

Supplementary Online Content

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

eTable 1. Schema for creating cohort

Step	Criteria	# of observations	# excluded
	All female, Medicare beneficiaries (excluding entitlement solely due to ESRD or disability) ages 67 and older with a diagnosis code for breast cancer, treatment with lumpectomy between 2003-2007, and any code for radiation therapy associated for a diagnosis of breast cancer appearing within 12 months of lumpectomy.	119,576	
1	Exclude if diagnosis code for breast cancer appears only once or if two or more codes for distant metastasis from 12 months before to 12 months after diagnosis	115,569	4,007
2	Exclude if prevalent case (defined as claim indicating history of breast cancer within two years prior to diagnosis or if breast cancer diagnosis and breast cancer lymph node-directed surgery identified between 12 to 24 months prior to diagnosis)	105,206	10,363
3	Exclude if no part A or B coverage from 12 months prior to 12 months after diagnosis	102,509	2,697
4	Exclude if any HMO coverage from 12 months prior to 12 months after diagnosis	98,083	4,426
5	Exclude if actual <i>treatment</i> with radiation therapy cannot be confirmed from claims	96,537	1,546
6	Exclude if treated with both brachytherapy and external beam radiation	95,762	775
7	Exclude if treatment with whole breast irradiation cannot be confirmed due to delivery of less than 11 fractions of external beam radiation	92,735	3,027

Abbreviations: ESRD (end stage renal disease)

eTable 2. Claims codes for procedures and diagnoses

Condition or Procedure	ICD-9 Diagnosis Code	ICD-9 Procedure Code	CPT Code	Revenue Center
Breast cancer	174.X			
History of breast cancer	V10.3			
Distant metastasis	196.XX- 199.XX (excluding 196.0, 196.3, 198.2, 198.81)			
Axillary lymph node involvement	196.3			
Mastectomy		85.4, 85.41-85.48	19180,19182,19200,19220,19240,19303,19304, 19305,19306, 19307	
Lumpectomy		85.2, 85.20-85.25	19110, 19120, 19125, 19126, 19160, 19162, 19301, 19302	
Breast cancer lymph-node directed surgery		40.3, 40.23,40.51, 85.43, 85.47	38740, 38745, 38525, 19162, 19200, 19220, 19240	
Any code for radiation therapy	V58.0, V66.1, V67.1	92.2, 92.20-92.27, 92.29, 92.3, 92.30-92.39, 92.4, 92.41	77371, 77372, 77373, 77401-77525, 77761-77799, G0251, G0339, G0340	0330, 0333
Actual <i>treatment</i> with radiation therapy		92.21-92.27	77418, 77422, 77423, G0174, 77401-77416, 77522-77525, 77761-77799	
Actual <i>treatment</i> with external beam radiation*		92.21-92.26	77418, 77422, 77423, G0174, 77401-77416, 77522-77525	
Actual <i>treatment</i> with brachytherapy		92.27	77761-77799	
Placement of single-entry brachytherapy catheter			C9714, C9715, 19296, 19297, C1715, C1728	
Chemotherapy	V58.1, V66.2, V67.2	99.25	Q0083, Q0084, Q0085, J8520, J8521, J8530, J8540, J8560, J8597, J8610, J8999, J9000-J9999 (exclude J9003, J9165, J9175, J9202 J9209, J9212, J9213, J9214, J9215, J9216, J9217, J9218, J9219, J9220, J9221, J9222 J9223, J9224, J9225, J9226, J9240, J9295, J9381, J9395), 96400-96549	0331, 0332, 0335

* - To be considered to have received whole breast irradiation, a patient must have documentation of at least 11 external beam radiation treatments on separate days. This criteria helps to exclude patients treated with external beam-based partial breast irradiation or palliative radiation, both of which are commonly 10 treatments.

