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Variation in staging and treatment of local and regional breast cancer in the elderly

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Summary

Background: Few studies of practice variation in the management of early breast cancer for elderly women have examined the process of care in depth. This study evaluated the effects of age and other factors on surgical staging techniques and treatment.
Methods: Virginia cancer registry data were linked with Medicare claims and 1990 census data. The sample included all newly diagnosed patients with pathologic confirmed local and regional breast cancer in 1985-1989 (n=3,361). Analyses included descriptive univariate statistics and multiple logistic regression analysis for staging and treatment alternatives. Process of care variables included tumor size determination, axillary lymph node dissection, use of adjuvant therapy, and radiation if breast conserving surgery (BCS) was performed.
Results: About 75 percent of women had tumor size and axillary node dissection. Increasing comorbidity was associated with a lower likelihood of axillary node dissection. Nine percent of local compared to 44 percent of regional disease patients received adjuvant therapy. Hormonal therapy increased from 13 percent of women in 1985-1988 to 24 percent in 1989. Hormonal therapy did not vary with patient age. One-third of the patients with positive lymph nodes compared to 8 percent of node negative women received hormonal therapy. Blacks were more likely to present with advanced disease. A logistic regression model evaluated the multiple effects of patients and clinical characteristics: older women were more likely to present with larger tumors, were less likely to have axillary node dissections, and were less likely to receive chemotherapy or radiation.
Conclusions: Younger age was most consistently associated with staging and the use of chemotherapy in this cohort of elderly breast cancer patients. Based on the reported initial treatment plan, hormonal therapy was infrequently used and information from axillary lymph node assessment was used to stratify treatment. Although the low use of adjuvant hormonal therapy in elderly women may compromise survival, neither comorbid nor socioeconomic factors as measured in this study explained this practice pattern.

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Introduction

The initial therapy of invasive breast cancer is the most extensively studied area of practice variation in oncology. Researchers have focused on the variation in the use of breast-conserving surgery (BCS) for localized cancer. For BCS the primary predictors are patient age and geographic location. Health care organization factors such as metropolitan residence, on-site radiation therapy, and medical school affiliation, though less important, have also been identified as predictors of BCS [1-3].

Despite the plethora of data on BCS, few studies have addressed variation and the quality of care for invasive breast cancer beyond the initial surgical approach [3,4]. In order to perform such studies, detailed clinical data about the cancer is needed including anatomic stage such as tumor size and axillary nodal assessment, the use of adjuvant therapies or radiation therapy with BCS, and severity of co-morbidities.

This retrospective assessment of the patterns of breast cancer care in Virginia from 1985-1989 used a linked dataset from the Virginia tumor registry, Medicare files, and census data. The analyses principally concentrate on the process of care to determine if practice variation exists and seek to identify clinical, socioeconomic, and co-morbid factors associated with variation in the management of local and regional breast cancer for the elderly.

Methods

Data sources

Data for this study were obtained from the Virginia Cancer Registry (VCR), Medicare Provider Analysis and Review (MEDPAR) file for hospital utilization and payment, Medicare Health Insurance Master File (HCFA) to confirm Medicare eligibility, Medicare Annual Demographic Files, Area Resource File (ARF), and the 1990 Census Data for socioeconomic characteristics based on zipcode of residence.

During this period, the registry collected data on a voluntary basis from approximately 50 hospitals representing about 85 percent of the state's hospital beds. Data were collected from a chart audit of initial treatment and planned subsequent treatment. All participating hospitals were either American College of Surgeons approved programs or were collecting data seeking approval status. All cases in this analysis had pathologic confirmation.

Sample

The sample included all persons with a new diagnosis of breast cancer aged 65 or older who were reported to the VCR from 1985 through 1989 [5,6]. The total number of cases was 5,005, or about one thousand per year. During the same period the American Cancer Society estimated an expected 3,500 new breast cancer cases in Virginia with about 45 percent being in women age 65 or more [7]. This suggests that the VCR captured approximately 63 percent of breast cancer cases. There were 1674 cases that were excluded due to the following reasons in decreasing frequency: non-Virginia residence, women who had metastatic disease at the time of their first identification of cancer, carcinoma in situ, enrollment in a health maintenance organization (HMO), breast cancer diagnosed at autopsy, and patients with multiple cancers. HMO patients were excluded due to their lack of MEDPAR data on utilization under Medicare risk contracts.

