

Supplementary Online Content

Carleton N, Zou J, Fang Y, et al. Outcomes after sentinel lymph node biopsy and radiotherapy in older women with early-stage, estrogen receptor–positive breast cancer. *JAMA Netw Open*. 2021;4(4):e216322. doi:10.1001/jamanetworkopen.2021.6322

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. ICD-9 and ICD-10 Codes Used to Define Comorbidities

Comorbidity	ICD-9 Codes	ICD-10 Codes
Congestive heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 415.0, 416.0-1, 416.8-417.1, 417.8-9, 425.0, 425.11, 425.18, 425.2-9, 428.0-23, 428.30-33, 428.40-43, 428.9-429.1	A18.84, I09.81, I11.0, I13.0, I13.2, I26.01-02, I26.09-127.2, I27.81, I27.89-9, I28.0-1, I28.8-9, I42-3, I50.1, I50.20-23, I50.30-33, I50.40-43, I50.9, I51.4-5
Vascular disease	410.01-02, 410.11-12, 410.21-22, 410.31-32, 410.41-42, 410.51-52, 410.61-62, 410.71-72, 410.81-82, 410.91-92, 412, 440.21, 440.30-32, 440.8-9, 444.01, 444.09, 444.1, 444.21-22, 444.81, 444.89-90, 445.01-02, 445.81, 445.89	I21.01-02, I21.09, I21.11, I21.19, I21.21, I21.29, I21.3-4, I22.0-2, I22.8-9, I25.2, I70.211-213, I70.218-219, I70.301-303, I70.308-309, I70.311-313, I70.318-319, I70.321-323, I70.328-329, I70.331-335, I70.338-339, I70.341-345, I70.348-349, I70.35, I70.361-363, I70.368-369, I70.391-393, I70.398-399, I70.401-403, I70.408-409, I70.411-413, I70.418-419, I70.421-213, I70.428-429, I70.431-435, I70.438-439, I70.441-445, I70.448-45, I70.461-463, I70.468-469, I70.491-493, I70.498-499, I70.501-503, I70.508-509, I70.511-513, I70.518-519, I70.521-523, I70.528-529, I70.531-535, I70.538-539, I70.541-545, I70.548-549, I70.55, I70.561-563, I70.568-569, I70.591-593, I70.598-599, I70.601-603, I70.608-609, I70.611-613, I70.618-619, I70.621-623, I70.628-629, I70.631-635, I70.638-639, I70.641-645, I70.648-649, I70.65, I70.661-663, I70.668-669, I70.691-693, I70.698-699, I70.701-703, I70.708-709, I70.711-713, I70.718-719, I70.721-723, I70.728-729, I70.731-735, I70.738-739, I70.741-745, I70.748-749, I70.75, I70.761-763, I70.768-769, I70.791-793, I70.798-799, I70.8, I70.90-91, I74.01, I74.09-11, I74.19, I74.2-5, I74.8-9, I75.011-013, I75.019, I75.021-023, I75.029, I75.81, I75.89

