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Preoperative Delays in the US Medicare Population With Breast Cancer

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A B S T R A C T

Purpose
Although no specific delay threshold after diagnosis of breast cancer has been demonstrated to affect outcome, delays can cause anxiety, and surgical waiting time has been suggested as a quality measure. This study was performed to determine the interval from presentation to surgery in Medicare patients with nonmetastatic invasive breast cancer who did not receive neoadjuvant chemotherapy and factors associated with a longer time to surgery.

Methods
Medicare claims linked to Surveillance, Epidemiology, and End Results data were reviewed for factors associated with delay between the first physician claim for a breast problem and first therapeutic surgery.

Results
Between 1992 and 2005, 72,586 Medicare patients with breast cancer had a median interval (delay) between first physician visit and surgery of 29 days, increasing from 21 days in 1992 to 32 days in 2005. Women (29 days *v* 24 days for men; $P < .001$), younger patients (29 days; $P < .001$), blacks and Hispanics (each 37 days; $P < .001$), patients in the northeast (33 days; $P < .001$), and patients in large metropolitan areas (32 days; $P < .001$) had longer delays. Patients having breast conservation and mastectomies had adjusted median delays of 28 and 30 days, respectively, with simultaneous reconstruction adding 12 days. Preoperative components, including imaging modalities, biopsy type, and clinician visits, were also each associated with a specific additional delay.

Conclusion
Waiting times for breast cancer surgery have increased in Medicare patients, and measurable delays are associated with demographics and preoperative evaluation components. If such increases continue, periodic assessment may be required to rule out detrimental effects on outcomes.

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INTRODUCTION

Most published studies regarding delays focus on risks resulting from a delay in diagnosis of breast cancer,[1-3] suggesting that a delay is associated with lower disease-specific survival.[4] Paradoxically, current data do not demonstrate outcome differences from delays between diagnosis and surgery,[5,6] and although it has been suggested that this interval has increased,[7] overall breast cancer outcomes continue to improve.[8-10] Because breast cancer diagnostic procedures are typically nontherapeutic, the interval of concern should theoretically encompass the entire time from presentation to treatment of the disease.

There is a current trend to establish quality improvement standards for breast cancer treatment. The length of an undue delay remains undefined, largely because there are little data comprehensively examining this entire interval, and no prospective trial can ethically subject patients to intentional delays to determine a threshold for harm. Defining appropriate times to surgery can also be problematic because of variability in evaluation, the extent of imaging required, preoperative medical clearance, second opinions, and the time that patients require to make a decision when a treatment choice exists. Nonetheless, a shorter preoperative interval may improve patient satisfaction[11] and lower anxiety.[12]

Although there is little correlation with outcomes, time to surgery has now been suggested as a possible measure for surgeons,[13-15] even though there are few national data regarding time to treatment of breast cancer in the United States encompassing the entire interval spanning presentation to surgery. Studies evaluating times to surgery for

breast cancer are predominantly institutional and regional,[14,16-18] with few reports exploring factors associated with greater preoperative delay.[5,11]

On a national scale,[7,19] the preoperative interval has only been characterized in limited fashion for association between delays and preoperative factors.[7,20] Greater volumes of national data about treatment times for breast cancer exist for other countries, but the differences between health care systems may make such data irrelevant to the United States. This study was undertaken in the Medicare population to provide the first data detailing associations between evaluation components, surgery type, and interval length from the first physician appointment to the first therapeutic surgical procedure.

METHODS

Data were derived from the Surveillance, Epidemiology, and End Results (SEER) –Medicare linked claims database with approval from the National Cancer Institute.[21] This database matches SEER data with patient identifiers in the Medicare Master Enrollment File.[22]

Patients were included if they were likely to have claims from 1 year before and after the SEER month of diagnosis. Exclusion criteria are listed in Figure 1. All 16 applicable SEER registries were used to increase the external generalizability of the results. The SEER cancer diagnosis date is a clinical diagnosis date, specifying only a month and year. The interval between the first physician encounter and breast surgery was determined by searching from 1 year before to 1 year after the SEER diagnosis month. Patients having inconsistent or missing data were excluded. Although patients were restricted to their first breast cancer occurrence, those with a history of other malignancies were not excluded. Patients having preoperative radiotherapy or chemotherapy were excluded.[23]

Therapeutic intent was inferred by setting the therapeutic surgery date as that on which claims for one or more breast excision or mastectomy and one or more lymph node procedure were found, excluding patients having these performed on separate dates. Patients were defined as having a sentinel lymphadenectomy attempted or performed if a Medicare claim existed for sentinel node dye injection on that date and/or radionuclide injection on that date or up to 7 days prior.

Patients were classified as receiving breast-conserving surgery for claims including one or more local breast excision. Mastectomy patients included those having simultaneous local excisions. Bilaterality was not characterized because of difficulty distinguishing bilateral procedures from duplicate claims when modifiers were not reported.