Analytic variables

Race and sex were used from the VCR. Age at diagnosis was taken from the HCFA file. Availability of health care resource characteristics in the patient's county of residence was obtained from the ARF. The ARF was supplemented by data from HCFA about hospital characteristics including size, medical school teaching affiliation,

location (urban, other urban, or rural), and the number of radiation oncologists and surgeons in each county. The 1990 Census Bureau zipcode level file was used to identify median income and education for persons 65 and older in the patient's residence zipcode based on race and age.

A comorbidity index ranging from zero to six was constructed using the ICD-9 diagnostic codes from the index hospitalization before diagnosis. The index was based on a modified Charlson Index for ICD-9 Clinical Modification codes [8,9]. The index was modified for use in this study by excluding breast, lung, and colorectal cancer as comorbid conditions. This modification was necessary since the standard Charlson index would overestimate comorbidity since all solid tumors ICD-9 diagnoses are rated at least a three [8].

This study examined the patterns of initial breast cancer surgery, staging, and adjuvant treatment. Initial therapy included treatment reported from the VCR as received and planned at the time of diagnosis for the initial year after diagnosis. This was supplemented by any treatment HCFA claim up to six months after diagnosis. The initial therapy was classified as primary surgery, primary surgery plus adjuvant therapy, no therapy, or non-surgical therapy. Primary surgery included various forms of mastectomy and BCS. Adjuvant therapy was defined as anti-hormonal therapy (tamoxifen) or chemotherapy. Radiation therapy following BCS was not considered to be an adjuvant treatment. Non-surgical therapy included radiation, chemotherapy, or anti-hormonal therapy without associated surgery. If a discrepancy between the VCR and MEDPAR occurred, the more extensive therapy was used. For example, if the VCR reported BCS and MEDPAR reported mastectomy, treatment was coded as mastectomy. No attempt was made to verify the data by reviewing individual patient charts.

Only 55 percent of cases had complete TNM (tumor size, location and number of lymph nodes, and metastases) staging. Therefore, stratification of TNM reporting by hospital characteristics was not possible and the identification of individual hospitals was not available. For these reasons, a summary staging system (local, regional, and distant disease) from the VCR was used. Summary staging does not allow differentiation by tumor size needed to classify TNM stage I and II disease. Regional stage was defined by direct tumor extension, axillary node involvement, or the combination. Tumor size was taken from the VCR. When tumor size was missing, the specific cause could not be identified (e.g., failure to perform, request, or record). Lymph node status was reported as the number of lymph nodes examined and the number positive of those examined.

Analyses

Analyses were done using SAS. Univariate descriptive statistics and multiple logistic regressions were performed to assess factors associated with staging and treatment. The degrees of freedom for all chi-square tests were two.

Results

The final sample was 3,361. The number of new cases was nearly constant at about 750 per year. Local or regional summary stage distribution, primary therapy, and racial breakdown are shown in Table 1. The summary stage breakdown was 69.6 percent local and 30.4 percent regional disease. Of local or regional cases, about 2 percent received no therapy, 3 percent received only non-surgical therapy, 20 percent surgery plus adjuvant therapy, and 75 percent surgery alone. The following results are limited to the 95 percent of women who received surgical therapy. The results are divided into those related to staging and those related to treatment.

Tumor size

Tumor size was missing in 25.2 percent for local

Table 1. Summary stage distribution, type of initial therapy, and race

	Local (n=2339)	Regional (n=1022)
Type of initial therapy		
Surgery	89%	50%
Surgery + adjuvant therapy	9%	44%
Non-surgical therapy	2%	4%
No therapy	1%	2%
Race		
Whites	71%	29%
Blacks	56%	44%

Data are from Medicare eligible women reported to the Virginia Cancer Registry in 1985-1989. 335 women with metastatic disease and 417 women with in-situ cancer were excluded.

and 22.2 percent for regional disease. No patient demographic or treatment variables were associated with missing tumor size. The logistic regression model found that larger tumor size was associated with positive axillary nodes and increasing age (Table 2).

Axillary nodal assessment

24.6 percent of women did not have an axillary lymph node evaluation. About 13 percent of women did not have an axillary node evaluation but did have tumor size reported. Among women with tumor size not reported, twice as many women (41 percent vs. 20 percent, O.R. 2.8, C.I. 2.36,3.37, p<0.001) did not have an axillary node assessment.

