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Influence of Age on Guideline-Concordant Cancer Care for Elderly Patients in the United States

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Summary

We examined frequency of guideline-concordant cancer care in elderly patients, including "older" elderly (age ≥80 years) using the Surveillance, Epidemiology and End Results−Medicare dataset. Actual treatment of older elderly patients with breast, lung, and prostate cancer frequently diverged from guidelines, especially in curative treatment of advanced disease. Results suggest a need for better metrics than existing guidelines alone to evaluate

Purpose: To examine the frequency of guideline-concordant cancer care in elderly patients, including "older" elderly (age ≥80 years).

Methods and Materials: Using the Surveillance, Epidemiology and End Results−Medicare dataset in patients aged ≥66 years diagnosed with nonmetastatic breast cancer (n = 55,094), non−small cell lung (NSCLC) (n = 36,203), or prostate cancer (n = 86,544) from 2006 to 2011, chemotherapy, surgery, and radiation (RT) treatments were identified using claims. Pearson χ^2 tested associations between age and guideline concordance.

Results: Older patients were less likely to receive guideline-concordant curative treatment: in stage III breast cancer, receipt of postmastectomy RT (70%, 46%, and 21% in patients aged 66-79, 80-89, and ≥90 years, respectively; *P*<.0001); in stage I NSCLC, RT or surgery (89%, 80%, and 64% in age 66-79, 80-89, and ≥90 years; *P*<.0001); in stage III NSCLC, RT or surgery plus chemotherapy (79%, 58%, and 27% in age 66-79, 80-89, and ≥90 years; *P*<.0001); and in intermediate/high-risk prostate cancer, RT or prostatectomy (projected life expectancy >10 years: 85% and 82% in age 66-69 and 70-75 years; and ≤10 years: 70%, 42%, and 9% in age 76-79, 80-89, and ≥90 years; *P*<.0001). However, older patients were *more* likely to receive guideline-concordant de-intensified treatment: in stage I to II node-negative breast cancer, hypofractionated postlumpectomy RT (9%, 16%, and 23% in age 66-79, 80-89, and ≥90 years;

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quality and appropriateness of care in this population.

$P<.0001$); in stage I estrogen receptor−positive breast cancer, observation after lumpectomy (12%, 42%, and 84% in age 66-79, 80-89, and ≥90 years; $P<.0001$); in stage I NSCLC, stereotactic body RT instead of surgery (7%, 16%, and 25% in age 66-79, 80-89, and ≥90 years; $P<.0001$); and in lower-risk prostate cancer, no active treatment (25%, 54%, and 68% in age 66-79, 80-89, and ≥90 years; $P<.0001$).

Conclusion: Actual treatment of older elderly cancer patients frequently diverged from guidelines, especially in curative treatment of advanced disease. Results suggest a need for better metrics than existing guidelines alone to evaluate quality and appropriateness of care in this population. © 2017 Elsevier Inc. All rights reserved.

Introduction

Practice guidelines are vital to radiation oncology practice, aiming to promote standardized, evidence-based approaches to care. Guidelines are fundamentally designed to optimize *clinical outcomes* metrics in cancer patients, by disseminating consensus-based "best" practice. However, guidelines are also increasingly regarded as a valuable source to assess *quality* metrics of care delivery (1-3), an important consideration, given that creation and reporting of quality metrics have risen as policy priorities in health care for the elderly. In particular, Medicare—the primary source of health insurance for elderly patients—has now directly coupled reimbursement to compliance with quality measures through the Medicare Access and CHIP Reauthorization Act (4-6).

With the expectation of quality reporting and the Medicare Access and CHIP Reauthorization Act's future "pay for performance" impact on oncology practice, cancer care quality metrics are currently being formulated, selected, and refined (4, 7). Therefore, a thorough understanding of baseline performance—by characterizing contemporary frequencies of concordance with benchmark oncology practice guidelines—is needed in elderly patients, to establish the "current state" of cancer care delivery in this population. The need to understand delivery and quality of cancer care in elderly patients is underscored by cancer's rising incidence burden in US patients aged 65 years and older (8, 9).

Prior studies suggest that elderly patients receive less frequent cancer treatment, compared with younger patients (10-14). However, these studies were conducted in cohorts limited to specific disease sites and specific treatment comparisons. How patient age influences *overarching* patterns in guideline concordance of treatment decision making is still not clear. We hypothesized that: (*1*) older age would predict lower rates of guideline-concordant decisions for *curative treatment*; (*2*) there is variation by age in guideline-concordant decisions for *de-intensified treatment*; and (*3*) there are common patterns of how age modifies treatment decision making—across disease sites, stages, treatment modalities, and treatment paradigms.