The first clinician encounter was defined as the first visit having a breast-related diagnosis code ≤ 1 year before the SEER diagnosis date. These encounter dates and the definitive therapeutic surgery dates were established, defining the interval of interest. Thereafter, assessment within that interval was performed, excluding patients having neoadjuvant chemotherapy (defined by billing dates and codes). Although oral chemotherapeutic agents were not covered until 2006, chemotherapy claims are most accurate for agents used for breast cancer.[23] Imaging and procedures are enumerated by numbers of dates performed (eg, multiple mammographic studies on one patient on one date are counted as 1). Second breast cancers were characterized by the first day of their SEER month and year of diagnosis to establish diagnosis during their preoperative interval.

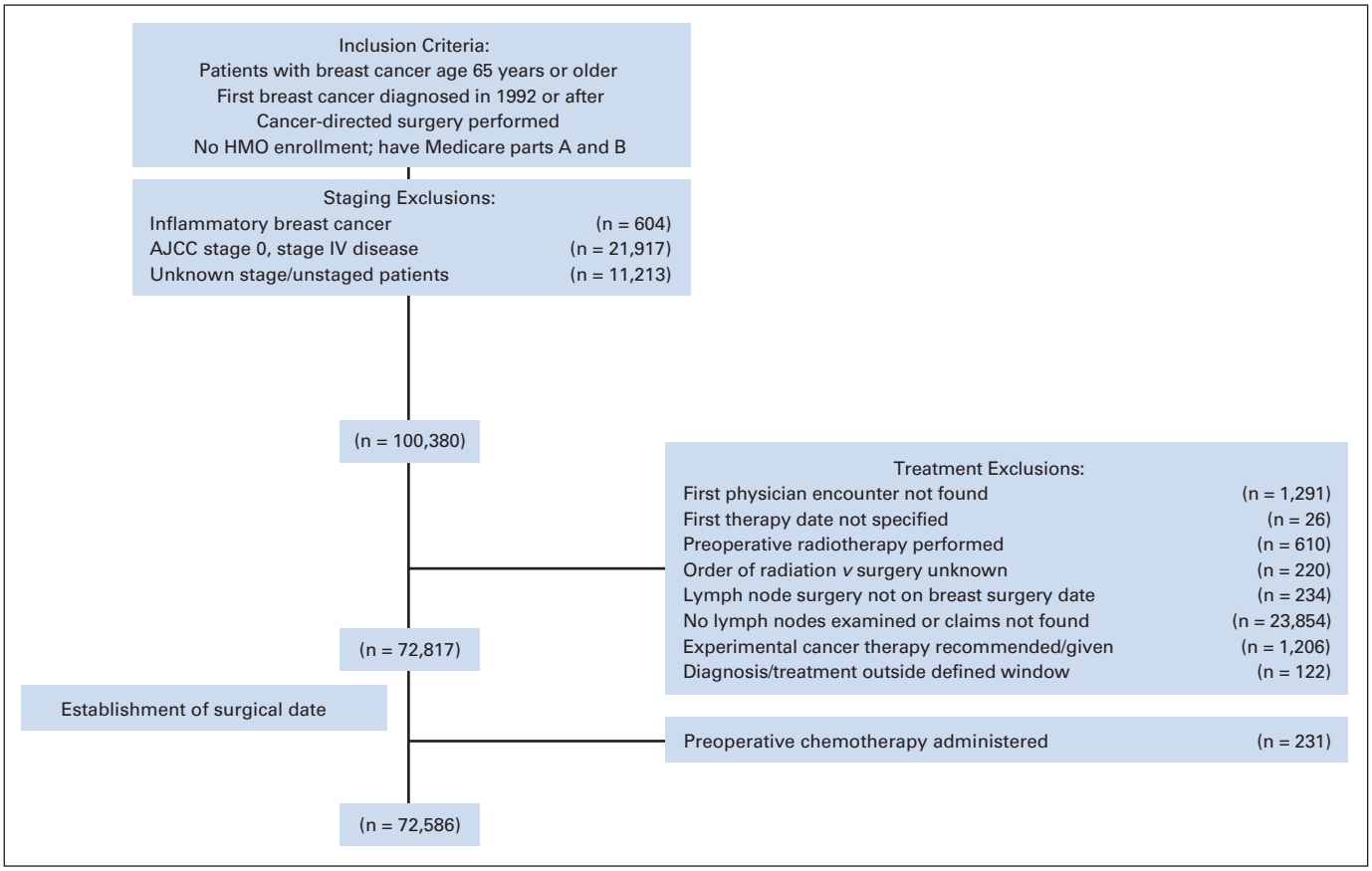

Fig 1. Cohort exclusion criteria. Numbers represent remaining patients after that set of exclusions. AJCC, American Joint Committee on Cancer; HMO, health maintenance organization.