The frequency of axillary node evaluation declined with age. 18 percent of women age 65 to 79 did not have an axillary nodal evaluation. This increased to 33 percent in women age 80-84 and 48 percent age 85 and up (chi-square=151, p<0.001 for age trend). The modified Charlson comorbidity index was associated with axillary node evaluation. Twenty-one percent of women who did not have an axillary node dissection had a comorbidity score of one or more compared with 16.5 percent of women who had an axillary node dissection (OR=3.37 C.I.=2.78,4.09, p<0.0001).

Adjuvant therapy

Using summary staging, 9 percent of women with local disease and 44 percent with regional disease received surgery plus an adjuvant therapy (Table 1). When stratifying by nodal status, adjuvant therapy was given to 9 percent of node negative women, 13 percent of women with nodes not examined, 42 percent of women with one to three positive axillary nodes, and 52 percent of women with four or more positive axillary nodes (Figure 1).

Chemotherapy was rarely used except among

Table 2. Logistic regression of factors predicting staging in local and regional breast cancer

Dependent variable	Independent variable*	Odds ratio (C.I.)	p-value
Tumor size ≥ 20 mm	Positive axillary nodes	2.76 (2.30,3.33)	0.0001
	Increasing age, per 10 yrs	1.32 (1.14,1.54)	0.008
	Other urban hospital	0.70 (0.55,0.90)	0.03
Axillary nodes not examined	Increasing age, per 10 yrs	2.45 (2.01,2.99)	0.0001
One or more (+) axillary nodes	White race	0.54 (0.37,0.78)	0.0001

* Only dependent variables found statistically significant (p<0.05) in logistic regression model are shown. However, each model included the following variables: age, race (black/white), marital status (married/ unmarried), comorbidity (0 to 3), median income in resident's zipcode, median educational level in resident's zipcode, physician density in resident's county (surgeons and radiation oncologists), urban vs. rural residence, positive (one or more) axillary lymph nodes vs. none, tumor size, hospital size, hospital teaching affiliation, and hospital location (large urban, other urban, rural). Data about the number of breast cancer cases per year or American College of Surgeon approval status at each hospital were not available.

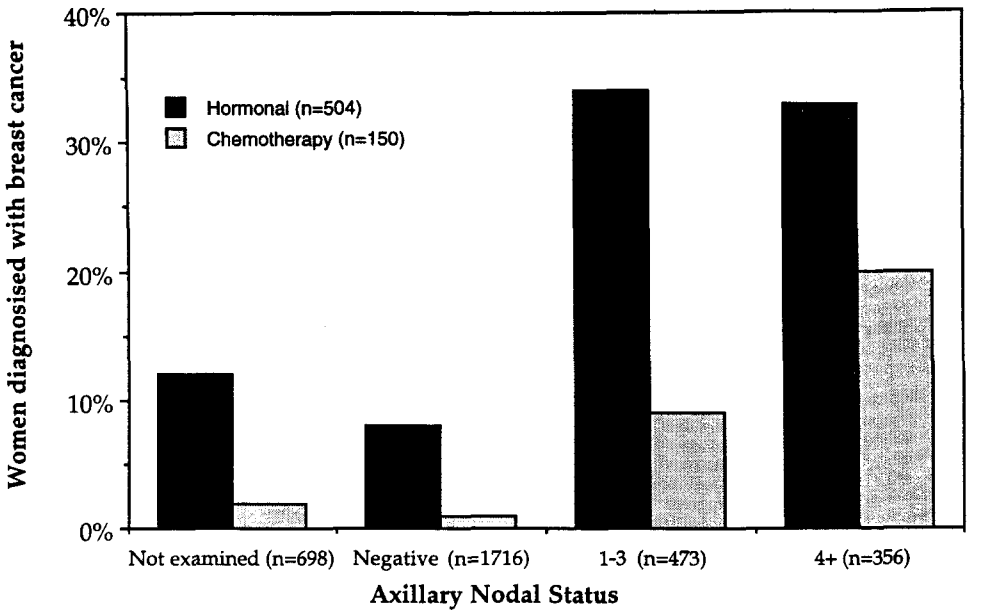

Figure 1. Adjuvant therapy use stratified by axillary lymph node status. Local or regional disease stratified by axillary lymph node involvement along the horizontal axis. Black bars are the percent initial use of hormonal (tamoxifen) therapy (n=504). Grey bars are the initial use of chemotherapy (n=150).

women with four or more positive nodes (20 percent). Hormonal therapy was used in 16 percent of all women. Hormonal therapy use increased from 8 percent in node negative women to 33 percent in node positive women. However, the frequency of hormonal therapy did not vary with the number of positive axillary nodes.