We surmised that if deviations from guidelines were detected more frequently with older age in cancer patients, such a finding could help signal barriers to disseminating "best" practices in the elderly (15-18). Alternatively, frequent deviations in older patients might also signal that current guidelines themselves are inherently insufficient for shaping quality and health care delivery metrics for the elderly. Such a finding would thereby help establish baseline gaps in cancer guideline and quality metric development for this population. Accordingly, in a nationally representative cohort of elderly cancer patients diagnosed with incident breast, lung, or prostate cancer, we sought to determine the relationship between age and concordance with select cancer care guidelines, with a focus on radiation treatment (RT).

Methods and Materials

Patient cohort

We used the Surveillance, Epidemiology and End Results (SEER)-Medicare dataset to examine treatment utilization (chemotherapy, surgery, radiation, and hormone therapy) in patients aged ≥66 years with incident breast (American Joint Committee on Cancer stage I-III), non−small cell lung (NSCLC) (stage I-III), or prostate (clinical stage T1-3, N0M0) cancer during the period 2006 to 2011. We excluded patients with prior diagnosis of another malignancy within the first year of diagnosis; unknown histology; no pathologic confirmation; and cancer diagnosis at autopsy/by death certificate. Medicare Part A and B coverage and no health maintenance organization enrollment 12 months before and 12 months after diagnosis were required. Patient and disease factors at diagnosis extracted from SEER included age, diagnosis year, disease stage, tumor grade, and estrogen receptor (ER) status (for breast cancer patients). Final samples included 55,094 breast, 36,203 NSCLC, and 86,544 prostate cancer patients (Tables E1-E3; available online at www.redjournal.org).

Age

Age was initially categorized as 66 to 79, 80 to 89, and ≥90 years, especially to highlight patterns of treatment in the older elderly—octogenarians (age 80-89 years) and nonagenarians (age ≥90 years). Analyses of patients aged ≥90 years are presented as a unique age category. In certain analyses, when results included n≤11, results are suppressed to prevent compromise of patient identities. Where this was applicable, we state "the number of patients aged ≥90 years was too low to report."

Where guidelines specifically reflected age, additional age categories were analyzed (with inflection points at age 70 years for early breast cancer patients and age 75 years for prostate cancer patients, based on use of the National Social Security Index actuarial estimate of life expectancy of at least 10 additional years for US men aged ≤75 years) (19, 20).

Other covariates

A modified Charlson comorbidity index was derived (21-23) from claims for comorbid diseases occurring between 12 months before and 1 month after cancer diagnosis. As previously established, to enhance specificity, diagnosis codes identified in Part B files must have occurred in 2 separate claims over >30 days or also in Part A claims (24, 25). Performance status score was derived from the Medicare Durable Medical Equipment file, indicating use of home oxygen, cane, commode, wheelchair, or hospital bed (26, 27), categorized as 0 = none, 1 = 1 item, or 2 = 2 or more items (26) (Tables E4a and E4b; available online at www.redjournal.org).

Cancer treatment and outcomes

Treatment through 1 year from diagnosis was defined by *International Classification of Diseases, 9th Revision* procedure and Healthcare Common Procedure Coding System/Current Procedural Terminology claims codes for chemotherapy, site-specific surgery (eg, lumpectomy, mastectomy, radical prostatectomy, sublobar resection, lobar resection, lobectomy), and RT. Stereotactic body radiation therapy (SBRT) was based on procedure claims (regardless of number of radiation fractions). Number of radiation fractions was based on radiation delivery claims with unique dates of service, or weekly treatment management codes (representing 5 fractions delivered) when claim dates were unavailable. Chemotherapy codes identified cytotoxic and targeted systemic therapies and androgen deprivation therapy (Tables E4a and E4b; available online at www.redjournal.org). Oral endocrine therapy claims in breast cancer patients were available in patients with Medicare Part D coverage and coded for this subset (28). Overall survival and cause-specific survival were based on Medicare death date and SEER cause of death. Time to event was calculated from diagnosis.

Practice guidelines

Frequency of concordance of treatment with the following select practice guidelines, based on National Comprehensive Cancer Network guidelines (20) for each disease site, was assessed.

Breast

- In select early-stage breast cancer patients (stage I-II, node negative), treated with lumpectomy plus postlumpectomy RT: use of *hypofractionation*, defined as 15 to 23 RT fractions. This proxy definition of hypofractionation, based on number of fractions, was selected because details of actual radiation dose delivered per fraction are not available in SEER-Medicare (29).
- In select early-stage breast cancer patients (stage I, ER+, treated with lumpectomy): use of *observation* instead of postlumpectomy RT.
- In select advanced-stage breast cancer patients (stage III, treated with mastectomy): use of *postmastectomy RT*.

Non–small cell lung cancer

- In stage I NSCLC patients: use of potentially *curative treatments*, including SBRT, other external beam RT, any surgery (including sublobar resection, lobectomy, and pneumonectomy) versus no treatment.
- In stage III NSCLC patients: use of potentially *curative treatments*, including any RT or any surgery (with or without chemotherapy) versus no treatment.