Arterial injury	414.19, V12.50, 459.89, 414.10, 442.9, V12.59	I72.9, Z86.79, I25.3, I99.8
Deep vein thrombosis	415.11, 453.40, 453.42, 453.50, 453.52, 453.89, 997.2, 997.79, 998.83, 998.89, V12.51	I82.509, I82.5Z9, I82.409, T81.72XA, I82.401, I82.4Z9, I82.403, I82.90, T81.89XA, Z86.718
Pulmonary embolism	997.2, 997.79, 415.11, 415.19, 416.2, V12.55	I26.99, I27.82, T81.718A, Z86.711
Stroke	362.34, 430-432.1, 432.9, 433.00-01, 433.10-11, 433.20-21, 433.30-31, 433.80-81, 433.90-91, 434.00-01, 434.10-11, 434.90-91, 435.0-3, 435.8-9, 438.0, 438.6-7, 438.9-10, 438.12-14, 438.19-22, 438.30-32, 438.40-42, 438.50-53, 438.81-85, 438.89, V12.54	H34.00-03, G45.0-3, G45.8-G46.2, I60.00-02, I60.10-12, I60.20-22, I60.30-32, I60.4-52, I60.6-I61.6, I61.8-I62.03, I62.1, I62.9-I63.00, I63.011-012, I63.019-020, I63.031-032, I63.039, I63.09-112, I63.119-12, I63.131-132, I63.139, I63.19-20, I63.211-212, I63.219, I63.22, I63.231-232, I63.239, I63.29, I63.30, I63.311-312, I63.319, I63.321-322, I63.329, I63.331-332, I63.339, I63.341-342, I63.349, I63.39-40, I63.411-412, I63.419, I63.421-422, I63.429, I63.431-432, I63.439, I63.441-442, I63.449, I63.49-50, I63.511-512, I63.521-522, I63.529, I63.531-532, I63.539, I63.541-542, I63.549, I63.59-6, I63.8-9, I65.01-03, I65.09, I65.21-23, I65.29, I65.8-9, I66.01-03, I66.09, I66.11-13, I66.19, I66.21-23, I66.29-3, I66.8-9, I67.841, I67.848, I69.00-023, I69.028, I69.031-034, I69.039, I69.041-044, I69.049, I69.051-054, I69.059, I69.061-065, I69.069, I69.090-093, I69.098, I69.10-11, I69.120-123, I69.131-134, I69.139, I69.141-144, I69.149, I69.151-154, I69.159, I69.161-165, I69.169, I69.190-193, I69.198, I69.20-223, I69.228, I69.231-234, I69.239, I69.241-244, I69.249, I69.251-252, I69.254, I69.259, I69.261-265, I69.269, I69.290-293, I69.298, I69.30-323, I69.328, I69.331-334, I69.339, I69.341-344, I69.349, I69.351-354, I69.359, I69.361-65, I69.369, I69.390-393, I69.398, I69.80-81, I69.821-823, I69.828, I69.831-834, I69.839, I69.841-844, I69.849, I69.851-854, I69.859, I69.861-865, I69.869, I69.891-893, I69.898, I69.90-91,

		I69.920-923, I69.928, I69.931-934, I69.939, I69.941-944, I69.949, I69.951-954, I69.959, I69.961-965, I69.969, I69.990-993, I69.998, Z86.73
Chronic obstructive pulmonary disease	427.31-32, 491.1, 491.20-491.22, 491.8-492.0, 492.8, 493.00-493.22, 494.0-1, 496	I480-I48.4, I48.91-2, J41.1, J41.8, J42, J43.0-3, J44.0-1, J44.9, J45.20-22, J45.20-22, J45.30-32, J45.40-42, J45.50-52, J47.0-1, J47.9
Fibromyalgia	729.1	M79.7
Psoriatic arthritis	696.3, 696.4, 696.5, 696.0, 696.1, 696.2, 696.8	L42, L30.5, L40.59, L40.0, L40.8, L94.5, L40.51, L40.53, L40.3, L40.4, L41.1, L41.5, L40.1, L40.50, L40.2, L41.3, L44.0, L40.52, L40.9, L41.0, L41.8, L44.8, L45, L41.4, L41.9, L40.54
Rheumatoid arthritis	714.0, 714.1, 714.81, 357.1, 359.6, 714.2, 714.89, 714.9	M05.542, M05.549, M05.572, M05.579, M05.412, M05.429, M05.459, M05.462, M05.711, M05.712, M05.721, M05.751, M05.769, M05.819, M05.842, M05.851, M05.862, M05.872, M06.071, M06.211, M06.239, M06.242, M06.252, M06.30, M06.332, M06.342, M06.351, M06.811, M05.00, M05.021, M05.039, M05.051, M05.20, M05.229, M05.251, M05.261, M05.262, M05.279, M05.30, M05.332, M05.60, M05.661, M05.671, M05.10, M05.142, M05.522, M05.552, M05.571, M05.441, M05.461, M05.472, M05.479, M05.731, M05.752, M05.779, M05.821, M06.00, M06.019, M06.021, M06.031, M06.059, M06.212, M06.219, M06.241, M06.261, M06.269, M06.271, M06.29, M06.312, M06.319, M06.349, M06.379, M06.842, M06.849, M06.9, M05.062, M05.079, M05.222, M05.249, M05.342, M05.351, M05.622, M05.632, M05.649, M05.679, M05.119, M05.169, M05.50, M05.532, M05.562, M05.59, M05.411, M05.431, M05.442, M05.49, M05.762, M05.829, M05.832, M05.859, M06.032, M06.039, M06.052, M06.062, M06.221, M06.231, M06.341, M06.361, M06.812, M06.821,

