)	3
78 (23652844)	3
77 (25805427)	3
76 (21947592)	3
75 (20494311)	4
74 (14986052)	2
73 (23436342)	3
72 (24166728)	2
71 (26624971)	3
70 (29708782)	3
69 (18941065)	3

68 (16677795)	2
67 (26650831)	3
66 (20224378)	3
65 (26063880)	4
64 (20566826)	M
63 (18436185)	3
62 (17018307)	2
42 (16432360)	3
35 (15728611)	2
34 (23297042)	Inadequate
33 (19333654)	3
31 (23359240)	4
30 (22623692)	1
1 (25727555)	4

US breast	Usually appropriate	Strong	0 0 mSv	0 0 mSv [ped]	8	8	0	0	0	0	1	1	3	7	3
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References	Study Quality
107 (30103213)	3
106 (23062366)	2
105 (22476757)	3
104 (24169359)	3
103 (20359567)	3
102 (21947594)	3
101 (15765374)	4
100 (15972702)	2
99 (16154816)	4
27 (16733676)	4

Mammography diagnostic	Usually appropriate	Strong	☼☼ 0.1-1mSv		7	7	1	0	0	0	2	3	4	3	2
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References	Study Quality
50 (28526187)	3

49 (29110671)	2
48 (25056851)	4
47 (25287438)	3
46 (8596826)	3
45 (10769724)	4
44 (26495873)	3
43 (11026579)	4
42 (16432360)	3
27 (16733676)	4
14 (14533601)	3
13 (15865110)	3
12 (11720669)	2
11 (14652148)	2
10 (15486214)	3

Digital breast tomosynthesis diagnostic	Usually appropriate	Strong	☼☼ 0.1-1mSv		7	7	1	0	0	0	2	3	4	4	1
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References	Study Quality
50 (28526187)	3
49 (29110671)	2
48 (25056851)	4
47 (25287438)	3
46 (8596826)	3
45 (10769724)	4
44 (26495873)	3
43 (11026579)	4
42 (16432360)	3
27 (16733676)	4
14 (14533601)	3
13 (15865110)	3
12 (11720669)	2
11 (14652148)	2

		10 (15486214)		3														
MRI breast without IV contrast	Usually not appropriate	Limited	0 0 mSv	0 0 mSv [ped]	1	1	10	2	3	0	0	0	0	0	0	0	0	0
		References	Study Quality															
		38 (29742918)	3															
FDG-PET/CT skull base to mid-thigh	Usually not appropriate	Strong	☼☼☼☼ 10-30 mSv	☼☼☼☼ 3-10 mSv [ped]	1	1	8	1	3	1	2	0	0	0	0	0	0	0
		References	Study Quality															
		61 (25915099)	3															
		60 (11032590)	2															
		59 (22241914)	3															
		58 (24647576)	3															
		57 (23942075)	2															
		56 (24092940)	1															
		55 (17579854)	3															
		54 (8683314)	2															
		53 (29758503)	Good															
		52 (19877158)	3															
		51 (22734080)	Inadequate															
Sestamibi MBI	Usually not appropriate	Strong	☼☼☼ 1-10 mSv		1	1	8	5	2	0	0	0	0	0	0	0	0	0
		References	Study Quality															
		40 (31166752)	3															
		98 (30620672)	3															
		97 (25501326)	2															
		96 (24671359)	3															
		95 (15637688)	2															
		94 (22391702)	2															

**Variant 3: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known breast cancer, clinically node-negative. Axillary evaluation prior to neoadjuvant chemotherapy. Initial imaging.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations									
							1	2	3	4	5	6	7	8	9	
US axilla	Usually appropriate	Limited	0 0 mSv	0 0 mSv [ped]	7	7	0	1	0	0	3	2	2	3	4	
		References	Study Quality													
		116 (28130619)	3													
		115 (-3194381)	4													
		108 (35550807)	4													
MRI breast without and with IV contrast	Usually not appropriate	Strong	0 0 mSv	0 0 mSv [ped]	2	2	6	4	2	1	2	0	0	0	0	
		References	Study Quality													
		114 (27956116)	3													
		113 (20143266)	2													
		112 (23846781)	3													
		65 (26063880)	4													
		64 (20566826)	M													
		63 (18436185)	3													
		62 (17018307)	2													
		42 (16432360)	3													
		35 (15728611)	2													
		34 (23297042)	Inadequate													
		31 (23359240)	4													
		30 (22623692)	1													
		1 (25727555)	4													
		108 (35550807)	4													
Mammography diagnostic	Usually not appropriate	Expert Consensus	☢☢ 0.1-1mSv		1	1	11	2	1	0	1	0	0	0	0	
MRI breast without IV contrast	Usually not appropriate	Expert Consensus	0 0 mSv	0 0 mSv [ped]	1	1	12	2	0	0	1	0	0	0	0	