Prostate

- In intermediate- or high-risk prostate cancer patients (Gleason 7-10 or at least clinical T2b stage), use of potentially *curative treatments*, including RT (external beam RT and/or brachytherapy) or prostatectomy; further stratified by projected life expectancy >10 years (age ≤75 years) (19).
- In lower-risk prostate cancer patients (both clinical stage T1 and Gleason 6), use of *no active treatment*. Prostate-specific antigen is not available for patient risk stratification in SEER-Medicare.

Guidelines were classified into 2 treatment paradigm groupings for analysis: "do more," or *curative* treatment, including postmastectomy RT for stage III breast cancer, surgery or RT for stage I and stage III NSCLC, and definitive RT or surgery for intermediate-/high-risk prostate cancer; versus "do less," or *de-intensified* treatment. De-intensification indicated treatments with less invasiveness, time burden, or toxicity compared with other standard treatment options, and in this analysis included hypofractionated RT for early-stage breast cancer, observation after lumpectomy for stage I ER+ breast cancer, SBRT for stage I NSCLC, and no active treatment for lower-risk prostate cancer.

Statistical analyses

Associations between age and guideline-concordant treatment were tested using the Pearson χ^2 test. Multivariate logistic models examined associations between age and use of guideline-concordant treatments, adjusted for comorbidity and performance status. Because these 2 covariates demonstrated collinearity, separate models were fitted for each. In multivariate models, age was initially tested as a continuous variable. Because the linearity assumption did not universally show goodness of fit in all models by Hosmer and Lemeshow criteria, age was also tested categorically. Final models are presented using the categorical variable, with significance tested using the Wald χ^2 test. Time-to-event analyses evaluated associations between guideline concordance and overall survival and cause-specific survival using the Kaplan-Meier log-rank test. Analyses were conducted using SAS (SAS Institute, Cary, NC). Statistical tests were 2-sided. A *P* value of <.05 was considered statistically significant. This study was exempted by the MD Anderson Cancer Center review board.

Results

Median age was 74 years (interquartile range [IQR] 70-79 years): for breast patients 75 years (IQR 70-81 years), NSCLC 75 years (IQR 71-81 years), and prostate 73 years (IQR 69-77 years). A total of 22% of patients were aged ≥80 years and 2% were aged ≥90 years (Table E5; available online at www.redjournal.org).

General treatment patterns by age

Older patients were *less* likely to receive guideline-concordant curative treatment, but *more* likely to receive guideline-concordant de-intensified treatment (Figs. 1A and 1B). Specific frequencies of treatment use by cancer site are delineated below.

Specific treatment use by cancer site

Breast cancer

Benchmark 1: Use of hypofractionation (15-23 fractions) in stage I to II, node-negative breast cancer patients receiving postlumpectomy RT

Only 10% (of n = 20,631) were treated with hypofractionated RT. Use of hypofractionated RT increased with older age. Utilization was 9% in patients aged 66 to 79 years (of n = 16,473), compared with 16% aged ≥80 years (of n = 4021) and 23% aged ≥90 years (of n = 137); *P*<.0001.

Benchmark 2: Use of observation in stage I, ER+ breast cancer patients receiving lumpectomy

A total of 21% (of 18,940) were observed after lumpectomy. Among patients who underwent observation after lumpectomy (with available drug prescription data), 59% (of n = 1688) filled a prescription for endocrine therapy.

Observation increased with older age: 12% in patients aged 66 to 69 years (of 673), compared with 42% aged ≥80 years (of n = 867) and 84% aged ≥90 years (of n = 148); *P*<.0001. Because National Comprehensive Cancer Network guidelines specify observation as appropriate in patients aged ≥70 years, frequencies of observation (vs RT use) were further delineated using the additional cutpoint of age 70 years, demonstrating the most dramatic increase in observation after age 75 years: 6% age 66 to 67 years, 8% age 68 to 69 years, 10% age 70 to 74 years, and 19% age 75 to 79 years. Endocrine therapy use in these ER+ patients decreased with older age: 65% aged 66 to 79 (of n = 673), compared with 57% aged ≥80 years (of n = 867) and 41% aged ≥90 years (of n = 148; *P*<.0001).

Benchmark 3: Use of postmastectomy RT in stage III breast cancer patients

Only 60% of this patient group (of n = 3996) underwent RT. Use of postmastectomy RT decreased with older age. Utilization was 70% in patients aged 66 to 79 years (of n = 2607), compared with 46% aged ≥80 years (of n = 1196) and 21% aged ≥90 years (of n = 193); *P*<.0001. In this group, chemotherapy use was 60% (of n = 3996) and also negatively associated with age: 76% in patients aged 66 to 79 years (of n = 2607), compared with 32% aged ≥80 years (of n = 1196) and 9% aged ≥90 years (of n = 193); *P*<.0001.