	M06.822, M06.872, M05.049, M05.052, M05.059, M05.071, M05.09, M05.211, M05.252, M05.349, M05.359, M05.369, M05.372, M05.611, M05.631, M05.651, M05.652, M05.122, M05.161, M05.19, M05.569, M05.419, M05.421, M05.729, M05.741, M05.761, M05.772, M05.811, M05.839, M05.852, M05.871, M06.049, M06.08, M06.249, M06.272, M06.369, M06.371, M06.829, M06.859, M06.871, M06.879, M05.012, M05.022, M05.221, M05.239, M05.242, M05.269, M05.272, M05.321, M05.621, M05.639, M05.519, M05.521, M05.529, M05.539, M05.739, M05.841, M05.89, M05.9, M06.011, M06.041, M06.042, M06.069, M06.09, M06.222, M06.229, M06.279, M06.311, M06.339, M06.38, M06.39, M06.831, M05.259, M05.311, M05.312, M05.319, M05.331, M05.361, M05.362, M05.629, M05.642, M05.659, M05.662, M05.121, M05.132, M05.139, M05.162, M05.171, M05.172, M06.4, M05.511, M05.531, M05.559, M05.432, M05.439, M05.451, M05.452, M05.719, M05.742, M05.749, M05.759, M05.79, M06.012, M06.022, M06.20, M06.251, M06.259, M06.321, M06.322, M06.329, M06.359, M06.362, M06.80, M06.852, M05.029, M05.041, M05.061, M05.212, M05.231, M05.241, M05.29, M05.322, M05.329, M05.112, M05.152, M05.541, M05.551, M05.561, M05.449, M05.471, M05.70, M05.771, M05.80, M05.849, M06.051, M06.061, M06.072, M06.079, M06.232, M06.28, M06.331, M06.819, M06.832, M06.841, M06.851, M06.861, M06.89, M05.019, M05.032, M05.042, M05.072, M05.219, M05.232, M05.271, M05.352, M05.379, M05.39, M05.619, M05.669, M05.672, M06.1, M05.111, M05.131, M05.141, M05.159, M05.512,
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		M05.40, M05.422, M05.469, M05.722, M05.732, M05.812, M05.822, M05.831, M05.861, M05.869, M05.879, M06.029, M06.262, M06.352, M06.372, M06.839, M06.862, M06.869, M06.88, M05.011, M05.031, M05.069, M05.339, M05.341, M05.371, M05.612, M05.641, M05.69, M05.129, M05.149, M05.151, M05.179
Systemic lupus erythematosus	517.8, 289.81, 583.81, 424.91, 286.53, 420.0, 695.4, 710.0	M32.14, M32.9, D68.61, L93.1, M32.13, M32.15, M32.12, M32.11, L93.2, D68.62, L93.0, D68.312, M32.0, M32.10, M32.8, M32.19
Diabetes (includes both type 1 diabetes mellitus and type 2 diabetes mellitus; does not include diabetes insipidus)	T1DM: 250.01, 250.03, 250.41, 250.43, 250.51, 250.53, 250.61, 250.63, 250.71, 250.73, 250.81, 250.83 T2DM: 250.00, 250.02, 250.10-13, 250.20-23, 250.30-33, 250.40, 250.42, 250.50, 250.52, 250.60, 250.62, 250.70, 250.72, 250.80, 250.82, 250.90-93, V45.85, Z96.41	T1DM: E10.9, E10.21-22, E10.29, E10.36, E10.39-44, E10.49, E10.51-52, E10.59, E10.65, E10.69, E10.311, E10.319, E10.321, E10.329, E10.331, E10.339, E10.341, E10.349, E10.351, E10.359, E10.610, E10.618, E10.620-22, E10.628, E10.630, E10.638, E10.649 T2DM: E10.10-11, E10.641, E10.65, E10.69, E10.8, E11.00-01, E11.21-22, E11.29, E11.311, E11.319, E11.321, E11.329, E11.331, E11.339, E11.341, E11.349, E11.351, E11.359, E11.36, E11.39-44, E11.49, E11.51-52, E11.59, E11.610, E11.618, E11.620-22, E11.628, E11.630, E11.638, E11.641, E11.649, E11.65, E11.69, E11.8-9, E13.00-01, E13.10-11, E13.21-22 E13.29, E13.311, E13.319, E13.321, E13.329, E13.331, E13.339, E13.341, E13.349, E13.351, E13.359, E13.36, E13.39-44, E13.49, E13.51-52, E13.59, E13.610, E13.618, E13.620-22, E13.628, E13.630, E13.638, E13.641, E13.649, E13.65, E13.69, E13.8-9
Chronic kidney disease	585.3, 585.4, 585.5	N18.3, N18.4, N18.5