FDG-PET/CT skull base to mid-thigh	Usually not appropriate	Strong	☼☼☼☼ 10-30 mSv	☼☼☼☼ 3-10 mSv [ped]	1	1	8	2	4	1	0	0	0	0	0
		References		Study Quality											
		111 (22872522)		2											
		110 (14722036)		1											
		109 (24744045)		2											
		108 (35550807)		4											
Digital breast tomosynthesis diagnostic	Usually not appropriate	Expert Consensus	☼☼ 0.1-1mSv		1	1	11	2	1	0	1	0	0	0	0
US-guided fine needle aspiration biopsy axillary node	Usually not appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	1	1	10	1	2	0	2	0	0	0	0
		References		Study Quality											
		2 (16079956)		3											
		117 (25797740)		2											
US-guided core biopsy axillary node	Usually not appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	1	1	9	2	2	0	1	0	0	0	1
		References		Study Quality											
		2 (16079956)		3											
		117 (25797740)		2											

**Variant 4: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known breast cancer, clinically node-positive. Axillary evaluation prior to neoadjuvant chemotherapy. Initial imaging.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
US axilla	Usually appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	9	9	0	0	0	0	0	0	0	4	11
		References		Study Quality											
		2 (16079956)		3											
		119 (31500785)		3											

117 (25797740)	2
115 (-3194381)	4
108 (35550807)	4

MRI breast without and with IV contrast	May be appropriate	Strong	0 0 mSv	0 0 mSv [ped]	5	5	0	1	2	2	9	1	0	0	0
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References	Study Quality
114 (27956116)	3
113 (20143266)	2
112 (23846781)	3
65 (26063880)	4
64 (20566826)	M
63 (18436185)	3
62 (17018307)	2
42 (16432360)	3
35 (15728611)	2
34 (23297042)	Inadequate
31 (23359240)	4
30 (22623692)	1
1 (25727555)	4
108 (35550807)	4

FDG-PET/CT skull base to mid-thigh	May be appropriate	Strong	☼☼☼☼ 10-30 mSv	☼☼☼☼ 3-10 mSv [ped]	5	5	0	1	3	3	3	5	0	0	0
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References	Study Quality
118 (23456316)	2
116 (28130619)	3
111 (22872522)	2
110 (14722036)	1
109 (24744045)	2
108 (35550807)	4

Mammography diagnostic	Usually not appropriate	Expert Consensus	☼☼ 0.1-1mSv		1	1	12	2	0	0	1	0	0	0	0
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MRI breast without IV contrast	Usually not appropriate	Expert Consensus	○ 0 mSv	○ 0 mSv [ped]	1	1	12	2	1	0	0	0	0	0	0
Digital breast tomosynthesis diagnostic	Usually not appropriate	Expert Consensus	⊗⊗ 0.1-1mSv		1	1	12	2	0	0	1	0	0	0	0
US-guided fine needle aspiration biopsy axillary node	Usually not appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	1	1	13	2	0	0	0	0	0	0	0
		References	Study Quality												
		2 (16079956)	3												
		117 (25797740)	2												
US-guided core biopsy axillary node	Usually not appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	1	1	13	2	0	0	0	0	0	0	0
		References	Study Quality												
		2 (16079956)	3												
		117 (25797740)	2												

**Variant 5: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known breast cancer, clinically node-negative. Axillary evaluation after completion of neoadjuvant chemotherapy, axilla not previously evaluated. Initial imaging.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
MRI breast without and with IV contrast	Usually not appropriate	Strong	○ 0 mSv	○ 0 mSv [ped]	2	2	6	3	3	2	1	0	0	0	0
		References	Study Quality												
		122 (28919579)	3												
		121 (27451892)	2												
		120 (31583546)	4												
		114 (27956116)	3												
		113 (20143266)	2												
		112 (23846781)	3												