The use of the two different forms of adjuvant therapy did vary with patient age. In women with one or more positive nodes, chemotherapy use declined with age. Figure 2 shows the decline from 20 percent of women age 65-69 to less than 4 percent of women age 80 or more. However, for node positive women, hormonal therapy showed no variation with age, being a relatively constant 32 percent.

Temporal trends in the use of adjuvant therapy are shown in Figure 3. The use of any adjuvant therapy did not vary between 1985 and 1988. However, hormonal therapy increased from 13 percent in 1985-1988 to 24 percent in 1989 without a change in frequency of chemotherapy (O.R. 2.20, C.I. 1.78,2.72, $p<0.0001$).

Radiation therapy

Of women receiving surgery, the percentages of mastectomy or BCS with and without radiation therapy did not vary from 1985 to 1989. Breakdown of these therapies by age is shown in Figure 4. About 80 percent of women age 65-80 received mastectomy. However, in women having BCS, radiation therapy use declined markedly with age from two-thirds of the women age 65-69 to only 7 percent of women age 85+ ($p <0.0001$).

Black women and advanced disease

Race was not significantly associated with the frequency of axillary nodal examination, the use of adjuvant therapies stratified by either stage or nodal involvement, the type of surgery, or the use of radiation therapy. In contrast to the lack of any difference in staging or treatment, the clinical stage at presentation was consistently more advanced for Blacks. Using summary staging as

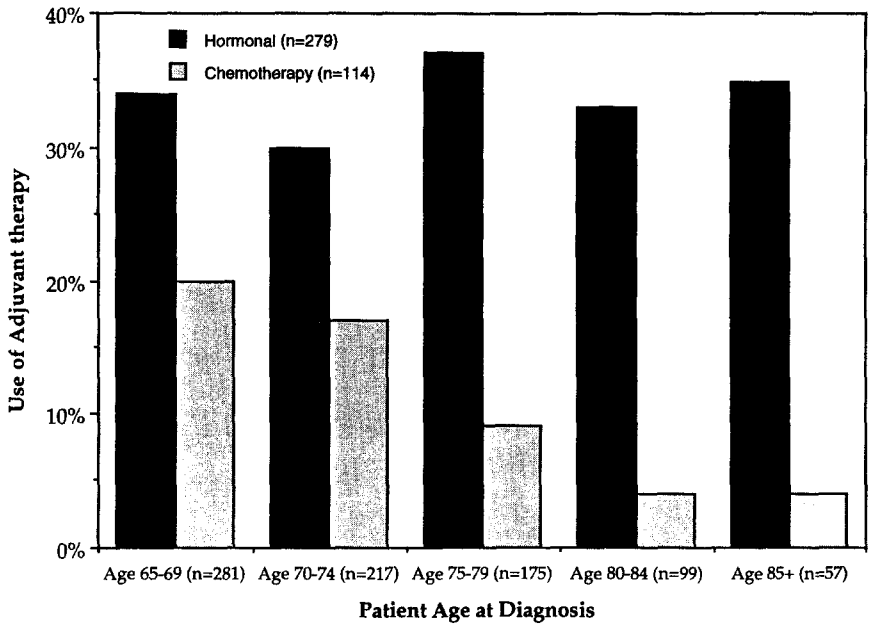

Figure 2. Adjuvant therapy stratified by age in node-positive disease. Local or regional disease with axillary lymph node involvement (n=872) stratified by patient age along the horizontal axis. Black bars are the initial use of hormonal (tamoxifen) therapy (n=279). Grey bars are the initial use of chemotherapy (n=114).