eTable 2. Calculation of Modified Charlson Comorbidity Index

The widely used Charlson comorbidity index (CCI) was adapted to calculate a modified Charlson comorbidity index (mCCI) to capture the extent to which the patients in this study had pre-existing conditions at the time of breast cancer diagnosis. Of note, in the original CCI, any solid tumor would give a patient a score of 2; because all patients in this study had a solid tumor (breast cancer), each patient's baseline score would be 2. The final mCCI score is a sum of the scores for each comorbid condition a patient had.

Charlson Comorbidity Index (CCI)	Modified Charlson Comorbidity Index (mCCI)	Score
Myocardial Infarction	Not captured.	1
Congestive Heart Failure	Included as is.	1
Peripheral Vascular Disease	Included using the following listings: vascular disease, arterial injury, DVT, or PE.	1
Cerebrovascular Disease	Included using the following listings: stroke.	1
Dementia	Not captured.	1
Chronic Obstructive Pulmonary Disease	Included as is.	1
Connective Tissue Disease	Included using the following listings: fibromyalgia, psoriatic arthritis, rheumatoid arthritis, and lupus.	1
Peptic Ulcer Disease	Not captured.	1
Mild Liver Disease	Not captured.	1
Diabetes	Included as is.	1
Any solid tumor	All patients had a solid tumor; thus all patients had a baseline score of 2.	2
Diabetes with Chronic Complications	Not captured.	2
Hemiplegia or Paraplegia	Not captured.	2
Renal Disease	Included using the following listings: chronic kidney disease.	2
Leukemia or lymphoma	Not captured.	2
Moderate or Severe Liver Disease	Not captured.	3
AIDS	Not captured.	6
Metastatic solid tumor	Not captured.	6