FDG-PET/CT skull base to mid-thigh	Usually not appropriate	Strong	☼☼☼☼ 10-30 mSv	☼☼☼☼ 3-10 mSv [ped]	2	2	7	2	6	0	0	0	0	0	0
		References		Study Quality											
		118 (23456316)		2											
		111 (22872522)		2											
		110 (14722036)		1											
		109 (24744045)		2											
		108 (35550807)		4											
US axilla	Usually not appropriate	Strong	○ ○ mSv	○ ○ mSv [ped]	2	2	5	3	2	4	0	1	0	0	0
		References		Study Quality											
		126 (29381381)		1											
		125 (31407967)		3											
		124 (31605348)		4											
		123 (31740186)		3											
		112 (23846781)		3											
Mammography diagnostic	Usually not appropriate	Limited	☼☼ 0.1-1mSv		1	1	10	4	0	0	0	0	0	1	0
		References		Study Quality											
		108 (35550807)		4											
MRI breast without IV contrast	Usually not appropriate	Expert Consensus	○ ○ mSv	○ ○ mSv [ped]	1	1	12	3	0	0	0	0	0	0	0
Digital breast tomosynthesis diagnostic	Usually not appropriate	Limited	☼☼ 0.1-1mSv		1	1	10	4	0	0	0	0	0	1	0
		References		Study Quality											
		108 (35550807)		4											
US-guided fine needle aspiration biopsy axillary node	Usually not appropriate	Expert Consensus	○ ○ mSv	○ ○ mSv [ped]	1	1	12	2	0	0	1	0	0	0	0
US-guided core biopsy axillary node	Usually not appropriate	Expert Consensus	○ ○ mSv	○ ○ mSv [ped]	1	1	12	2	0	0	0	0	1	0	0

**Variant 6: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known breast cancer with clinical suspicion of metastatic disease. Staging or assessment of response to neoadjuvant chemotherapy. Initial imaging.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations									
							1	2	3	4	5	6	7	8	9	
CT chest abdomen pelvis with IV contrast	Usually appropriate	Limited	⊕⊕⊕⊕ 10-30 mSv	⊕⊕⊕⊕ 3-10 mSv [ped]	9	9	0	0	0	0	0	0	1	6	8	
		References	Study Quality													
		128 (19664478)	4													
		127 (20516453)	3													
Bone scan whole body	Usually appropriate	Limited	⊕⊕⊕ 1-10 mSv	⊕⊕⊕⊕ 3-10 mSv [ped]	9	9	0	0	0	0	0	0	1	4	10	
		References	Study Quality													
		127 (20516453)	3													
FDG-PET/CT skull base to mid-thigh	Usually appropriate	Strong	⊕⊕⊕⊕ 10-30 mSv	⊕⊕⊕⊕ 3-10 mSv [ped]	9	9	0	0	0	0	0	0	0	5	10	
		References	Study Quality													
		134 (25971426)	4													
		133 (21057787)	1													
		132 (21880576)	3													
		131 (23220901)	4													
		130 (29923514)	3													
		129 (23725991)	4													
		127 (20516453)	3													
CT chest abdomen pelvis without IV contrast	Usually not appropriate	Expert Consensus	⊕⊕⊕⊕ 10-30 mSv	⊕⊕⊕⊕ 3-10 mSv [ped]	1	1	13	1	0	0	1	0	0	0	0	

CT chest abdomen pelvis without and with IV contrast	Usually not appropriate	Expert Consensus	☼☼☼☼ 10-30 mSv	☼☼☼☼☼ 10-30 mSv [ped]	1	1	15	0	0	0	0	0	0	0	0
MRI chest abdomen pelvis without and with IV contrast	Usually not appropriate	Expert Consensus	○ 0 mSv	○ 0 mSv [ped]	1	1	11	2	0	0	2	0	0	0	0
MRI chest abdomen pelvis without IV contrast	Usually not appropriate	Expert Consensus	○ 0 mSv	○ 0 mSv [ped]	1	1	13	2	0	0	0	0	0	0	0

**Variant 7: Adult female or male or transfeminine (male-to-female) or transmasculine (female-to-male). Known axillary lymph node-positive breast cancer on prior mammography, US, or MRI. Axillary evaluation after completion of neoadjuvant chemotherapy, axilla previously evaluated. Next imaging study.**

Procedure	Appropriateness Category	SOE	Adults RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
US axilla	Usually appropriate	Moderate	○ 0 mSv	○ 0 mSv [ped]	8	8	0	0	0	0	1	2	3	4	5

References	Study Quality
126 (29381381)	1
125 (31407967)	3
124 (31605348)	4
112 (23846781)	3
108 (35550807)	4