Non−small cell lung cancer

Benchmark 1: Use of curative treatment in stage I NSCLC patients

A total of 86% of this patient group received any treatment, whereas 14% received no active treatment (of n = 15,777). Use of any treatment decreased with older age: 89% in patients aged 66 to 79 years (of n = 11,272), compared with 80% aged ≥80 years (of n = 4253) and 64% aged ≥90 years (of n = 252); *P*<.0001.

Of patients undergoing treatment, 9% received SBRT and 16% received other EBRT, whereas 72% received surgical resection (lobectomy, sublobar resection, or pneumonectomy) (of n = 13,577). Use of SBRT was associated with older age: 7% in patients aged 66 to 79 (of n = 9998), compared with 16% aged ≥80 years (of n = 3416), and 25% aged ≥90 years (of n = 163); *P*<.0001.

Benchmark 2: Use of curative treatment in stage III NSCLC patients

A total of 71% received any treatment, whereas 29% received no active treatment (of n = 17,142). Use of any treatment decreased with older age: 79% in patients aged 66 to 79 years (of n = 11,693), compared with 58% aged ≥80 years (of n = 4958) and 27% aged ≥90 years (of n = 491); *P*<.0001.

Specific use of standard curative multimodality therapy included chemoradiation in 37% of patients aged 66 to 79 years (of n = 11,693), compared with 20% aged ≥80 years (of n = 4958) and 3% aged ≥90 years (of n = 491); *P*<.0001. Use of surgery plus chemotherapy was 12% in patients aged 66 to 79 years (of n = 11,693), compared with 3% aged ≥80 years (of n = 4958); *P*<.0001. The number of patients aged ≥90 years was too low to report.