eTable 3. Baseline Characteristics of Patients

Patient characteristic	Total (N = 2,109)	No SLNB (n = 736)	SLNB (n = 1,373)	P value	No RT ^a (n = 848)	RT ^a (n = 1,219)	P value
Median age at diagnosis, years (Q1-Q3)	77.0 (73.0-82.0)	80.0 (74.0-86.0)	75.0 (72.0-79.0)	< 0.0001	80.0 (74.0-85.0)	75.0 (72.0-79.0)	< 0.0001
Median follow up time, years (Q1-Q3)	4.1 (2.5-5.7)	3.4 (1.7-5.1)	4.3 (3.1-6.0)	< 0.0001	3.4 (1.8-5.0)	4.5 (3.1-6.0)	< 0.0001
Insurance status							
Commercial / Private	451 (21.3)	130 (17.7)	321 (23.4)	0.0091	143 (16.9)	299 (24.5)	0.0004
Medicaid	33 (1.6)	13 (1.8)	20 (1.5)		16 (1.9)	14 (1.1)	
Medicare	1,526 (72.4)	561 (76.2)	965 (70.3)		645 (76.1)	854 (70.1)	
Not Insured	3 (0.1)	0 (0.0)	3 (0.2)		1 (0.1)	2 (0.2)	
Other / Unknown	96 (4.6)	32 (4.3)	64 (4.7)		43 (5.1)	50 (4.1)	
Median tumor size (mm) (Q1-Q3)	15.0 (9.0-22.0)	15.0 (9.8-27.0)	14.0 (9.0-20.0)	< 0.0001	15.0 (9.5-25.0)	14.0 (9.0-20.0)	< 0.0001
Clinical T Stage							
In Situ / T0	43 (2.0)	28 (3.8)	15 (1.1)	< 0.0001	17 (2.0)	24 (2.0)	0.0002
T1	1,411 (66.9)	369 (50.1)	1042 (75.9)		470 (55.4)	915 (75.1)	
T2 or Above	474 (22.5)	168 (22.8)	306 (22.3)		208 (24.5)	258 (21.2)	
Unknown	181 (8.6)	171 (23.2)	10 (0.7)		153 (18.0)	22 (1.8)	
Grade							
I	503 (23.9)	155 (21.1)	348 (25.3)	0.31	190 (22.4)	306 (25.1)	0.13
II	1,186 (56.2)	410 (55.7)	776 (56.5)		466 (55.0)	693 (56.8)	
III	288 (13.7)	99 (13.5)	189 (13.8)		129 (15.2)	154 (12.6)	
NA / Unknown	132 (6.3)	72 (9.8)	60 (4.4)		63 (7.4)	66 (5.4)	
Pathologic node positivity after SLNB	--	--	159 (11.5)	--	39 (24.5) ^b	116 (73.0) ^b	--
Tumor histology							
DCIS / IDC	1,447 (68.6)	488 (66.3)	959 (69.8)	0.55	591 (69.7)	849 (69.6)	0.93
LCIS / ILC	278 (13.2)	96 (13.0)	182 (13.3)		117 (13.8)	157 (12.9)	
Mixed IDC / ILC	68 (3.2)	21 (2.9)	47 (3.4)		29 (3.4)	37 (3.0)	
Mucinous adenocarcinoma	62 (2.9)	26 (3.5)	36 (2.6)		26 (3.1)	38 (3.1)	
Other / Unknown	254 (12.0)	105 (14.3)	149 (10.9)		85 (10.0)	138 (11.3)	
Surgical Intervention							
SLNB	1,373 (65.1)	--	--	--	391 (46.1)	959 (78.7)	< 0.0001
Lumpectomy	1,367 (64.8)	356 (48.4)	1011 (73.6)	< 0.0001	304 (35.8)	1039 (85.2)	< 0.0001
Mastectomy	583 (27.6)	223 (30.3)	360 (26.2)	0.046	405 (47.8)	165 (13.5)	< 0.0001
No Lumpectomy or Mastectomy	156 (7.4)	154 (20.9)	2 (0.1)	< 0.0001	137 (16.2)	14 (1.1)	< 0.0001
Therapy							
Hormone therapy	1,786 (84.7)	578 (78.5)	1208 (88.0)	< 0.0001	651 (76.8)	1110 (91.1)	< 0.0001

