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Clinical-Bladder cancer

Longitudinal patterns of cost and utilization of medicare beneficiaries with bladder cancer

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Abstract

Background: Bladder cancer (BC) is highly prevalent and costly. This study documented cost and use of services for BC care and for other (non-BC) care received over a 15-year follow-up period by a cohort of Medicare beneficiaries diagnosed with BC in 1998.

Methods: Data came from the Surveillance, Epidemiology and End Results Program linked to Medicare claims. Medicare claims provided data on diagnoses, services provided, and Medicare Parts A and B payments. Cost was actual Medicare payments to providers inflated to 2018 US$. Cost and utilization were BC-related if the claim contained a BC diagnosis code. Otherwise, costs were for "other care." For utilization, we grouped Part B-covered services into 6 mutually-exclusive categories. Utilization rates were ratios of the count of claims in a particular category during a follow-up year divided by the number of beneficiaries with BC surviving to year-end.

Results: Cumulatively over 15-years, for all stages combined, total BC-related cost per BC beneficiary was $42,011 (95% Confidence Interval (CI): $42,405−$43,417); other care cost was about twice this number. Cumulative total BC-related cost of 15-year BC survivors for all stages was $43,770 (CI: $39,068−$48,522), intensity of BC-related care was highest during the first year following BC diagnosis, falling substantially thereafter. After follow-up year 5, there were few statistically significant changes in BC-related utilization. Utilization of other care remained constant during follow-up or increased.

Conclusions: Substantial costs were incurred for non-BC care. While increasing BC survivorship is an important objective, non-BC care would remain a burden to Medicare.

Keywords: Bladder cancer; Cost; Utilization; Medicare; Elderly; Health economics

Abbreviations: BC, bladder cancer; SEER, the surveillance, epidemiology and end results program; ICD-9-CM, International Classification of Disease 9th Edition, Clinical Modification; CI, 95% confidence interval

1. Introduction

Bladder cancer (BC) is a highly prevalent and costly [1] condition that disproportionately affects the U.S. elderly: half of all BC cases in the United States in 2016 [2] were among individuals 73+. BC is especially prevalent among men [3−6], with localized being the most common stage at diagnosis [7] and its prevalence is predicted to increase [8]. These characteristics make Medicare the most likely payer for BC-related care now and in the future. Concerns about Medicare solvency and associated pressures for reform, in response to an expected rise in the number of eligible individuals, improved survivorship among many previously high-mortality diseases including cancers, and across-the-board increases in health care costs is driving demand for information as to where cost saving is possible, and humane pathways to doing so. This study addresses a part of this systemic problem by documenting long-term patterns in costs and service use of elderly persons initially diagnosed with BC in 1998 with a follow-up of up to 15 years.

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2. Materials and methods

We used data from the Surveillance, Epidemiology and End Results program (SEER) [9] linked to Medicare claims. Medicare claims spanning from 1997 to 2013 provided demographic information, diagnoses (International Classification of Disease 9th Edition, Clinical Modification (ICD-9-CM), specific types of services provided (Procedural ICD-9-CM, Current Procedural Terminology 4th Edition, Healthcare Common Procedure Coding System), and Medicare Parts A and B payments. SEER was used to confirm the Medicare-based BC diagnosis date and to provide BC stage at diagnosis.

Our initial cohort consisted of all individuals ($n = 4,772$) diagnosed with BC in 1998; this was the latest year in SEER-Medicare that would allow a full 15-year follow-up period. We then excluded individuals without 12 consecutive months of enrollment in Parts A and B during the 1-year look-back period used to identify co-morbidities and full Parts A and B coverage for the 2009 to 2013 period unless the reason for loss of coverage was death. Beneficiaries enrolled in Medicare Advantage were excluded as no Medicare claims were collected for these individuals. After screening for nonparticipation, the sample consisted of 3,136 individuals. Finally, we dropped an additional 148 individuals for whom we lacked information on cancer stage, yielding a final analysis sample of 2,988. In 1998 data on TNM staging was not available. Instead SEER used the American Joint Committee on Cancer classification system. Using this classification, we stratified our sample into subsamples by BC stage as follows: localized − in situ and stage I ($n = 2,258$); regional − stage II, stage III, and stage IV with extent of disease (EOD) codes ≤ 10 ($n = 619$); distant − stage IV with EOD codes 75, 80, or 85 ($n = 111$).