MRI breast without and with IV contrast	Usually not appropriate	Strong	○ 0 mSv	○ 0 mSv [ped]	3	3	2	2	4	1	5	1	0	0	0
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References	Study Quality
122 (28919579)	3
121 (27451892)	2
120 (31583546)	4
114 (27956116)	3
113 (20143266)	2
112 (23846781)	3

		108 (35550807)		4														
FDG-PET/CT skull base to mid-thigh	Usually not appropriate	Limited	☼☼☼☼ 10-30 mSv	☼☼☼☼ 3-10 mSv [ped]	3	3	3	4	5	1	2	0	0	0	0	0	0	0
		References		Study Quality														
		135 (21308372)		2														
		112 (23846781)		3														
Mammography diagnostic	Usually not appropriate	Limited	☼☼ 0.1-1mSv		1	1	11	2	0	0	1	1	0	0	0	0	0	0
		References		Study Quality														
		108 (35550807)		4														
MRI breast without IV contrast	Usually not appropriate	Expert Consensus	○ 0 mSv	○ 0 mSv [ped]	1	1	12	3	0	0	0	0	0	0	0	0	0	0
US breast	Usually not appropriate	Limited	○ 0 mSv	○ 0 mSv [ped]	1	1	12	2	0	1	0	0	0	0	0	0	0	0
		References		Study Quality														
		136 (28423171)		3														
Digital breast tomosynthesis diagnostic	Usually not appropriate	Expert Consensus	☼☼ 0.1-1mSv		1	1	11	2	0	0	1	1	0	0	0	0	0	0
US-guided fine needle aspiration biopsy axillary node	Usually not appropriate	Strong	○ 0 mSv	○ 0 mSv [ped]	1	1	10	2	1	1	1	0	0	0	0	0	0	0
		References		Study Quality														
		141 (26727919)		4														
		140 (24101169)		3														
		139 (28766234)		3														
		138 (26811528)		2														
		137 (22772869)		3														
		119 (31500785)		3														
		112 (23846781)		3														
US-guided core biopsy axillary node	Usually not appropriate	Strong	○ 0 mSv	○ 0 mSv [ped]	1	1	10	2	1	1	0	0	1	0	0	0	0	0



144 (17985188)	3
143 (23244481)	4
142 (29972239)	Good
141 (26727919)	4
139 (28766234)	3
138 (26811528)	2
119 (31500785)	3
117 (25797740)	2
108 (35550807)	4

MRI breast without and with IV contrast	Usually not appropriate	Strong	0 0 mSv	0 0 mSv [ped]	2	2	7	3	4	0	1	0	0	0	0
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References	Study Quality
1 (25727555)	4
113 (20143266)	2
112 (23846781)	3
65 (26063880)	4
64 (20566826)	M
63 (18436185)	3
62 (17018307)	2
42 (16432360)	3
35 (15728611)	2
34 (23297042)	Inadequate
31 (23359240)	4
30 (22623692)	1
108 (35550807)	4

Mammography diagnostic	Usually not appropriate	Expert Consensus	☼☼ 0.1-1mSv		1	1	13	2	0	0	0	0	0	0	0
MRI breast without IV contrast	Usually not appropriate	Expert Consensus	0 0 mSv	0 0 mSv [ped]	1	1	11	4	0	0	0	0	0	0	0
Digital breast tomosynthesis diagnostic	Usually not appropriate	Expert Consensus	☼☼ 0.1-1mSv		1	1	13	2	0	0	0	0	0	0	0

## **Appendix Key**

A more complete discussion of the items presented below can be found by accessing the supporting documents at the designated hyperlinks.

**Appropriateness Category:** The panel's recommendation for a procedure based on the assessment of the risks and benefits of performing the procedure for the specified clinical scenario.

**SOE:** Strength of Evidence. The assessment of the amount and quality of evidence found in the peer reviewed medical literature for an appropriateness recommendation.

- **References:** The citation number and PMID for the reference(s) associated with the recommendation.
- **Study Quality:** The assessment of the quality of an individual reference based on the number of study quality elements described in the reference.

**RRL:** Relative Radiation Level. A population based assessment of the amount of radiation a typical patient may be exposed to during the specified procedure.

**Rating:** The final rating (1-9 scale) for the procedure as determined by the panel during rating rounds.

**Median:** The median rating (1-9 scale) for the procedure as determined by the panel during rating rounds.

**Final tabulations:** A histogram showing the number of panel members who rated the procedure as noted in the column heading (ie, 1, 2, 3, etc.).

Additional supporting documents about the AC methodology and processes can be found at [www.acr.org/ac](http://www.acr.org/ac).