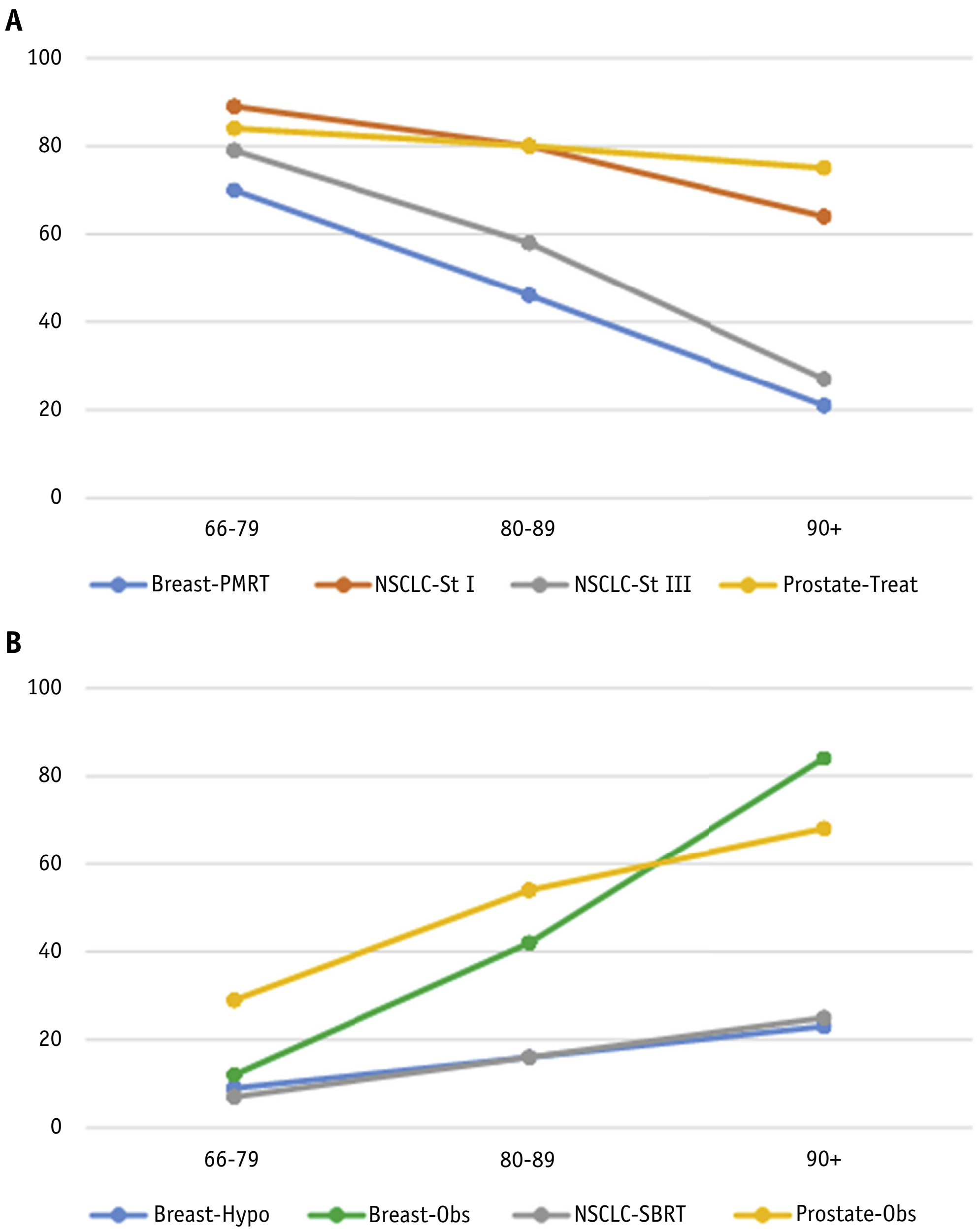

Fig. 1. (A) "do more": age and concordance with curative treatment guidelines. (B) "do less": age and concordance with deintensified treatment guidelines. *Abbreviations:* NSCLS = non−small cell lung cancer; PRMT = postmastectomy radiation therapy; SBRT = stereotactic body radiation therapy.

Prostate cancer

Benchmark 1: Use of curative treatment (definitive RT or prostatectomy) in intermediate- or high-risk stage and/or grade prostate cancer patients, based on projected life expectancy >10 years (age ≤75 years) and ≤10 years (age >75 years)

A total of 84% (of n=31,168) of patients aged ≤75 years received either up-front definitive RT alone (54%, of n=31,168) or prostatectomy (33%, of n=31,168)—both considered curative treatment, and 72% of all patients received curative treatment. Use of curative treatment decreased with older age. Among patients with projected life expectancy >10 years, curative treatment utilization was 85% in patients aged 66 to 69 years (of n=13,397), compared with 82% in those aged 70 to 75 years (of n=17,771); $P<.0001$. Among patients with projected life expectancy ≤10 years, curative treatment utilization was 70% in patients aged 76 to 79 years (of n=8561); 42% in those aged 80 to 89 years (of n=8914); and 9% in patients aged 90+ years (of n=617); $P<.0001$.

Benchmark 2: Use of no active treatment in lower-risk stage and grade prostate cancer patients (cT1 and Gleason 6)

A total of 22% (of 84,272) of these patients received no active treatment. No treatment was used in 18% of patients aged 66 to 69 years (of n=24,262), 20% aged 70 to

75 years (of n=31,658), 25% aged 76 to 79 years (of n=14,355), 31% aged ≥80 years (of n=13,198), and 39% aged ≥90 years (of n=799); $P<.0001$.

Almost all remaining patients received definitive treatment (RT or prostatectomy), though a small portion received androgen deprivation therapy alone: 4% in patients aged 66 to 69 years (of n=24,262), 6% aged 70 to 75 years (of n=31,658), 12% aged 76 to 79 years (of n=14,355), 32% aged ≥80 years (of n=13,198), and 53% aged ≥90 years (of n=799); $P<.0001$.

Comorbidities, performance status, and outcomes

Worse comorbidity and decreased performance status showed similar patterns of association with guideline concordance, demonstrating lower concordance with curative treatments and higher concordance with de-intensified treatment (Figs. 2A, B and 3A, B; and Table E6; available online at www.redjournal.org). However, in multivariable analyses, for every guideline, age remained an independent predictor of guideline concordance ($P<.0001$), even after accounting for confounding by comorbidity and performance