Cost was measured as actual payments Medicare made to providers. Cost and utilization were BC-attributable if the claim contained a BC-related ICD-9-CM code in any diagnosis field of a claim (Appendix). All other costs were labeled as "other care." To avoid double counting due to duplicate bills for the same service, we only counted claims with a unique payment amount/attributable cause combination in a single month. When there was more than 1 claim for a person for the same services with identical payment amounts filed in the same month, we only counted 1 claim. This approach may have made our estimates more conservative especially for frequently used low cost procedures.

We aggregated Medicare payments by month for inpatient, outpatient, physician, skilled nursing facility, home health, hospice, and durable medical equipment providers for care received. Since Medicare only provided data on inpatient and skilled nursing facility care aggregated at the stay level, the cost of such care was allocated to the admission date. Cost of care at other settings was allocated to the month the service was provided. Payments in nominal dollars were inflated to 2018 dollars using monthly values of the Experimental Consumer Price Index—Medical. Supplemental insurers' and out-of-pocket payments were unavailable.

We measured cost in 3 ways. (1) Mean total cost for BC and other care per beneficiary. The numerator consisted of total Parts A and B Medicare payments for the beneficiary. The dominator was the number of beneficiaries in the group with a BC diagnosis. Payments were set to $0 after an individual's death, but the person was counted in the dominator, which was fixed throughout follow-up. (2) Mean cost per BC survivor. The numerator consisted of Parts A and B payments made for persons who survived to follow-up year end (measured from month of diagnosis). The denominator was the number of such persons surviving to follow-up year end. Unlike the first measure, the number of persons declined by follow-up year. (3) Mean 15-year cost per BC survivor was calculated as (2) but only included persons surviving 15 years following diagnosis.

We grouped covered services into 6 mutually-exclusive utilization categories (Appendix): (1) physician visits; (2) laboratory (blood, urine tests); (3) imaging (CT scan, MRI, ultrasound, chest X-ray, PET, standard urography, nuclear medicine imaging); (4) cystoscopy and intravesical therapy (cystoscopy, intravesical chemotherapy, Bacillus Calmette-Guerin therapy); (5) surgery (transurethral resection of bladder tumor, cystectomy, upper urinary tract procedures; urethra and prostate procedures); and (6) chemotherapy/radiotherapy. Utilization rates were calculated with the number of claims per beneficiary per year in a category in the numerator and the count of the number of persons surviving to the end of the follow-up year in the denominator. The result was the number of service units by category/beneficiary/year. Attribution was handled identically to cost.

A Duke University Institutional Review Board approved our study protocol. All analysis was done using SAS 9.4 software.

3. Results

The sample cohort was predominantly male (73%) and white (92%). At diagnosis 50% were age 77+ and 16% age 85+ (Table 1). Given the cohort's advanced age, 15-year survival was low (11.85% all-stage; 14.39% localized; 4.68% regional; 0.00% distant). One-year survival was 81.16% all-stage, 90.17% localized, 60.25% regional, and 14.41% distant BC (Fig. 1).

The cumulative 15-year all-stage BC-related cost per beneficiary was $42,011 (95% Confidence Interval (CI):$42,405−$43,417), over a third of total cost (Fig. 2). Stratified by stage, BC-related cost/beneficiary rose from $36,544 (CI:$39,914−$38,174) − 29.4% of total cost for localized to $46,597 (CI:$38,278−$54,915) − 77.7% of total cost for regional with distant BC falling in between. Except for regional BC, *survivor-specific* 15-year BC-related cost per beneficiary was within 1-2 standard errors of total 15-year BC-related cost (i.e., including savings

Table 1
Sample characteristics[a]