	Radiation therapy	1,219 (57.8)	260 (35.3)	959 (69.8)	< 0.0001	--	--	--
	Chemotherapy	108 (5.1)	35 (4.8)	73 (5.3)	0.61	30 (3.5)	76 (6.2)	0.006
Modified Charlson comorbidity index (mCCI) Score								
	2	875 (41.5)	251 (34.1)	624 (45.4)	< 0.0001	320 (37.7)	544 (44.6)	0.03
	3	313 (14.8)	102 (13.9)	211 (15.4)		129 (15.2)	180 (14.8)	
	4	79 (3.7)	39 (5.3)	40 (2.9)		31 (3.7)	44 (3.6)	
	≥ 5	72 (3.4)	37 (5.0)	35 (2.5)		38 (4.5)	33 (2.7)	
	NA	770 (36.5)	307 (41.7)	463 (33.7)		330 (38.9)	418 (34.3)	
mCCI Score, mean (SD)		2.5 (0.9)	2.7 (1.1)	2.5 (0.8)	< 0.0001	2.6 (1.0)	2.5 (0.8)	0.0112
Comorbidity ^c								
	Congestive heart failure	72 (5.3)	43 (10.0)	29 (3.2)	< 0.0001	45 (5.3)	27 (2.2)	0.0002
	Diabetes	230 (17.2)	84 (19.6)	146 (16.0)	0.61	91 (10.7)	136 (11.2)	0.78
	Coronary artery disease	138 (10.3)	63 (14.7)	75 (8.2)	0.007	61 (7.2)	75 (6.2)	0.37
	Stroke	91 (6.8)	45 (10.5)	46 (5.1)	0.005	46 (5.4)	43 (3.5)	0.047
	COPD	99 (7.4)	37 (8.6)	62 (6.8)	0.59	46 (5.4)	52 (4.3)	0.25
	Chronic kidney disease	48 (3.6)	22 (5.1)	26 (2.9)	0.13	20 (2.4)	26 (2.1)	0.76
Recurrence								
	No Recurrence	2,028 (96.2)	703 (95.5)	1,325 (96.5)	0.28	801 (94.5)	1,186 (97.3)	0.002
	Locoregional	28 (1.3)	8 (1.1)	20 (1.5)	0.55	22 (2.6)	6 (0.5)	< 0.0001
	Distant	53 (2.5)	25 (3.4)	28 (2.0)	0.08	25 (2.9)	27 (2.2)	0.32
Surgical Site SLNB ^d								
	Academic	571 (27.1)	131 (17.8)	440 (32.0)	< 0.0001	--	--	
	Non-Academic	1,538 (72.9)	605 (82.2)	933 (68.0)		--	--	

Data are displayed as number (percentage) unless otherwise specified.

a There were n = 42 patients with unknown radiation therapy status.

b Calculated as a percentage of the total node positive cases (e.g., 39 patients out of 159 patients that were node positive after SLNB did not go on to have RT).