Abbreviations: ICD (International Classification of Diseases), CPT (Common Procedural Terminology)

eTable 3. Claims codes for toxicity outcomes

ICD-9 Diagnosis Code	Description
Post-operative infection	
611.0	Inflammatory disease of breast
680.2	Carbuncle/furuncle of trunk including breast
682.2	Cellulitis/abscess of trunk including pectoral region, chest wall
682.3	Cellulitis/abscess of upper arm and forearm including axilla/shoulder
682.9	Cellulitis/abscess of unspecified site
686.X	Other local infections of skin and subcutaneous tissue including pyoderma, pyogenic granuloma, other, unspecified
998.51	Infected postoperative seroma
998.59	Other postoperative infection
035.X	Erysipelas
19020*	Mastotomy with exploration or drainage of abscess, deep
Post-operative non-infectious complication	
998.0	Post-operative shock
998.11	Hemorrhage complicating a procedure
998.12	Hematoma complicating a procedure
998.13	Seroma complicating a procedure
998.6	Persistent postoperative fistula
998.83	Non-healing surgical wound
998.89	Other specified complications
998.9	Postoperative complication NOS
Post-radiation complication	
508.0, 508.1	Radiation pneumonitis
611.3	Fat necrosis
611.71	Breast pain
807.0X-807.1X	Rib fracture

* - Common procedural terminology (CPT) code
 Abbreviations: ICD (International Classification of Diseases)

eTable 4. Proportional hazards regression model for predicting subsequent mastectomy for the propensity score-matched cohort

Predictor	N	# with mastectomy	HR	95% CI		P
Treatment factors						
Type of radiation						
WBI	6939	76	1	.	.	.
Brachytherapy	6939	151	1.87	1.36	2.58	<0.001
Chemotherapy						
no	12992	203	1	.	.	.
yes	886	24	1.93	0.72	5.17	0.19
Axillary lymph node surgery						
no	2378	44	1			
yes	11500	183	0.46	0.21	1.01	0.05
Patient factors						
Age (years)						

67-69	2776	54	1	.	.	.
70 – 74	4240	65	0.59	0.26	1.31	0.19
75 – 79	3712	53	0.66	0.29	1.52	0.33
≥ 80	3150	55	0.91	0.40	2.07	0.82

Race

White	13019	>200	1	.	.	.
Black	648	>15	1.69	0.63	4.54	0.30
Others	211	<11	3.65	0.83	16.14	0.09

This table reports adjusted (multivariate) HRs for the propensity score matched cohort stratified by matched pair (a total of 6939 matched pairs are included in the analysis). Covariates with residual imbalance at P<0.05 in the matched cohort are included in this model for adjustment only; to understand the association of covariates with the outcome, see Table 3. The unadjusted HR for brachytherapy versus WBI in this matched pair analysis is 1.86 (95% CI 1.37 - 2.52; P<0.001). Abbreviations: CI (confidence interval), HR (hazard ratio), WBI (whole breast irradiation). Cell sizes less than 11 are noted as “<11” in concert with privacy protections governing publications derived from this data source and adjacent cells have been modified accordingly to prevent calculation of cell sizes that are < 11.

eTable 5. Multivariate logistic model for post-operative infectious complication within one year of diagnosis

Predictor	N	# with infection within 1 year of diagnosis	OR	95% CI		P
Treatment factors						
Type of radiation						
WBI	85658	8852	1	.	.	.
Brachytherapy	6939	1124	1.76	1.64	1.88	<0.001
Chemotherapy						
no	79109	8206	1	.	.	.
yes	13488	1770	1.16	1.09	1.23	<0.001
Axillary lymph node surgery						
no	20458	1720	1	.	.	.
yes	72139	8256	1.31	1.24	1.39	<0.001
Patient and Tumor factors						
Age (years)						

67-69	19071	2021	1	.	.	.
70 – 74	28787	3188	1.06	1.00	1.12	0.07
75 – 79	25056	2644	1.01	0.95	1.07	0.87
≥ 80	19683	2123	1.04	0.98	1.12	0.21
Race						
White	85317	9311	1	.	.	.
Black	5089	457	0.77	0.70	0.86	<0.001
Other non-white	2191	208	0.80	0.69	0.93	0.004
Charlson Comorbidity score						
0	68417	6831	1	.	.	.
1	18269	2274	1.29	1.23	1.36	<0.001
2	4186	585	1.49	1.36	1.64	<0.001
3 or more	1725	286	1.86	1.63	2.12	<0.001
Axillary lymph node involvement						
no	81042	8259	1	.	.	.