	Full Sample	Localized	Regional	Distant
Male	2,190 (0.73)	1,686 (0.75)	437 (0.71)	67 (0.60)
White	2,744 (0.92)	2,091 (0.93)	559 (0.90)	94 (0.85)
Black	122 (0.04)	76 (0.03)	37 (0.06)	<11
Other	122 (0.04)	91 (0.04)	23 (0.04)	<11
Age 66−70	385 (0.13)	298 (0.13)	66 (0.11)	21 (0.19)
Age 70−75	722 (0.24)	561 (0.25)	134 (0.22)	27 (0.24)
Age 75−80	788 (0.26)	612 (0.27)	153 (0.25)	23 (0.21)
Age 80−85	622 (0.21)	451 (0.20)	146 (0.24)	25 (0.23)
Age 85+	471 (0.16)	336 (0.15)	120 (0.19)	15 (0.14)
Congestive heart failure	435 (0.15)	328 (0.15)	87 (0.14)	20 (0.18)
Cardiac arrhythmia	524 (0.18)	400 (0.18)	109 (0.18)	15 (0.14)
Valvular disease	167 (0.06)	129 (0.06)	32 (0.05)	<11
Pulmonary circulation disorders	57 (0.02)	45 (0.02)	11 (0.02)	<11
Peripheral vascular disorders	462 (0.15)	355 (0.16)	93 (0.15)	14 (0.13)
Hypertension	1,377 (0.46)	1,053 (0.47)	277 (0.45)	47 (0.42)
Hypertension w/ Complications	255 (0.09)	190 (0.08)	51 (0.08)	14 (0.13)
Paralysis	121 (0.04)	86 (0.04)	30 (0.05)	<11
Other neurological disorders	164 (0.05)	119 (0.05)	34 (0.05)	11 (0.10)
Chronic pulmonary disease	718 (0.24)	520 (0.23)	165 (0.27)	33 (0.30)
Diabetes mellitus	569 (0.19)	430 (0.19)	121 (0.20)	18 (0.16)
Diabetes mellitus w/ complications	174 (0.06)	131 (0.06)	38 (0.06)	<11
Hypothyroidism	317 (0.11)	238 (0.11)	64 (0.10)	15 (0.14)
Renal failure	98 (0.03)	68 (0.03)	24 (0.04)	<11
Liver disease	88 (0.03)	68 (0.03)	19 (0.03)	<11
Peptic ulcer disease	91 (0.03)	74 (0.03)	13 (0.02)	<11
HIV/AIDS	<11	<11	<11	<11
Lymphoma	22 (0.01)	18 (0.01)	<11	<11
Metastatic cancer	80 (0.03)	58 (0.03)	18 (0.03)	<11
Solid tumor w/o metastasis	213 (0.07)	166 (0.07)	38 (0.06)	<11
Rheumatoid arthritis/collagen	128 (0.04)	95 (0.04)	29 (0.05)	<11
Coagulopathy	149 (0.05)	119 (0.05)	25 (0.04)	<11
Morbid obesity	39 (0.01)	30 (0.01)	<11	<11
Weight loss	108 (0.04)	73 (0.03)	24 (0.04)	11 (0.10)
Fluid and electrolyte disorders	241 (0.08)	175 (0.08)	53 (0.09)	13 (0.12)
Blood loss anemia	62 (0.02)	49 (0.02)	<11	<11
Deficiency anemia	210 (0.07)	153 (0.07)	44 (0.07)	13 (0.12)
Alcohol abuse	34 (0.01)	23 (0.01)	<11	<11
Drug abuse	<11	<11	<11	<11
Psychoses	46 (0.02)	38 (0.02)	<11	<11
Depression	145 (0.05)	112 (0.05)	27 (0.04)	<11
N	2,988	2,258	619	111
15-year survivors	354	325	29	0

Note: Data presented are the numbers of cases with sample means in parentheses.
[a] Cell counts of <11 are not reported in detail per CMS data use restrictions.

from nonsurvivorship). However, the cumulative cost for other care was uniformly higher.

Except for distant, BC-related cost in the first year of care was lower for survivors rather than for the total sample reflecting savings associated with end-of life care (Table 2). However, starting with year 3 for localized and year 2 for regional, consistent with the differences in mortality, BC-related costs were higher for survivors, reflecting mortality-related savings. A similar pattern was observed for other care.

For survivors ongoing BC-related costs at year 5 decreased substantially from their first-year highs but were still in the $3,205 to $4,741 range. Although at 5+ years from diagnosis few direct cost comparisons between localized and regional cancers were statistically significant due to large standard errors associated with progressively lower sample size of the regional subgroup, at 10+ years the regional cancer subgroup incurred substantial amounts of BC-related costs whereas the localized subsample demonstrated very little change.