Most data were derived from physician claims, supplemented by outpatient and inpatient hospital claims. All submitted Medicare claims were reviewed for relevant procedures and dates. If conflicts arose between Current Procedural Terminology codes and International Classification of Diseases Ninth Revision–Clinical Modification (ICD-9-CM) procedure codes, whose descriptions are less specific, Current Procedural Terminology data were preferentially used. If there were conflicts between physician and outpatient hospital claims, physician claims were used. The terms surgical delay and preoperative interval refer to the time interval from the first physician visit to first therapeutic surgery.

Because the preoperative interval distribution was highly skewed, median (quantile) regressions were used for analyses.[24] The bootstrap method with 1,000 repetitions was used for SEs. Charlson comorbidity index[25] was estimated from diagnosis codes using the method of Klabunde.[26,27] The diagnosis year was included as a restricted cubic spline[28] to account for variation over the 1992 to 2005 period.

Adjusted median delays were computed using mean covariate values and parameters estimated in the multivariable models. Evaluation components were first detailed in four models, focusing separately on imaging, biopsies, clinician visits, and operative procedures, each including demographic/tumor variables. To explore the effect of time on delay and the relation to practice pattern changes, the interval increase was assessed, adjusting for factors in the models. Statistical significance was set at $P = .05$ (two-sided). Analyses were performed using SAS software, version 9.2 (SAS Institute, Cary, NC), and STATA software, release 12 (StataCorp, College Station, TX).

RESULTS

Among patients developing invasive breast cancer after 1991 who were ≥ 65 years old and who underwent cancer-directed surgery, 72,586 patients remained after exclusions (Fig 1). Mean and median age were both 75 years, and median surgical delay was 29 days (interquartile [IQ] range, 15 to 51 days; mean, 56.5 days) with a mode of 15 days (n = 1,955; 2.7%; Fig 2). Overall median delay increased from 21 days in 1992 to 32 days in 2005. Breast-conserving surgery accounted for 23.4% of cancer-directed surgeries in 1992 (median delay, 22 days), increasing to 59.5% of surgeries in 2005 (median delay, 31 days). Delays for mastectomies began at 21 days in 1992, increasing to 34 days in 2005. In multivariable analysis, adjusted median surgical delay was notably greater for women (29 days *v* 24 days for men; $P < .001$; Table 1) and blacks and Hispanics (each 37 days *v* 28 days for whites; each $P < .001$).

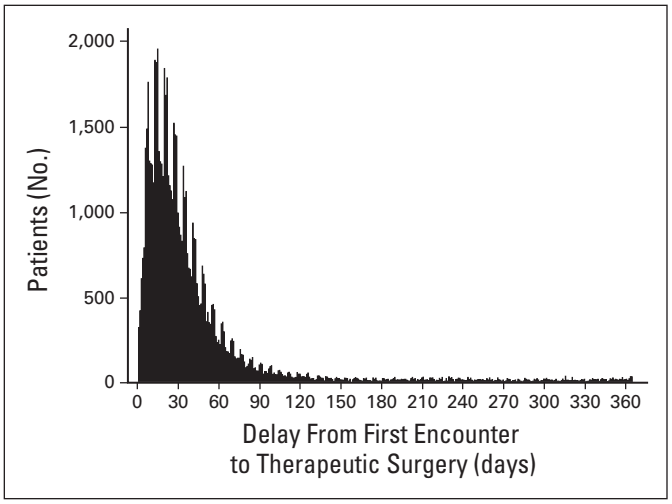

Fig 2. Interval length between first physician encounter and therapeutic surgery. Delay for all patients undergoing surgery within 365 days of first presentation. Each bar represents 1 day (total patients displayed, n = 70,988; 97.8%). Mode is 15 days (n = 1,955; 2.7%).

The three most frequent diagnosis codes for the first physician encounter were consistent, irrespective of surgical delay. These were for a breast mass (ICD-9-CM: 611.72; 50.6%), malignant breast neoplasm, site unspecified (ICD-9-CM: 174.9; 12.5%), and abnormal breast findings (ICD-9-CM: 793.8; 6.5%; Appendix Table A1, online only). Nearly 92% of patients had one evaluation/management claim on their initial encounter date (45.3% with surgeons, 17.7% with internists, 12.0% with family practitioners, and 5.6% with obstetrics/gynecology). The other 8% had either multiple evaluation/management claims (6%) or were found only in outpatient claims where specialty code is not provided (2%).

After the initial physician encounter, a mean of three encounters occurred within the interval, including established patient, consultation, and new patient visits. A mean of two established patient visits and 1.1 new patient/consultation visits occurred.

For patients having biopsy claims of any type within the preoperative interval (n = 50,830), median time from first visit to biopsy increased from 9 days (IQ range, 4 to 19 days) in 1992 to 13 days (IQ range, 6 to 30 days) in 2005 ($P < .001$), and median time from biopsy to surgery increased from 14 days (IQ range, 8 to 22 days) in 1992 to 22 days (IQ range, 14 to 34 days) in 2005 ($P < .001$). Except for multiple patient encounters, excisional biopsy added the greatest adjusted delay of any factor at 17 days, whereas reconstruction was associated with a 12-day adjusted added delay (Table 2). A collapsed model adjusting for factors listed in Table 1 noted overall contributions to delay by imaging, biopsies, additional visits, and mastectomy (*v* breast conservation) of 10.4, 12.9, 10.8, and 0.6 days, respectively (all $P < .001$, except mastectomy: $P = .0012$).