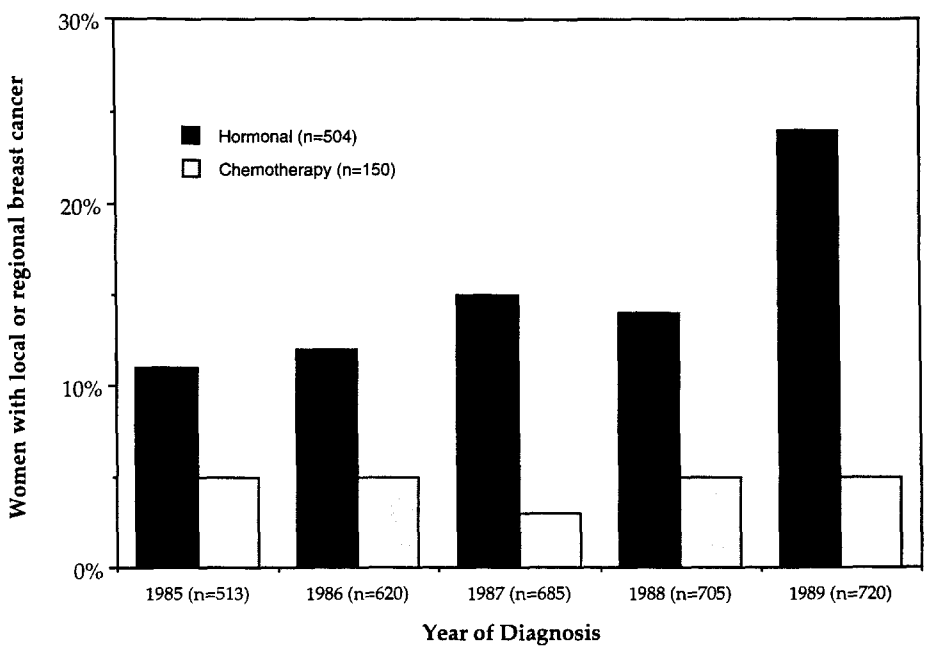

Figure 3. Adjuvant therapy and year of diagnosis. For local or regional disease, year of diagnosis along the horizontal axis. Black bars are the percent initial use of hormonal (tamoxifen) therapy (n=279). Grey bars are the percent initial use of chemotherapy (n=114).

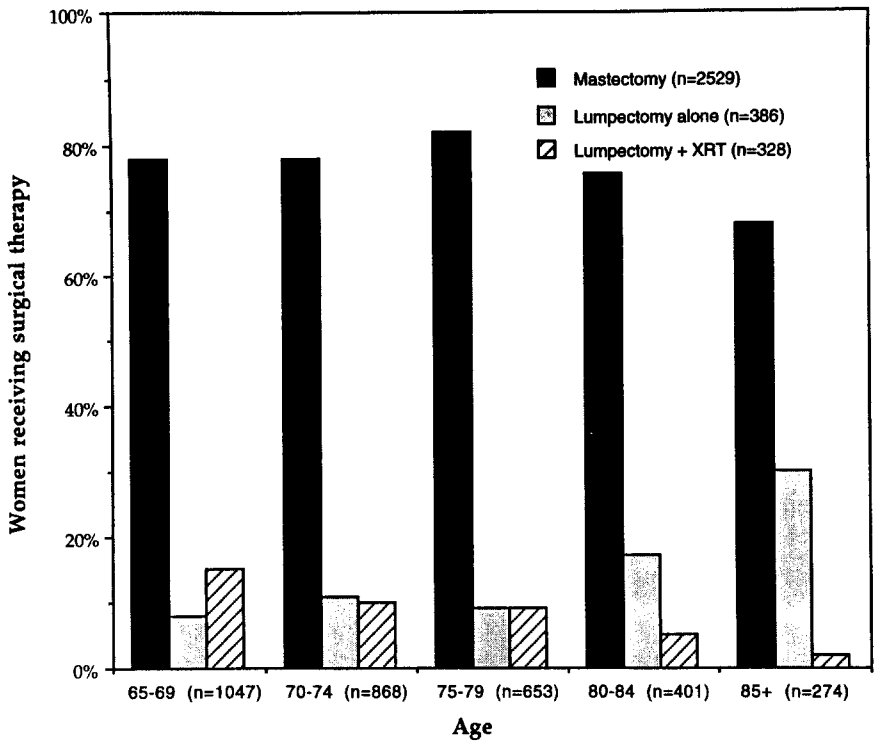

Figure 4. Primary surgical therapy stratified by age. Patients with local or regional breast cancer receiving a surgical therapy stratified by age along the horizontal axis. The black bar is the percent of patients receiving mastectomy (n=2529), the grey bar is BCS alone (n=386), and the striped bar is BCS and radiation therapy (n=328).

shown in Table 1, 71 percent of Whites compared to 56 percent of Blacks presented with local disease (OR 1.93, C.I. 1.56,2.39). Forty-seven percent of black women compared to 55 percent of white women whose tumor sizes were known were less than 2 cm (OR=1.43, C.I. 1.12,1.82).