Consistent with the above, 1-year utilization (mean per-person-claims in category) of BC-related care was progressively higher in more advanced stage-specific groups (Table 3). The largest 1-year utilization increases were for chemo/radiotherapy: 1.37 (CI:1.23−1.51) for localized; 5.77 (CI:4.85−6.69) for regional; and 11.13 (CI:5.99−15.27) for distant. However, even physician visits followed this pattern with utilization rates of 3.94 (CI:3.76−4.12) for localized,

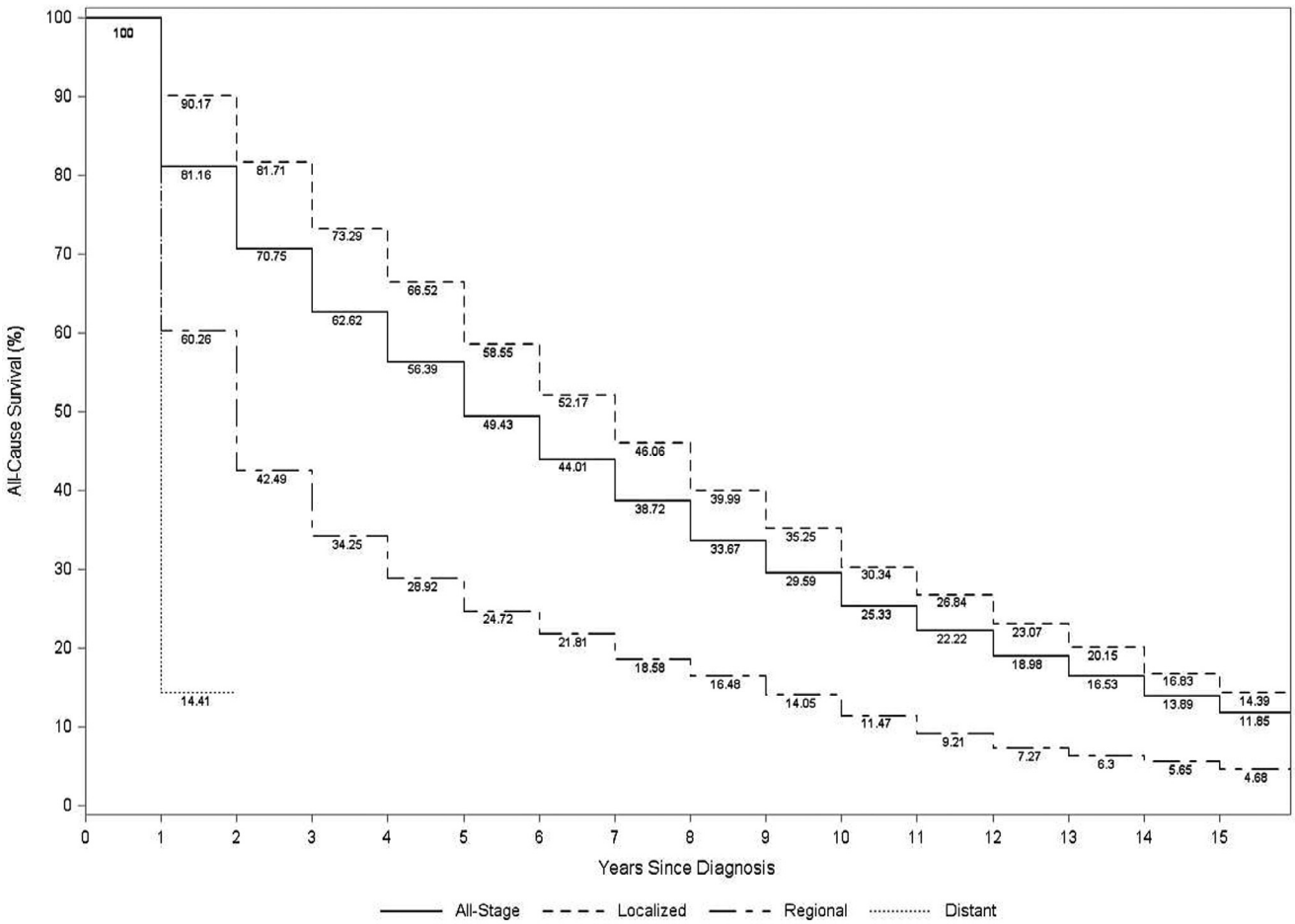

Fig. 1. All cause survival.

9.86 (CI:8.98−10.74) for regional and 16.63 (CI:9.11−24.15) for distant. As anticipated, cystoscopy and intravesical therapy use was highest for localized and lowest for distant BC and regional was associated with the highest mean number of surgical encounters. The regional subgroup included some patients with bladder-preserving therapies.