Mammography was identifiable in 67,751 patients (93.1%), including those performed during the preoperative interval and ≤ 6 months before it, with 34,229 of these women (50.5%) having mammography before the first physician visit and 8,387 (12.4%) having mammography both before the visit and during the preoperative interval. Among 21,169 patients (31.2%) having mammography solely within the preoperative interval, median time from visit to mammogram was 4 days (mean, 12.3 days), and unadjusted median surgical delay was 34 days (mean, 47.5 days). If a mammogram was performed solely in the 6 months before the preoperative interval, the median unadjusted preoperative interval length was lower at 22 days (n = 34,229; $P < .001$). Imaging and procedure codes are listed in Appendix Table A2 (online only).

During the preoperative interval, 50,830 patients (70.0%) had biopsy claims, excluding image guidance claims without an associated biopsy code. Of these, 84.4% had one biopsy date, 13.5% had two biopsy dates, and 2.1% had ≥ three biopsy dates. Among 3,858 patients (5.3%) who had a second breast cancer diagnosed with or after the index lesion, 52.3% of second breast cancers were found preoperatively and 25.8% (n = 995) were found within the preoperative interval. Unadjusted surgical delays for common operative combinations are listed in Table 3; greater delays of up to 49 days were associated with longer reconstruction procedures.

Table 1. Patient Demographics and Tumor Characteristics and Associated Surgical Delay

Demographic or Characteristic	No. of Patients (N = 72,586)	%	Multivariable Adjusted Delay (days)		
			Median	95% CI	Pairwise *P*
Sex					
Female*	71,865	99.0	29.3	29.0 to 29.5	—
Male	721	1.0	23.8	23.8 to 25.3	< .001
Age, years					
65-69*	15,772	21.7	29.4	28.9 to 29.8	—
70-74	20,465	28.2	29.4	29.0 to 29.8	.87
75-79	18,861	26.0	29.3	28.9 to 29.7	.69
80-84	11,750	16.2	28.9	28.4 to 29.4	.19
85+	5,738	7.9	28.4	27.7 to 29.0	.011
Race					
White*	64,804	89.3	28.6	28.4 to 28.8	—
Black	4,228	5.8	36.7	35.4 to 38.0	< .001
Asian	1,465	2.0	30.1	28.5 to 31.8	.072
Hispanic	851	1.2	36.8	34.5 to 39.1	< .001
Native American	131	0.2	30.9	28.1 to 33.7	.11
Other/unknown	1,107	1.5	29.3	27.7 to 30.9	.39
Charlson comorbidity index					
0*	50,413	69.5	28.7	28.4 to 29.0	—
1	15,030	20.7	30.1	29.7 to 30.6	< .001
2	4,688	6.5	30.3	29.5 to 31.2	< .001
3-10	2,455	3.4	31.7	30.5 to 32.9	< .001
Setting†					
Large metropolitan*	41,338	57.0	31.7	31.4 to 32.1	—
Metropolitan	20,007	27.6	26.4	26.1 to 26.8	< .001
Urban	4,540	6.3	26.3	25.5 to 27.1	< .001
Less urban	5,541	7.6	23.8	23.2 to 24.5	< .001
Rural	1,160	1.6	23.6	22.3 to 25.0	< .001
Region‡					
Northeast*	12,458	17.2	33.3	32.7 to 33.9	—
South	9,345	12.9	25.3	24.7 to 25.8	< .001
Midwest	16,250	22.4	28.6	28.2 to 29.0	< .001
West	34,533	47.6	29.1	28.7 to 29.4	< .001
Histology					
Invasive ductal*	62,458	86.0	28.9	28.6 to 29.1	—
Invasive lobular	7,929	10.9	31.8	31.1 to 32.6	< .001
Other/unknown	2,199	3.0	29.6	28.5 to 30.8	.19
Second breast cancer identified preoperatively§					
None*	71,591	98.6	28.9	28.7 to 29.2	—
Second cancer found	995	1.4	49.1	45.8 to 52.4	< .001
AJCC stage‖					
3rd edition					
I*	30,790	42.4	31.2	30.8 to 31.6	—
IIA	15,774	21.7	28.3	27.8 to 28.8	< .001
IIB	7,777	10.7	26.5	25.9 to 27.0	< .001
IIIA	1,971	2.7	25.9	24.6 to 27.2	< .001
IIIB	1,180	1.6	23.7	22.0 to 25.4	< .001
6th edition					
I	8,367	11.5	28.8	27.8 to 28.0	< .001
IIA	3,696	5.1	28.0	26.7 to 29.3	< .001
IIB	1,470	2.0	27.6	25.7 to 29.5	< .001
IIIA	902	1.2	29.3	26.9 to 31.6	.12
IIIB	242	0.3	27.1	23.3 to 31.0	.042
IIIC	417	0.6	26.9	22.8 to 31.0	.042

Abbreviation: AJCC, American Joint Committee on Cancer.