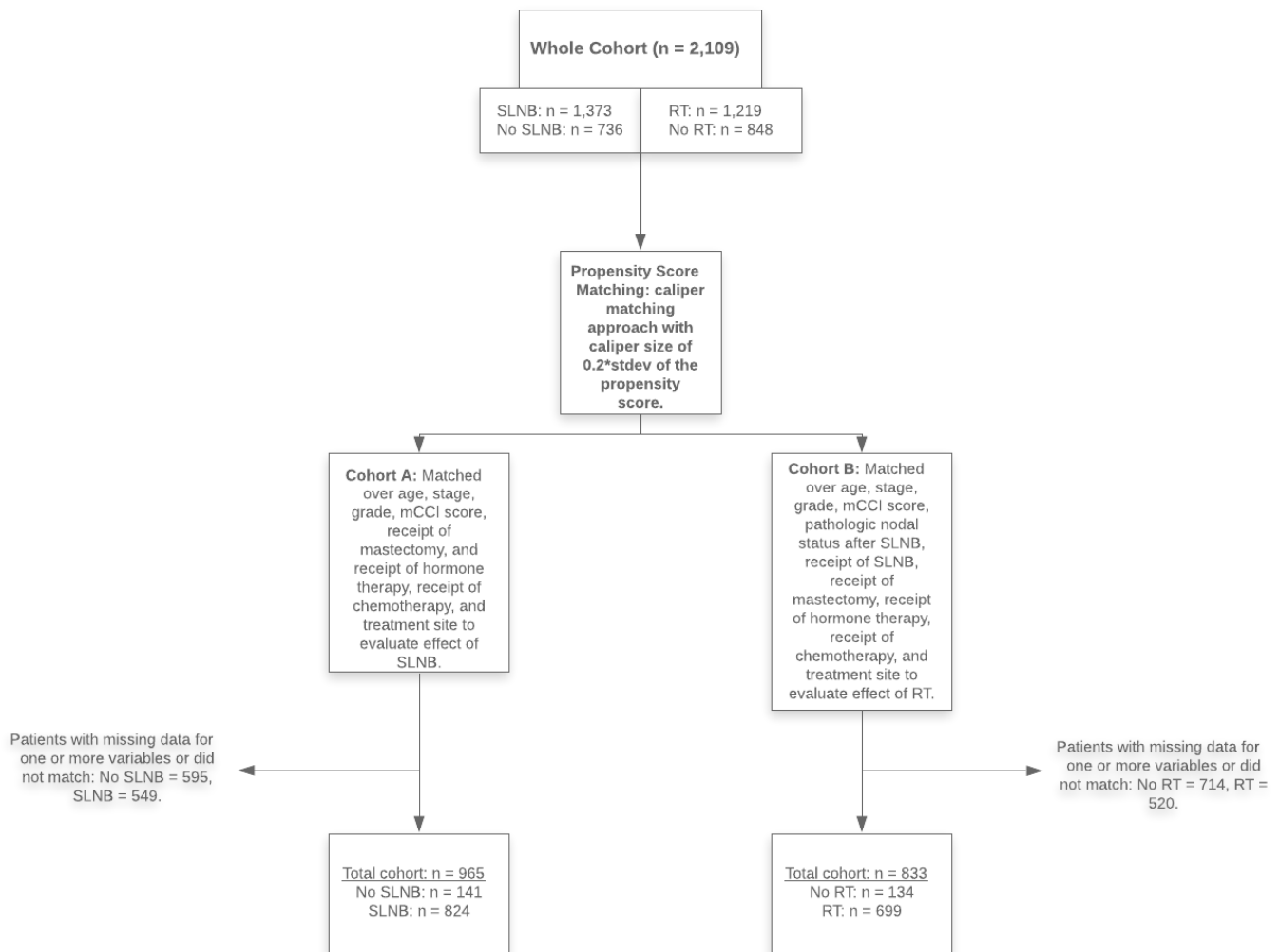
c Calculated as a percentage of those with comorbidity data (n = 1,339).

d Data from SLNB use in non-academic centers is aggregated from 14 different community hospitals, while data for the academic surgical site is two academic hospitals.

Statistical tests used: Mann-Whitney test, Chi-square test, Fisher's exact test.