The rate of use of BC-related services decreased dramatically from year 2 onwards with few statistically significant changes in utilization remaining at years 5+. For localized BC, low levels of care were observed in all categories, even those not associated with routine maintenance-related care such as surgery, chemo/radiotherapy suggesting possible recurrence. However, for regional, BC-related utilization of these 3 categories were negligible at year 5 and zero at year 15.

Within each stage-specific stratum, routine care (physician visits, laboratory tests and imaging) remained fairly constant throughout the 15-year period showing few meaningful differences although localized demonstrated slightly higher laboratory testing rates and slightly lower imaging rates. Rates of non-BC-related cystoscopy/intravesical, surgery and chemo/radiotherapy were negligible throughout.

4. Discussion

We documented substantial declines in BC-related cost and utilization following the first year after BC diagnosis. Although in the first year, costs and utilization predictably increased with cancer stage, in the long run the very high mortality rates of persons with more advanced BC at diagnosis dramatically decreased cost. The initial higher service intensity of regional and especially distant subgroups was offset by high mortality rates and slightly lower long-term rates of high-cost service use such as surgery among the (fewer) survivors. Holding other factors constant, high mortality yields savings to payers such as Medicare while higher treatment intensity, especially if successful, tends to increase cost. Although the high mortality rates associated with distant BC precluded longitudinal analysis, differences in BC-related utilization between localized and regional groups narrowed during follow-up while non-BC-related utilization differences remained high. Much of the care received by beneficiaries with BC was for care for which BC was not recorded on the claim, demonstrating the importance of distinguishing care attributable to the disease from other care in cost of illness studies.