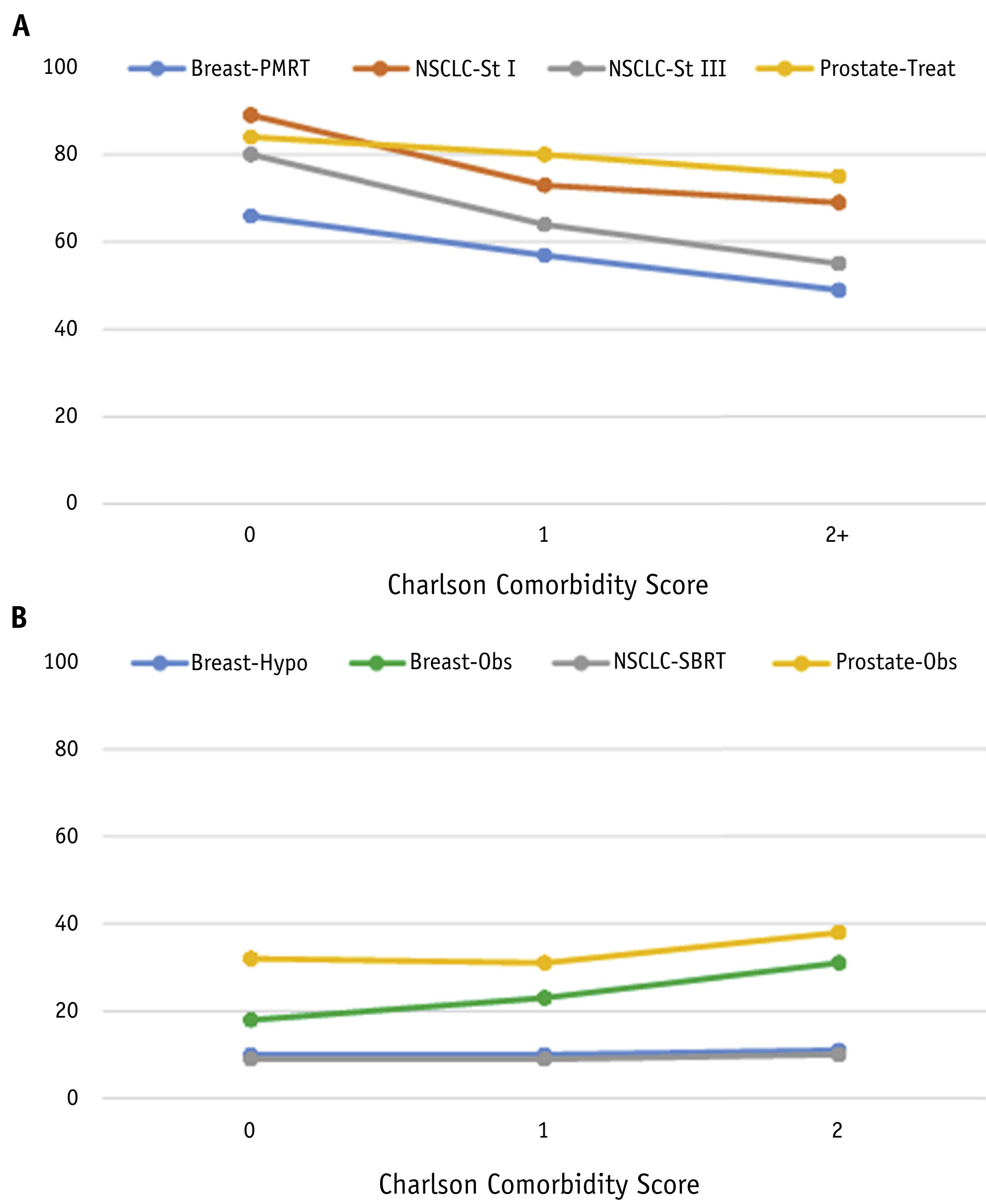

Fig. 2. (A) "do more": comorbidity and concordance with curative treatment guidelines. (B) "do less": comorbidity and concordance with de-intensified treatment guidelines. *Abbreviations:* NSCLS = non−small cell lung cancer; PRMT = postmastectomy radiation therapy; SBRT = stereotactic body radiation therapy.