*Referent value for pairwise univariate comparisons.

†Setting definitions are as follows: large metropolitan = counties in metropolitan areas of ≥ 1,000,000 population; metropolitan = counties in metropolitan areas of < 250,000 to 1,000,000 population; urban = urban population of ≥ 20,000 adjacent or nonadjacent to a metropolitan area; less urban = urban population of 2,500 to 19,999 adjacent or nonadjacent to a metropolitan area; and rural = completely rural or < 2,500 urban population, adjacent or nonadjacent to a metropolitan area.

‡Region groupings are as follows: northeast = Connecticut and New Jersey registries; south = Atlanta, rural Georgia, Kentucky, and Louisiana registries; midwest = Detroit and Iowa registries; and west = Hawaii, New Mexico, Seattle, Utah, and California registries.

§Includes ipsilateral and contralateral breast.

‖AJCC 3rd edition in use from 1992 to 2003; AJCC 6th edition in use from 2004 to 2005. Eight patients were listed as stage III, not otherwise specified, and could not be subclassified between stage IIIA or IIIB. These eight patients were combined with stage IIIA.

Table 2. Four Separate Multivariable Models for Contributed Delay by Preoperative Evaluation Component

Preoperative Evaluation Component	No. of Patients	%	Multivariable Analysis			
			Adjusted Median Delay (days)	Associated Delay (days)	95% CI	Pairwise *P*
Preoperative imaging						
No mammogram use*	38,461	53.0	24.6	—		
Mammogram use	34,125	47.0	38.7	14.1	13.7 to 14.6	< .001
No ultrasound use*	52,260	72.0	28.9	—		
Ultrasound use	20,326	28.0	37.3	8.3	7.7 to 9.0	< .001
No breast MRI use*	70,018	97.8	31.1	—		
Breast MRI use	1,568	2.2	37.5	6.4	4.7 to 8.1	< .001
No CT use*	65,420	90.1	29.9	—		
CT use	7,166	9.9	43.2	13.3	12.1 to 14.4	< .001
No bone scan use*	62,271	85.8	30.4	—		
Bone scan use	10,315	14.2	36.5	6.1	5.3 to 6.8	< .001
Preoperative biopsies						
FNA						
None*	69,616	95.9	29.7	—		
1	2,854	3.9	35.6	6.0	4.8 to 7.1	< .001
≥ 2	116	1.9	52.3	22.6	10.6 to 34.7	< .001
Core needle biopsy						
None*	48,379	66.7	25.4	—		
1	22,863	31.5	38.1	12.7	12.2 to 13.2	< .001
≥ 2	1,344	1.9	52.7	27.3	24.1 to 30.5	< .001
Excisional biopsy						
None*	42,038	57.9	22.3	—		
1	26,834	37.0	39.6	17.4	16.9 to 17.8	< .001
≥ 2	3,714	5.1	46.8	24.6	23.2 to 25.9	< .001
Preoperative clinician visits†						
Established patient encounters						
No additional visits*	23,804	32.8	20.8	—		
1 additional visit	21,032	29.0	26.8	6.0	5.8 to 6.3	< .001
≥ 2 additional visits	27,750	38.2	50.6	29.8	29.1 to 30.4	< .001
New patient/consultation encounters						
No additional visits*	25,387	35.0	24.9	—		
1 additional visit	27,566	38.0	32.7	7.9	7.5 to 8.2	< .001
≥ 2 additional visits	19,633	27.1	47.4	22.5	22.0 to 23.0	< .001
Operative procedure						
Breast procedure type						
Breast conservation*	33,775	46.5	27.9	—		
Mastectomy	38,811	53.5	30.3	2.3	1.9 to 2.8	< .001
Nodal evaluation						
Sentinel node biopsy‡						
Blue dye alone*	7,944	10.9	27.8	—		
Use of radionuclide	14,895	20.5	30.1	2.3	1.4 to 3.1	< .001
Axillary dissection§	49,747	68.6	29.1	1.3	0.4 to 2.2	.0023
Simultaneous reconstruction						
None*	71,381	98.3	29.0	—		
Performed	1,205	1.7	41.1	12.2	10.2 to 14.1	< .001

NOTE. Each model's multivariable analysis is adjusted for each of the factors listed in Table 1 and the year of diagnosis. Associated delay refers to the coefficient, which is the time added to the preoperative interval that is associated with the factor in question.

Abbreviations: CT, computed tomography; FNA, fine-needle aspiration; MRI, magnetic resonance imaging.

*Referent.