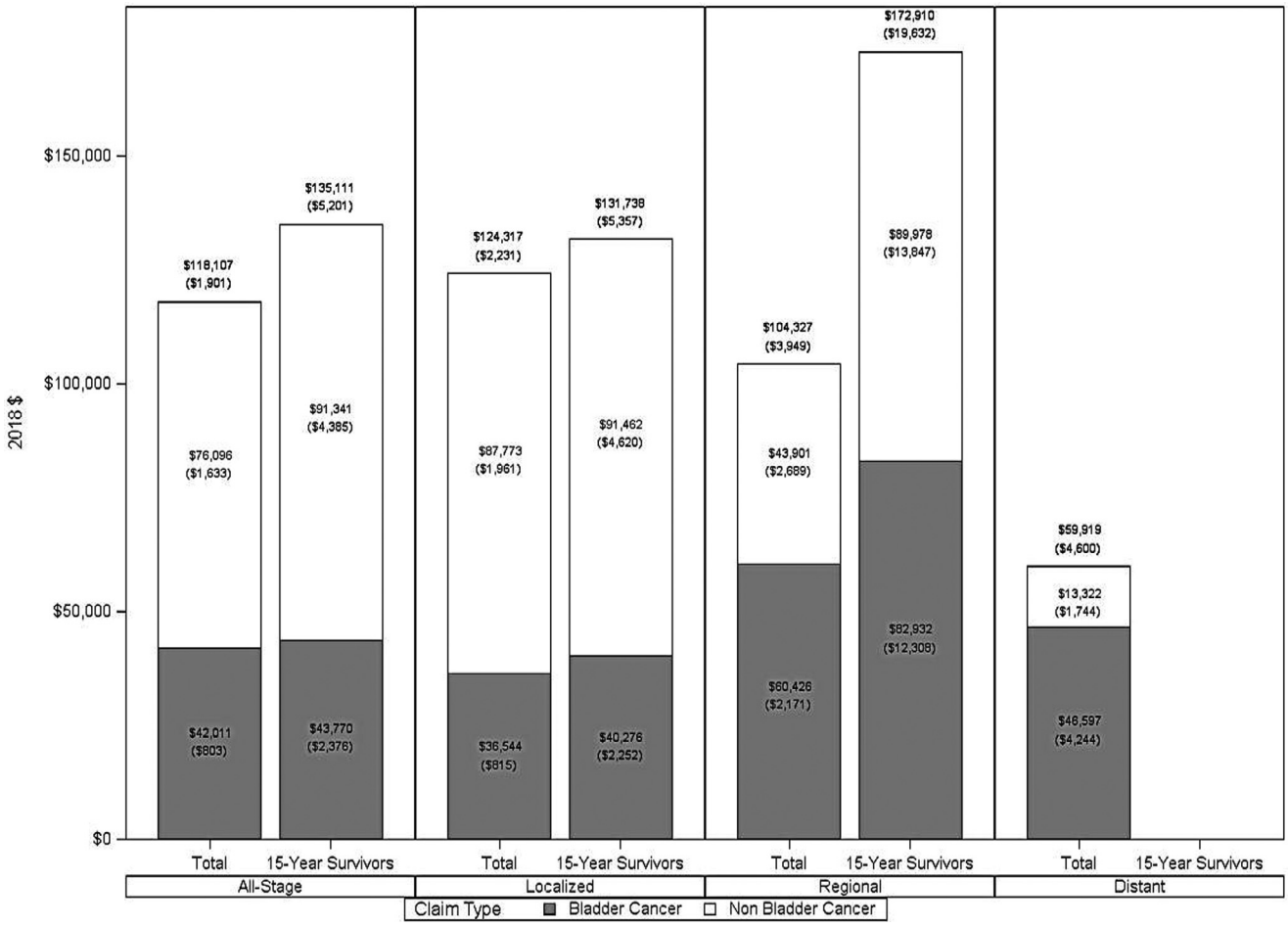

Fig. 2. Standard errors are reported in parentheses. Distant costs reflect only the 1st year of care given that the number of 2+ year survivors was >11.

Our estimates suggest that given the large differences in cost by stage, particularly in the first year following BC diagnosis, earlier identification of BC would result in major per-beneficiary savings, even when additional long-term non-BC-related care is considered. For example, if 15-year survivors diagnosed with regional BC analyzed in this study were diagnosed earlier with localized BC, the Medicare system could have saved a minimum of $41,172/person. This estimate deals with the best-case scenario, comparing long-term survivors with successfully treated BC in 2 subgroups. The savings associated by earlier detection among individuals who could not be successfully treated could be even higher.

Lack of adherence to BC care guidelines has been reported and our finding of low utilization rates in the later follow-up years is consistent with this. Empirical evidence has indicated underuse of cystectomy for muscle-invasive BC [10,11] with various reasons given for non-adherence including differences in care practices among providers [10,12−16]. However, a case can also be made that nonadherence to guidelines after initial treatment is accompanied by overuse in treatment intensity of early stage-BC in the U.S. with no measured benefit in improved survival or reduced use of subsequent major clinical interventions [17−19]. The high expense of care of persons with regional and distant BC in the first year documented here coupled with high mortality rates may indicate such care is not cost effective, at least with survival as the end-point. In cost-constrained environments, the degree to which patient and physician desire to treat should trump the payer's requirement to pay for a futile therapy is highly debatable.

To our knowledge this is the first study to document longitudinal patterns of use of BC and non-BC-related services received. Several studies of BC-related costs have been published previously. Our estimate of the aggregate cumulative cost/beneficiary diagnosed with BC in the U.S. is lower than prior estimates of lifetime BC cost [8,20−25]. However, there are important methodological improvements in our study. Specifically, we documented cost and utilization for a long follow-up period of up to 15 years while accounting for mortality overall and stage-specific differences in mortality. We documented each post-diagnosis year separately, with the first year of care corresponding to the initial phase of care described elsewhere [1,20,26,27] and although we do not explicitly deal with end-of-life costs, stage-specific differences in these costs are accounted

Table 2
Real cost per capita: means and standard errors[a]