yes	11555	1717	1.45	1.36	1.54	<0.001
Sociodemographic factors						
Region						
Northeast	20422	2164	1	.	.	.
West	14970	1690	1.06	0.99	1.14	0.11
Midwest	21392	2319	1.03	0.96	1.10	0.40
South	33074	3524	1.00	0.94	1.06	0.95
Missing	2739	279	0.86	0.74	0.99	0.04
Urban/Rural status						
Metropolitan area	74344	8006	1	.	.	.
Non-metropolitan area	17938	1915	0.99	0.93	1.06	0.80
Unknown	315	55	2.21	1.59	3.08	<0.001
Household median income						
<= \$39,823	23156	2473	1	.	.	.
\$39,824 - \$45290	23184	2478	1.00	0.94	1.07	0.90

\$45291 - \$53789	23116	2478	10.98	0.92	1.05	0.61
>= \$53790	23141	2547	1.03	0.96	1.11	0.36

Health services factors

Radiation oncologist density*

<= 6	23156	2516	1			
7-14	23200	2531	0.99	0.93	1.06	0.76
15-21	23104	2572	1.04	0.97	1.11	0.31
>= 22	23137	2357	0.94	0.88	1.01	0.08

*Per 1,00,000 persons in patient's county of residence.

This analysis is inclusive of 92,597 patients (138 patients with unknown variables regarding socioeconomic status were excluded (0.15% of the entire cohort) as reliable parameter estimates could not be calculated). This table reports adjusted (multivariate) ORs for all the variables above. Abbreviations: CI (confidence interval), OR (odds ratio), WBI (whole breast irradiation). Model fit is acceptable (P = 0.70; Hosmer and Lemeshow goodness of fit test)

eTable 6. Multivariate logistic model for post-operative non-infectious complication within one year of diagnosis

Predictor	N	# with non-infectious complication within 1 year of diagnosis	OR	95% CI		P
Treatment factors						
Type of radiation						
WBI	85658	7707	1	.	.	.
Brachytherapy	6939	1128	2.03	1.89	2.17	<0.001
Chemotherapy						
no	79109	7420	1	.	.	.
yes	13488	1415	1.04	0.97	1.11	0.25
Axillary lymph node surgery						
no	20458	1472	1	.	.	.
yes	72139	7363	1.36	1.28	1.45	<0.001

Patient and Tumor factors

Age (years)

67-69	19071	1734	1	.	.	.
70 – 74	28787	2745	1.06	0.99	1.13	0.08
75 – 79	25056	2451	1.09	1.02	1.17	0.009
≥ 80	19683	1905	1.09	1.01	1.17	0.02

Charlson Comorbidity score

0	68417	6215	1	.	.	.
1	18269	1929	1.17	1.11	1.24	<0.001
2	4186	465	1.26	1.14	1.39	<0.001
3 or more	1725	226	1.53	1.33	1.77	<0.001

Axillary lymph node involvement

no	81042	7419	1	.	.	.
yes	11555	1416	1.36	1.27	1.45	<0.001

Sociodemographic factors**Region**

Northeast	20422	1773	1	.	.	.
West	14970	1518	1.18	1.09	1.27	<0.001
Midwest	21392	2249	1.24	1.15	1.32	<0.001
South	33074	3034	1.06	0.99	1.13	0.09
Missing	2739	261	1.03	0.89	1.20	0.67
Urban/Rural status						
Metropolitan area	74344	7100	1	.	.	.
Non-metropolitan area	17938	1694	1.03	0.96	1.10	0.44
Unknown	315	41	1.71	1.19	2.46	0.004
Household median income						
<= \$39,823	23156	2071	1	.	.	.
\$39,824 - \$45290	23184	2219	1.06	0.99	1.13	0.11
\$45291 - \$53789	23116	2328	1.12	1.05	1.21	0.001
>= \$53790	23141	2217	1.10	1.02	1.18	0.012

Health services factors

Radiation oncologist density*

<= 6	23156	2205	1	.	.	.
7-14	23200	2093	0.93	0.87	1.00	0.06
15-21	23104	2279	1.03	0.96	1.10	0.41
>= 22	23137	2258	1.04	0.97	1.12	0.24

* Per 1,000,000 persons in patient's county of residence.

This analysis is inclusive of 92,597 patients (138 patients with unknown variables regarding socioeconomic status were excluded (0.15% of the entire cohort) as reliable parameter estimates could not be calculated). This table reports adjusted (multivariate) ORs for all the variables above. Abbreviations: CI (confidence interval), OR (odds ratio), WBI (whole breast irradiation). Model fit is acceptable (P = 0.83; Hosmer and Lemeshow goodness of fit test)