†Does not include the first clinician visit.

‡Not exclusive of axillary dissection; includes those attempted or performed.

§Exclusive of sentinel node biopsy. Group includes nonsentinel axillary node biopsies/sampling and 16 patients with internal mammary lymph node biopsies.

Multivariable analyses in Table 2 elaborate adjusted added delays associated with each factor. The unadjusted surgical delay for all patients increased by 11 days between 1992 and 2005 ($P < .001$), dropping to a 5-day increase ($P < .001$) when adjusted for factors in Tables 1 and 2.

DISCUSSION

In this study, we noted increases in the time to surgery overall and specific delays associated with imaging modalities, biopsy methods,

Table 3. Surgical Delay by Specific Surgical Procedure Type

Procedure Category	No. of Patients	%	Surgical Delay (days)	
			Median*	Interquartile Range
All breast conservation procedures	33,775	46.5	29	16-52
All mastectomy procedures	38,811	53.5	28	15-50
All mastectomy procedures without reconstruction	37,606	96.9	28	15-50
All mastectomy procedures undergoing any immediate reconstruction	1,205	3.1	43	26-77
Immediate implant reconstruction	967	2.5	42	26-77
Immediate autogenous tissue reconstruction	197	0.5	46	28-77
Immediate autogenous tissue and implant reconstruction	14	0.04	49	30-85
Immediate reconstruction of an unspecified type	27	0.07	35	21-70
Specific common procedures				
Lumpectomy with sentinel lymphadenectomy (with or without axillary lymphadenectomy)	17,063		31	17-55
Mastectomy with sentinel lymphadenectomy (with or without axillary lymphadenectomy) with no simultaneous reconstruction	2,356		36	20-67
Mastectomy with sentinel lymphadenectomy (with or without axillary lymphadenectomy) with simultaneous reconstruction	220		47	29-125
Modified radical mastectomy with no simultaneous reconstruction	31,378		27	14-48
Modified radical mastectomy with simultaneous reconstruction	830		41	25-70

*Medians represent unadjusted surgical delay.

clinician visits, and operative procedures, irrespective of demographics, comorbidities, second breast cancers, and cancer stage. The specific contribution by each preoperative component has not previously been published to our knowledge, and our racial disparity findings provide specifics to previously noted delays.[19,20] The data herein provide the first comprehensive preoperative delay information for components of the evaluation, which has been needed as greater consideration has been given to using time to surgery as a quality measure.

In this analysis, unlike in prior series, we felt that surgical waiting times must include analysis of the associated surgical procedures. We have found that breast cancer procedures have varied waiting times, probably because procedures must be scheduled into available operating room time, and longer procedures, those requiring coordination with other departments (such as nuclear medicine), and those involving coordination between surgeons may be more difficult to schedule. This is demonstrated by greater times for mastectomies, radionuclide use for sentinel node biopsy (*v* use of blue dye alone), and cases involving simultaneous reconstruction. These findings may enable individual institutions and surgeons to improve times to surgery by predicting the impact of these components and assessing their times relative to the country for the common procedures delineated in Table 3. Despite accounting for metropolitan setting and US region, we found that racial disparities for time to surgery remained, although whether these are a result of financial, prejudicial, cultural, or other factors remains unknown. It must also be recognized that a statistically significant difference in delay may be different than a clinically significant one. Until outcomes data support a specific problematic threshold, the reader must make a judgment about whether the delays seen here are clinically meaningful.

There is less available data on waiting times to surgery in the United States than there is for Canada and the United Kingdom. In a series from Ontario evaluating the practices of 62 surgeons in eight cancer centers, breast and other cancer types were combined.[29] Median time from first visit to treatment decision was 0 days, median time from treatment decision to surgery was 20 days, and median time from referral to surgery was 37 days. In the United Kingdom, treatment times varied once a 2-week waiting rule for patients with breast cancer was implemented.[30] In the United Kingdom and Canada, breast cancer survival is slightly lower than in the United States,[31] although it remains unknown whether this is associated with preoperative delay or other factors.[32,33]

In the most comprehensive US study to date, analysis of Commission on Cancer hospitals composing the National Cancer Data Base (NCDB) demonstrated that cancer surgery waiting times have increased for all cancer sites evaluated, including breast, between 1995 and 2005.[7] This NCDB study did not evaluate surgical specifics, but like their overall increase in time to surgery, we found delays increasing from 21 days in 1992 to 32 days in 2005, with similar trends for breast conservation and mastectomies. Although our study was unable to determine whether a single institution performed evaluation and treatment, the NCDB study noted a median waiting time from diagnosis to treatment of 22 days when performed at the same institution versus 26 days if performed at different hospitals. We noted a greater delay associated with increasing numbers of physician visits. These may include plastic surgery or other specialists, second opinions, or transfers of care, consistent with those NCDB findings. Although clinician specialty at presentation theoretically may also be associated with different delays, neither our study nor the NCDB study evaluated this. Instead, we felt that the number of clinician visits was more pertinent than specialty and better reflected practice patterns, which may vary widely even within specialty.