Logistic regression

Logistic regression was used to identify predictors of staging and treatment controlling for clinical, demographic, socioeconomic, and hospital factors. The individual variables included and the results are summarized in Tables 2 and 3.

Tumor size greater than 20 mm was associated, as expected, with positive axillary nodes. Greater tumor size was associated with increasing age, and was less frequent if care was given at an "other urban" hospital. An "other urban" hospital is a small metropolitan location, such as Roanoke, compared to an large metropolitan "urban" hospital, such as the Tidewater area or Fairfax county.

Increasing age was the strongest predictor of the omission of an axillary nodal assessment. For each ten-year increment of age, the probability of omitting an axillary dissection increased 2.5 fold. After adjusting for other variables, comorbidity, defined as any versus none using the modified Charlson Index, was not a predictor.

Predictors of adjuvant therapy in addition to surgery were examined (Table 3). In all women over age 65 with breast cancer, nodal status was the most important predictor of the use of adjuvant therapy; women with positive axillary nodes

Table 3. Logistic regression of factors predicting treatment in local and regional breast cancer

Dependent variable	Independent variable*	Odds ratio (C.I.)	p-value
Any adjuvant therapy			
Hormones or chemotherapy plus surgery vs. surgery alone*	Positive axillary nodes	8.1 (6.7,9.9)	0.0001
	Tumor Size < 5 cm	0.56 (0.38,0.81)	0.0001
	Increasing age (10 year age group)	0.77 (0.75,0.78)	0.003
Positive axillary node** patients			
Surgery + chemotherapy versus surgery + hormones	Increasing age (10 year age group)	0.43 (0.28,0.65)	0.0001
	Number surgeons in county of patient residence (increments of 10)	0.97 (0.95,0.99)0.002	

* Only dependent variables found statistically significant ($p<0.05$) in logistic regression model are shown. However, each model included the following variables: age, race (black/white), marital status (married/ unmarried), comorbidity (0 to 3), median income in resident's zipcode, median educational level in resident's zipcode, physician density in resident's county (surgeons and radiation oncologists), urban vs. rural residence, positive (one or more) axillary lymph nodes vs. none, tumor size, hospital size, hospital teaching affiliation, and hospital location (large urban, other urban, rural). Data about the number of breast cancer cases per year or American College of Surgeon approval status at each hospital were not available.

** 872 patients with positive axillary node involvement

were eight times as likely to receive adjuvant treatment. After adjusting for nodal involvement, older age was a modest predictor against any adjuvant therapy and comorbidity again appeared to have no significant effect after adjusting for other variables.

Among women with positive axillary nodes receiving an adjuvant therapy, the most significant predictor of using chemotherapy compared to hormones was age. This was a powerful predictor, with the use of chemotherapy declining by two-thirds per decade of age. The number of surgeons in the patient's county of residence was statistically significant, but the importance of the association was minimal with an odds ratio of 0.97. Among node positive women, no factors could be identified predicting the use of hormonal therapy plus surgery compared to surgery alone.

Discussion

Since invasive breast cancer is the second leading cause of cancer death in elderly women and appropriate staging and treatment can reduce mortality, variation in the patterns of care for this condition may reflect a serious deficiency in the quality of care. Several actions beyond the choice of surgery exist for optimal breast cancer management. Although standards of care gradually evolve over time, there is consensus that optimal breast cancer management should include measuring tumor size and estrogen receptor levels, an axillary lymph node dissection in stage I and II disease, the use of anti-estrogen therapy for an estrogen-receptor rich neoplasm, and radiation therapy to women following limited surgery [10,11]. Many experts believe that process measures are important determinants of the quality of care. Sometimes, process measures have been directly linked to an outcome like survival. In other situations, these associations are not as clear [12].

This report described the staging and treatment patterns of elderly Virginia women with breast cancer. The patterns of care reported here from Virginia can be compared to reports from two other databases that did similar analyses (Table 4). In addition, this report presented a series of logistic regressions that identified clinical,

Table 4. Breast cancer initial management comparison based on Virginia, Illinois, and American Cancer Society databases

Variable (stage)	Illinois All Ages 1988 [3]	Virginia Age >65 1985-89	American Cancer Society All ages 1988 [13]
No tumor size (I and II)	not reported	24%	23%
No estrogen receptors	11%	not reported	not reported
No lymph node dissection (I and II)	9%	24%	18%
Adjuvant therapy (II)	56%	44%	49%
Radiation therapy with BCS (I and II)	52%	46%	not reported
Metastatic disease at presentation*	5%	8%	5%
Data source	Mandatory registry	Voluntary registry and Medicare claims	Voluntary registry

* Includes carcinoma in situ

socioeconomic, and hospital characteristics associated with these staging and treatment process outcomes.