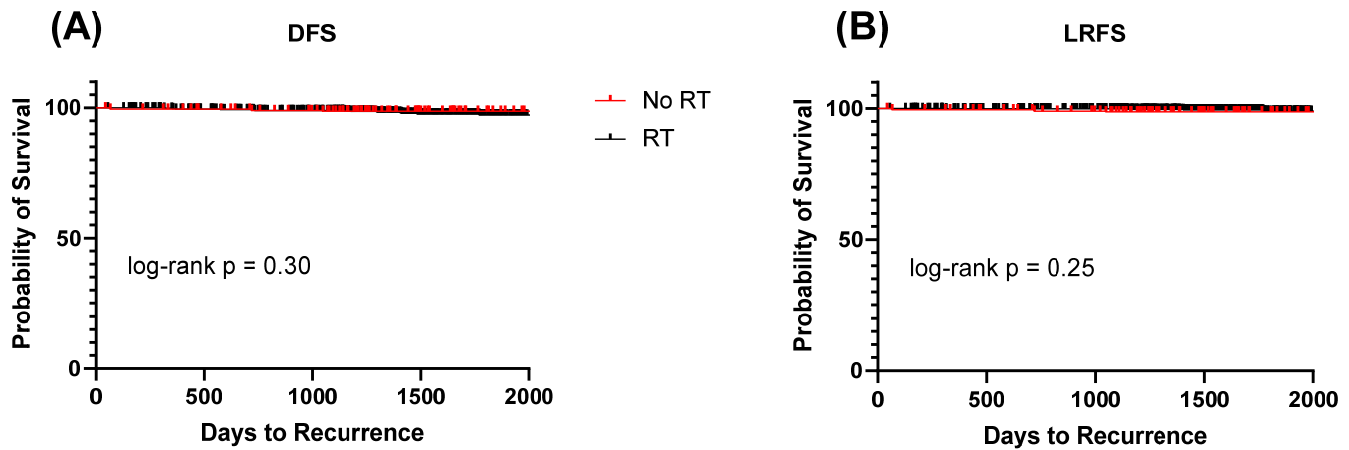
eFigure 1. Flowchart for the Derivation of the Propensity Score Matched Cohorts

Flowchart for how the propensity score matched cohorts were derived. Cohort A, which was matched over the variables seen in the figure, was used to evaluate the results of SLNB. Cohort B, which was matched over the same variables as Cohort A with the addition of receipt of SLNB and the pathologic node status, was used to evaluate the results of RT.



eFigure 2. Re-analysis of Cohort B Excluding Those Patients That Underwent Mastectomy

Using propensity score matched Cohort B, we now exclude patients who underwent mastectomy from the analysis. From the No RT group, n = 45 (36%) were excluded from the propensity matched cohort. However, since the No RT group was matched 1:5 with the RT group, this did not result in a significant loss in patients. From the RT group, n = 78 (11%) patients were excluded from the propensity matched cohort. We found that the data was very similar to that shown in Figure 3 and Table 2: RT does not impact DFS (p = 0.30 on log-rank testing) **(A)** or LRFS (p = 0.25 on log-rank testing) **(B)**; further, in multivariate analysis **(C)**, we found that RT did not significantly impact LRFS (p = 0.26) or DFS (p = 0.67). Further, after omitting mastectomy patients, we again find small absolute rates of recurrence (No RT group: 3.5% vs. RT group: 2.3%), supporting the fact that RT can be omitted about breast conserving surgery.



(C)

Variable	LRFS		DFS	
	HR (95% CI)	P-Value	HR (95% CI)	P-Value
Radiation Therapy	0.48 (0.14, 1.68)	0.26	1.23 (0.48, 3.18)	0.67
Pathologic Node Status*	--	--	1.73 (0.51, 5.93)	0.38
Age	1.21 (1.08, 1.35)	0.001	1.16 (1.07, 1.26)	< 0.0001
mCCI Score	0.82 (0.31, 2.17)	0.69	1.11 (0.66, 1.87)	0.70
Grade 2 & 3 vs. 1 Disease	0.64 (0.16, 2.62)	0.54	0.77 (0.25, 2.33)	0.64
T2 & Above vs. T1 Tumor	2.57 (0.64, 10.37)	0.18	3.34 (1.21, 9.25)	0.02