Curiously, we noted a sawtooth pattern in the time to surgery consisting of 3-day spikes, each centered at regular 7-day intervals (Fig 2). Fedewa et al[20,34] plotted similar sawtooth patterns in two studies evaluating times to any first treatment in minorities[20] and to postoperative chemotherapy,[34] although they did not comment on the shapes of their histograms. We believe that this consistent finding demonstrates a real pattern of care in waiting times nationwide and is related to specific days of the week when clinic or operating room

block time is scheduled, as well as weekend days when fewer facilities are open.

Time-specific quality indicators for breast cancer have previously been developed. The National Comprehensive Cancer Network and American Society of Clinical Oncology endorsed[35] three such criteria, namely the start of radiotherapy within 1 year of diagnosis, hormonal agent use within 1 year of diagnosis, and receipt of adjuvant chemotherapy within 120 days of diagnosis. The National Quality Forum has endorsed this last measure for women with hormone receptor–negative breast cancer based on an average of 30 days from initial diagnosis to completing surgery.[35] Nevertheless, outcome differences have not been noted in several studies evaluating delays in waiting times to surgery,[5,6] chemotherapy administration[34] up to 12 weeks,[36] and radiotherapy up to 20 weeks.[37,38] Such studies must be retrospective, as ethics prohibits prospectively subjecting patients to intentional delay to assess consequent harm, and it behooves the clinician to provide as timely care as feasible. Still, some systems such as the United Kingdom's National Health System are also now considering abandoning measured performance targets for patient waiting times,[39] presumably because of practical considerations.

The rate of increase in time to surgery seen here was lessened by adjusting for the demographic and preoperative evaluation components assessed. This suggests that a change in practice patterns may be contributing to that increasing delay. Whether this represents changes in breast cancer presentation or greater numbers of episodes of care (ie, visits, biopsies, imaging, and so on) remains uncertain, but with a growing patient population, any defined acceptable preoperative interval length may become increasingly difficult to achieve. More episodes of care may cause delay but may allow for better assessment of treatment alternatives, because there have been changes in treatment standards over time associated with improvements in outcomes.[10,40-42] The paradox of increasing surgical delay during such improvements suggests that the effect of small preoperative delays should not be overstated, and the association of defined delays with each preoperative component may demonstrate that some delays are unavoidable. Although delay may be associated with anxiety, the delays associated with evaluation components are short. Excisional biopsy demonstrated the largest adjusted delay, adding 17 days, but this is no longer standard of care for diagnosis,[43] and it is unlikely that even this would affect outcomes.

It must be recognized that the supply of clinicians or other resources may also affect delay, and we could not assess some factors that undoubtedly contributed, such as patient decision-making time and the scheduling challenges of the patient and clinician. We also noted that only 70% of patients had identifiable biopsy claims in the preoperative interval. This may reflect image guidance claims billed without the biopsy codes, biopsies performed before the first clinician visit, and excisional biopsies performed at the therapeutic surgery. Additionally, the short delay associated with breast magnetic resonance imaging (MRI) relative to ultrasound and mammography was also surprising (Table 1) in light of prior data reported by us[44] and others[11,16,45] noting a greater interval difference with breast MRI in the routine preoperative setting. Breast MRI was only performed in 2% of these patients, however, and their indications remain unknown. Ductograms, positron emission tomography scans, and brain MRIs, each performed in less than 1% of patients, were not included because of their rarity. We predicted that procedural bilaterality may also affect waiting times and attempted to assess this, but we had concerns about accuracy. This was also highly correlated with second cancers, which were included in our models. We also noted a low number of reconstruction claims, although this may be reflective of delayed reconstruction, cohort age, or period of study because reconstruction use has increased over time.[46]

Despite potential limitations, the SEER-Medicare data set has been demonstrated to be accurate for several aspects of care,[22,23,47] and although these trends and associations cannot be assumed to be generalizable to the commercially insured or uninsured US population, the highest breast cancer age-specific incidence rates for men and women occur in those older than 65 years, who are eligible for Medicare.[48] As patient numbers grow and resources become fewer, increasing delays may require periodic assessment to ensure that there is no detrimental effect on breast cancer outcomes.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The author(s) indicated no potential conflicts of interest.