Hand et al. studied the 1988 patterns of care in Illinois of histologically confirmed breast cancer using Illinois cancer registry data [3]. Their study focused on defining hospital characteristics associated with performance defined as greater frequency of the previously described actions. Their report did not include a breakdown by patient age, how often tumor size was missing, or if these cases were excluded. A second comparison source is the voluntary hospital based national American Cancer Society database of all breast cancer cases from the same period [13].

No other reports on the use of adjuvant therapies limited to the Medicare eligible population are available. When all age groups are considered using summary staging classification of regional disease, the use of adjuvant therapy in 1988 was 49 percent in the American Cancer Society database, 56 percent in Illinois, and 85 percent in patients treated at Community Clinical Oncology Program (CCOP) hospitals (Table 4) [14]. The 44 percent use of systemic adjuvant therapy in the Virginia elderly is surprisingly similar to the frequency reported in the two broader databases of women of all ages.

Results from the present study show that age is the most consistent factor in predicting staging and axillary nodal positivity in predicting adjuvant treatment in the elderly with breast cancer. Older women were more likely to present with larger tumors but were less likely to undergo an axillary node dissection, to receive chemotherapy, or to radiation therapy if treated with BCS. The only major action that did not vary with age was the use of hormonal therapy, which varied only with axillary nodal involvement.

No socioeconomic factors were strong predictors of clinical staging or treatment actions, in contrast to their role in early cancer detection. Receiving care at an "other urban" hospital was associated with smaller tumor size. Whether this represents a surrogate for other socio-demographic factors is unclear given that suburban Washington is considered "urban" and the city of Richmond is "other urban."

Elderly black Virginia women presented with more advanced disease using tumor size, clinical stage, and axillary node involvement. However, after adjusting for these prognostic factors, no differences between Blacks and Whites were found in the frequency of staging or the use of adjuvant therapies. These findings suggest that Blacks, during the years of this study, experienced either unidentified access to diagnosis barriers or biologic differences, since staging and treatment did not vary between races. Major biologic differences are unlikely given the Black/White Cancer Survival Study, started in 1985-86, of all age groups, which found that about 75 percent of the racial difference in survival was explained by known prognostic factors [15].

The sudden increase in the use of hormonal therapy in 1989 (24 percent vs. 13 percent in 1985-88) is correlated with the December 1988 publication of the meta-analysis of the worldwide experience with adjuvant tamoxifen or chemotherapy [16] and the May 1988 National Cancer Institute Clinical Alert [17]. Although most elderly node-positive women in our study population still did not receive adjuvant therapy, the increase suggests rapid dissemination of these recommendations into practice.

In 1985 to 1989, reporting of estrogen receptor status was not required by the VCR, so that an analysis of the use of anti-hormonal agents stratified by receptor status could not be done. Other population based studies have found that 75-80 percent of elderly women's breast cancer is estrogen-receptor rich [18]. Since most elderly women could benefit from anti-hormonal therapy, even the 24 percent use in Virginia during 1989 reflects substantial underutilization. The rate of dissemination into practice at a statewide level for this elderly population was much lower than observed at CCOP sites, where the use of systemic adjuvant therapies (primarily hormonal) in all estrogen-receptor positive patients increased from about 15 percent in 1987 to about 60 percent in 1989 [14]. Given that tamoxifen has been found to reduce by 21 percent the odds of death in women age 70 or more [19], and that only about three-quarters of deaths in elderly women with node-positive cancer are due to cancer [20,21], many additional lives could be saved if tamoxifen were more widely used.

For women with known estrogen receptor positive cancers, axillary node dissection is controversial, especially in the elderly who have a higher frequency of complications with the procedure [18]. However, if hormonal therapy was planned for all estrogen-receptor positive women, independent of axillary nodes, then at least 70 percent of women who did not have an axillary node assessment should have been treated. However, in this study only 12 percent of women who did not have an axillary dissection were planned to receive this treatment.