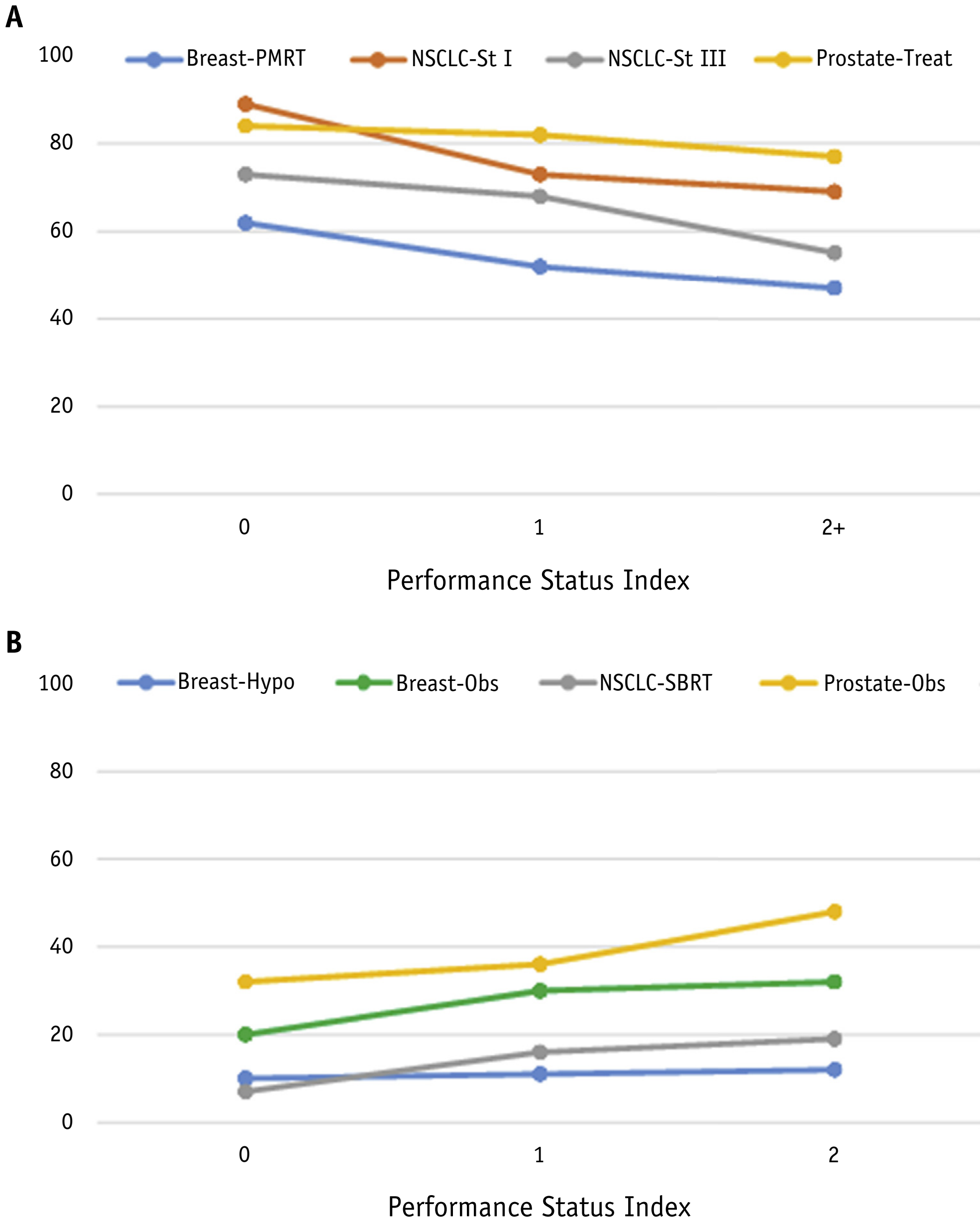

Fig. 3. (A) "do more": performance status and concordance with curative treatment guidelines. (B) "do less": performance status and concordance with de-intensified treatment guidelines. *Abbreviations:* NSCLS = non−small cell lung cancer; PRMT = postmastectomy radiation therapy; SBRT = stereotactic body radiation therapy.

status (Table 1). Regarding outcomes, use of curative therapies was associated with increased overall and cause-specific survival (Table E7; available online at www.redjournal.org).

Discussion

In elderly patients with breast, lung, or prostate cancer, guideline-concordant care was significantly associated with age. There were similar patterns of the impact of age on treatment decisions across disease sites, stages, and treatment modalities, though patterns were opposite depending on treatment paradigm. Consistent with our hypothesis, decisions for *curative treatment* were less frequent as age increased, especially for the older elderly, who constituted almost 20% of this cohort. Concordance with curative therapies was 70% to more than 80% in patients aged <80 years, compared with approximately 30% to 50% in patients aged ≥80 years. In contrast, the frequency of decisions for *de-intensified treatment* increased with age. The relationships between age and guideline concordance could not be fully explained by differences in comorbidity or performance status. This age-associated variation in frequency of guideline-concordant care suggests that current guidelines may insufficiently inform clinical decisions for

Table 1 Adjusted odds of achieving guideline concordance with older age for curative and de-intensified treatment guideline, accounting for comorbidity and for performance status

Characteristic	OR	95% CI	*P*
do more: Adjusted for comorbidity			
Breast-PMRT			<.001
Age 80-89 vs 66-79 y	0.37	0.33-0.43	
Age ≥90 vs 66-79 y	0.11	0.08-0.16	
NSCLC-St I			<.001
Age 80-89 vs 66-79 y	0.57	0.51-0.62	
Age ≥90 vs 66-79 y	0.27	0.20-0.35	
NSCLC-St III			<.001
Age 80-89 vs 66-79 y	0.40	0.38-0.43	
Age ≥90 vs 66-79 y	0.11	0.09-0.13	
Prostate-Treat			<.001
Age 80-89 vs 66-79 y	0.18	0.17-0.18	
Age ≥90 vs 66-79 y	0.02	0.02-0.03	
do less: Adjusted for comorbidity			
Breast-Hypofx			<.001
Age 80-89 vs 66-79 y	2.04	1.85-2.26	
Age ≥90 vs 66-79 y	3.48	2.34-5.17	
Breast-Obs			<.001
Age 80-89 vs 66-79 y	5.39	4.98-5.83	
Age ≥90 vs 66-79 y	37.68	28.88-49.16	
NSCLC-SBRT			<.001
Age 80-89 vs 66-79 y	2.53	2.24-2.86	
Age ≥90 vs 66-79 y	4.50	3.12-6.49	
Prostate-Obs			<.001
Age 80-89 vs 66-79 y	2.81	2.59-3.06	
Age ≥90 vs 66-79 y	4.96	3.33-7.37	
do more: Adjusted for performance status			
Breast-PMRT			<.001
Age 80-89 vs 66-79 y	0.37	0.32-0.42	
Age ≥90 vs 66-79 y	0.11	0.08-0.16	
NSCLC-St I			<.001
Age 80-89 vs 66-79 y	0.52	0.47-0.57	
Age ≥90 vs 66-79 y	0.24	0.18-0.31	
NSCLC-St III			<.001
Age 80-89 vs 66-79 y	0.38	0.36-0.41	
Age ≥90 vs 66-79 y	0.10	0.08-0.13	
Prostate-Treat			<.001
Age 80-89 vs 66-79 y	0.18	0.17-0.18	
Age ≥90 vs 66-79 y	0.02	0.02-0.03	
do less: Adjusted for performance status			
Breast-Hypofx			<.001
Age 80-89 vs 66-79 y	2.04	1.84-2.25	
Age ≥90 vs 66-79 y	3.46	2.33-5.14	
Breast-Obs			<.001
Age 80-89 vs 66-79 y	5.49	5.08-5.94	
Age ≥90 vs 66-79 y	38.27	29.34-49.91	
NSCLC-SBRT			<.001
Age 80-89 vs 66-79 y	2.59	2.29-2.93	
Age ≥90 vs 66-79 y	4.74	3.26-6.89	
Prostate-Obs			<.001
Age 80-89 vs 66-79 y	2.83	2.60-3.07	
Age ≥90 vs 66-79 y	5.03	3.38-7.47	