AUTHOR CONTRIBUTIONS

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Appendix

Table A1. Most Frequent ICD-9-CM Primary Breast Diagnosis Codes Appended to First Clinician Encounter, in Use for ≥ 100 First Encounters, and Accounting for 99%

Breast-Related Diagnosis Code	Description	No.	%
611.72	Lump or mass in breast	36,712	50.6
174.9	Malignant neoplasm of breast (female), unspecified	9066	12.5
793.8	Abnormal findings of breast	4741	6.5
610.1	Diffuse cystic mastopathy	3050	4.2
793.80	Abnormal mammogram, unspecified	2942	4.1
174.4	Malignant neoplasm of upper outer quadrant of female breast	1707	2.4
611.71	Mastodynia	1199	1.7
238.3	Neoplasm of uncertain behavior of breast	1110	1.5
174.8	Malignant neoplasm of other specified sites, female breast	1096	1.5
239.3	Neoplasm of unspecified nature of breast	1080	1.5
610.0	Solitary cyst of breast	787	1.1
793.81	Mammographic microcalcification	631	0.9
793.89	Other (abnormal) findings on radiologic exam of the breast	615	0.9
233.0	Carcinoma in situ of breast	594	0.8
611.79	Other signs and symptoms in breast	578	0.8
174.1	Malignant neoplasm of central portion of female breast	568	0.8
217	Benign neoplasm of breast	544	0.8
611.9	Unspecified breast disorder	519	0.7
174.2	Malignant neoplasm of upper inner quadrant of female breast	429	0.6
611.0	Inflammatory disease of breast	398	0.6
V10.3	Personal history of malignant neoplasm of breast	395	0.5
782.2	Localized superficial swelling, mass, or lump	321	0.4
174.5	Malignant neoplasm of lower outer quadrant of female breast	295	0.4
610.9	Benign mammary dysplasia, unspecified	269	0.4
786.6	Swelling, mass, or lump in chest	247	0.3
174.3	Malignant neoplasm of lower inner quadrant of female breast	246	0.3
173.5	Other malignant neoplasm of skin of trunk, including breast	245	0.3
V76.12	Other screening mammogram	239	0.3
174.0	Malignant neoplasm of nipple and areola of female breast	228	0.3
611.8	Other specified disorders of breast	209	0.3
V76.10	Breast screening, unspecified	170	0.2
610.2	Fibroadenosis of breast	152	0.2
V16.3	Family history of malignant neoplasm of breast	138	0.2
611.7	Signs and symptoms in breast	117	0.2
174	Malignant neoplasm of female breast	104	0.1

Abbreviation: ICD-9-CM, International Classification of Diseases, Ninth Revision–Clinical Modification.

Table A2. Operative CPT Codes and ICD-9-CM Procedure Codes

Simplified Group Description	CPT Codes	ICD-9-CM Procedure Codes
Excisional biopsy	19120, 19125, 19126	85.12, 85.2, 85.20, 85.21, 85.22, 85.24, 85.25
Lumpectomy/segmental mastectomy	19160, 19301	85.20-85.25
Lumpectomy and lymph node combined procedures	19162, 19302	
Mastectomy	19180, 19303, 19182, 19304	85.40-85.42, 85.34, 85.36
Mastectomy and lymph node combined procedures	19240, 19307, 19220, 19306, 19200, 19305	85.43-85.48
Lymph node excision procedures	38500, 38525, 38530, 38740, 38745	40.11, 40.22, 40.23, 40.29, 40.3, 40.5, 40.50, 40.51
Sentinel node injections	38792, 38900, 38790, 78195	40.19, 85.19, 92.16
General reconstruction	19324, 19366	85.50, 85.7, 85.70, 85.8
Implant reconstruction	19325, 19340, 19357	85.33, 85.35, 85.53, 85.54, 85.95, 85.99
Autogenous tissue flap reconstruction	19364, 19361, 19362, 19367, 19368, 19369, 69990, 09920, −20	85.71-85.76, 85.79, 85.84, 85.85
Chemotherapy administration	96400-96402, 96405, 96406, 96408-96417, 96420, 96422, 96423, 96425, 96440, 96445, 96450, 96520-96523, 96530, 96542, 96545, 96549, 99601, 99602, 0636, 331-333	99.25
Mammography	76082, 76083, 76085, 76090, 76091, 76092, 77051, 77055-77057(-52), G0202(-52)-G0207, G0236	87.36, 87.37
Ductography/galactography	19030, 76086-76089, 77053, 77054	85.19
Breast and axillary ultrasound	76645, 76880-76882	88.73
Breast MRI	76093, 76094, 77058, 77059, 76376, 76377	88.97
CT	70450, 70460, 70470, 70480-70482, 70486-70488, 70490-70492, 71250, 71260, 71270, 72125-72133, 72192-72194, 73200-73202, 73700-73702, 74150, 74160, 74170, 74176-74178, 76497	87.03, 87.41, 87.71, 88.01, 88.38
PET and PET-CT	78811-78816, 78890, 78891, 78999, G0235, G0253, G0254	92.11, 92.12, 92.18, 92.19
Bone scan	78300, 78305, 78306, 78315, 78399	92.14
Brain MRI	70551-70553	88.91

NOTE. All procedure codes for the time period encompassed by the study were included.
Abbreviations: CPT, Current Procedural Terminology; CT, computed tomography; ICD-9-CM, International Classification of Diseases, Ninth Revision–Clinical Modification; MRI, magnetic resonance imaging; PET, positron emission tomography.