Although axillary nodal involvement was the primary predictor of the use of adjuvant therapy, 20 percent of the younger (age < 80) elderly did not have an axillary dissection compared to 9 percent of all women in Illinois. After adjusting for other factors, chronologic age was the only but powerful predictor of axillary dissection. No hospital variables were significant for omission of axillary dissection in Virginia, similar to the findings from Illinois [3].

The risk of local recurrence after BCS varies with tumor size, the extent of the breast excision, and patient age. Although patients undergoing BCS with or without radiation therapy may have equal survival, withholding radiation therapy is associated with greater risk of local recurrence [22]. The landmark National Surgical Adjuvant Breast Project trial using a limited gross excision of tumor, called BCS, found that a local recurrence risk of 39 percent after 8 years declined to 10 percent with radiation therapy [23]. Studies are conflicting if similar risks of local recurrence in the elderly without radiation are present. A small U.S. case series found that 38 percent of women age 70 to 79 treated with BCS alone had a local recurrence at median follow-up of 51 months [24]. However, a recent Italian randomized study that specifically looked at the risk in older women, age > 55, with small (< 25 mm) tumors found that only 4 percent of women who did not receive radiation had local recurrences after four years [25]. Therefore our finding that 30 percent of women age 75 or older did not receive radiation after BCS, though similar to the findings from nine SEER areas of similar age women (range 16 percent to 47 percent) from 1983 to 1986 [2], may or may not reflect underutilization. Withholding radiation therapy after BCS probably reflects the influences of patient preference and physician practices, and may reflect an implicit effectiveness or cost-effectiveness judgment by the physician. If the Italian findings are confirmed by others, then the 39 percent of Virginia women with tumor sizes of 20 mm or less who did not receive radiation would have been cared for appropriately.

Several limitations exist for the data presented in this study. During the years studied, the VCR was not population-based, so that it under-reports the number of cases per year, primarily missing cases treated at small, predominantly rural hospitals. A more serious limitation is the use of summary staging instead of TNM staging. This was necessary since TNM staging was not required by the VCR and could not be inferred due to the cases where tumor size or axillary node assessment were missing. This could lead to inaccuracies in distinguishing local versus regional disease and stage I from II disease, but should not influence the identification of more advanced disease. Virginia's lack of adequate staging was no different from that found in the national American Cancer Society database (Table 4).

All studies using registry information compared to chart or claims data are limited by the potential difference between the treatment care plan compared to actual delivered care [26,27]. This is particularly true for adjuvant therapies, including dosage, schedule, and duration. Tamoxifen is an oral medication for which Medicare does not provide payment and therefore no confirmatory claim is generated. Since the VCR recorded physician treatment intent in the hospital record, it could miss changes if women do not have referral and consideration of adjuvant therapies, particularly chemotherapy, until weeks after surgical therapy. Therefore, these results may represent a lower limit estimate of adjuvant treatment. However, to verify this assumption, an audit of medical records from hospitals, physicians, and pharmacies would be necessary. Nonetheless, missing data on adjuvant therapy were unlikely to be biased according to the comparisons made (i.e., axillary nodal status, age, stage, year of diagnosis). Thus, the relative rates used in the inferences should not be substantially altered, nor should the conclusions be altered by these missing data.

Actual or perceived comorbidity and anticipated benefit are likely to be the most compelling factors influencing physician recommendations. The co-morbidity index used may have been insensitive to important degrees of co-morbidity since 82 percent of this cohort had a comorbidity score of zero. Since the Charlson Index relies only on inpatient diagnoses, a more sensitive measure of comorbidity that could include outpatient or chronic illnesses might produce a better predictor of outcomes. An alternative explanation is that most women with breast cancer in this cohort likely had few comorbid illnesses that were relevant to disease management decisions.

Non-clinical variables such as median income, education, and rural location were not major factors in the use of radiation therapy or adjuvant therapies. Either these factors are not significant factors in the elderly or the use of zipcode-based information is inadequate compared to patient-specific data. This report was limited, as are all studies using secondary data, in that inferences could not be made about physician recommendations compared to actual treatment given.

These findings were similar to those reported by Greenfield in 1980-82, in which chronologic age rather than co-morbidity was the primary predictor of care [28]. This suggests that physicians may be making judgments or implicit cost-benefit determinations about the absolute benefit of staging and adjuvant therapies which may or may not be correct. The definition of treatment quality and "standards of care" for the elderly are likely to be different from younger women. Prospective studies are needed to determine if the observed less aggressive approach to elderly women compromises the survival of this population or actually represents the doctor's best clinical judgement or the patient's true preference.

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