Abbreviations: CI = confidence interval; Hypofx = hypofractionation; NSCLC = non–small cell lung cancer; Obs = observation; OR = odds ratio; PMRT = postmastectomy radiation therapy (stage III); SBRT = stereotactic body radiation therapy; St = stage.

care, particularly in older elderly patients, and especially in the settings of curative treatment, advanced cancer, and multimodality therapy (4-6).

In elderly patients, it remains unclear whether lack of guideline-concordant care may reflect appropriate clinical decision making versus inappropriate care, under-treatment, or over-treatment—the typical quality metrics guideline concordance is thought to reflect. Our results suggested a potential inflection point for age-dependent variations in guideline concordance, occurring at the age 80 years and older. Under age 80 years, frequencies of guideline-concordant practice across disease, sites, stages, and treatment modalities was surprisingly consistent, with little "spread" in absolute frequencies of guideline concordance: approximately 80% for "do more" treatments and approximately 20% for "do less" treatments. In contrast, variation in frequency of guideline-concordant practices widened for patients aged 80 years and older, suggesting that current guidelines may be insufficient for informing quality metrics of cancer care delivery, particularly in the older elderly. This insufficiency is notable because the older elderly are one of the fastest-growing cancer populations (9).

Barriers to guideline-concordant care and quality measures in older elderly cancer patients may be multifactorial. Particularly for curative treatment, older patients are often underrepresented in randomized trials informing guidelines. For example, only 2% of patients enrolled on Cancer and Leukemia Group B protocols for node-positive breast cancer were aged >70 years (30), though elder risk stratification has recently been included in select prospective studies, for example in NSCLC treatment trials (31-33).

Where clinical outcomes evidence exists, there remain mixed results for disease benefits versus toxicity risks for cancer treatments in the elderly. Select prior studies demonstrate under-treatment of elderly patients leading to worse cancer outcomes, and appropriate treatment improving overall survival and quality of life even in patients with comorbidity and poor performance status (10, 34-37). Yet other studies demonstrate older patients facing measurably increased toxicity (and mortality) risks associated with a variety of cancer treatment modalities (33, 38-40). Still other evidence demonstrates potential benefits of shorter or less-intensive regimens (eg, hypofractionation) as well-tolerated and potentially of special benefit to frail elderly patients (41-44). Conducting additional studies to identify the impact of age on mortality benefits and morbidity risks from cancer treatments (33) remains a key need in the development of age-adapted practice guidelines and quality measures.

Finally, decision making in elderly patients is driven by additional considerations: life expectancy, comorbidities (45, 46), functional status, biologic aggressiveness of disease (47, 48), benefits of palliation, availability of alternatives, and access to treatments are all important considerations in treatment choice (12, 49, 50), as well as patient preference, including decisions favoring less than curative treatment.

Implications of our results in context are 2-fold: oversimplified guideline-based quality benchmarking (for example, defining best quality as "100% guideline concordance") is inadequate. This approach can lead to undiscerning measures of quality cancer care, especially for the older elderly. Optimal quality benchmarking of guideline-based practice may involve, first, stratifying by treatment paradigm and, second, calibrating with age-adapted and case-mix factors, allowing for broader and more nimble definitions of quality benchmarks.

Limitations included proxy variable definitions from claims. Breast hypofractionation was based on number of radiation fractions, because details of radiation dose/fields are unavailable in SEER-Medicare. Endocrine therapy in breast cancer patients may have been underreported, because this variable was derived only from Medicare Part D coverage and not prescriptions filled under secondary insurance. Prostate-specific antigen levels are unavailable for risk group stratification in prostate cancer patients, and our "lower"-risk prostate cancer group may have included patients with prostate-specific antigen >10 ng/mL. Validation of age trends may be needed to further understand treatment use for these patient subsets.

Conclusion

Actual care for older elderly cancer patients frequently diverges from guidelines, and this divergence was especially marked for curative treatment for advanced disease. Results suggest a need for better metrics than existing guidelines alone to evaluate quality and appropriateness of care in this population.

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