	Localized		Regional		Distant Sample	
	Total	Survivors	Total	Survivors	Total	Survivors
1yr Post-Dx: Total	23,201 (602)	20,707 (540)	51,840 (1,864)	50,345 (2,372)	59,919 (4,600)	78,527 (13,808)
BC	12,353 (329)	11,302 (302)	39,342 (1,462)	38,893 (1,780)	46,597 (4,244)	61,161 (14,857)
Other	10,848 (437)	9,405 (395)	12,499 (877)	11,452 (1,058)	13,322 (1,744)	17,366 (6,587)
2yrs Post-Dx: Total	13,804 (601)	12,953 (568)	12,331 (1,008)	17,008 (1,760)		
BC	4,704 (232)	4,879 (252)	7,283 (695)	9,433 (1,195)		
Other	9,100 (530)	8,074 (468)	5,048 (578)	7,574 (1,130)		
3yrs Post-Dx: Total	11,721 (473)	12,401 (528)	7,902 (946)	15,177 (2,317)		
BC	3,814 (249)	4,015 (264)	3,929 (550)	7,144 (1,290)		
Other	7,907 (358)	8,386 (407)	3,973 (549)	8,032 (1,328)		
4yrs Post-Dx: Total	11,043 (475)	13,175 (580)	5,187 (604)	12,391 (1,532)		
BC	2,952 (183)	3,490 (215)	2,183 (398)	5,251 (1,090)		
Other	8,091 (405)	9,686 (505)	3,004 (352)	7,140 (859)		
5yrs Post-Dx: Total	10,133 (460)	12,673 (607)	4,168 (566)	12,406 (1,717)		
BC	2,510 (167)	3,205 (227)	1,654 (301)	4,741 (984)		
Other	7,623 (402)	9,468 (536)	2,514 (371)	7,665 (1,064)		
6yrs Post-Dx: Total	8,459 (396)	12,426 (598)	3,449 (490)	12,478 (1,804)		
BC	1,806 (124)	2,760 (192)	1,025 (208)	3,483 (742)		
Other	6,653 (348)	9,666 (532)	2,424 (380)	8,994 (1,484)		
7yrs Post-Dx: Total	8,194 (444)	13,279 (714)	3,254 (635)	12,318 (2,117)		
BC	1,627 (128)	2,995 (252)	807 (183)	2,907 (774)		
Other	6,567 (397)	10,284 (615)	2,448 (558)	9,411 (1,726)		
8yrs Post-Dx: Total	7,116 (399)	13,425 (756)	2,384 (479)	12,306 (2,607)		
BC	1,366 (114)	2,601 (221)	561 (117)	2,485 (530)		
Other	5,750 (363)	10,824 (690)	1,823 (424)	9,820 (2,377)		
9yrs Post-Dx: Total	6,366 (382)	13,344 (793)	2,332 (427)	10,149 (1,659)		
BC	1,051 (96)	2,285 (226)	381 (82)	2,258 (503)		
Other	5,316 (352)	11,059 (737)	1,952 (389)	7,892 (1,472)		
10yrs Post-Dx: Total	5,622 (375)	13,769 (942)	3,165 (565)	17,538 (3,401)		
BC	945 (100)	2,526 (289)	854 (251)	4,081 (1,193)		
Other	4,677 (342)	11,243 (865)	2,311 (436)	13,457 (2,820)		
11yrs Post-Dx: Total	4,712 (326)	14,062 (986)	2,370 (510)	15,253 (3,541)		
BC	785 (85)	2,318 (258)	461 (128)	3,112 (1,077)		
Other	3,927 (295)	11,743 (901)	1,909 (444)	12,141 (2,966)		
12yrs Post-Dx: Total	4,734 (348)	15,536 (1197)	1,791 (400)	13,050 (2,826)		
BC	677 (85)	2,242 (294)	428 (132)	3,679 (1,278)		
Other	4,057 (317)	13,294 (1111)	1,363 (297)	9,371 (1,826)		
13yrs Post-Dx: Total	4,025 (337)	14,772 (1199)	1,758 (453)	21,237 (5,311)		
BC	649 (81)	2,535 (331)	487 (177)	7,190 (2,567)		
Other	3,376 (306)	12,237 (1073)	1,270 (356)	14,047 (4,072)		
14yrs Post-Dx: Total	2,801 (247)	11,013 (1015)	1,021 (251)	14,991 (3,370)		
BC	577 (82)	2,413 (381)	297 (92)	3,998 (1,267)		
Other	2,224 (214)	8,599 (884)	724 (199)	10,993 (2,853)		
15yrs Post-Dx: Total	2,388 (224)	11,968 (1082)	1,374 (424)	17,267 (4,395)		
BC	731 (110)	3,883 (611)	733 (234)	10,590 (3,503)		
Other	1,657 (158)	8,085 (762)	641 (238)	6,677 (1,383)		

[a] Expenditures in adjusted 2018 dollars.

for. Finally, we distinguish between mean cost per BC case versus the marginal cost of extending life an additional year and separated out BC-attributable care from other care received by the individual.

Previous studies did not distinguish between BC and other care cost, or did not adequately describe the underlying method used even in supplementary material [28,29] (with some exceptions) [20,24]. This is important because elderly cancer persons generally have many comorbidities [30,31]. Those studies that distinguished between BC and non-BC care, did not measure cost by stage of initial BC diagnosis or account for comorbidities underlying the aggregate estimates of BC cost reported, and/or reported cost by phase of care rather than by years following BC diagnosis. One prominent study that identified BC-related cost attributed to BC, was based on data from a single major referral cancer center [20] which although informative and illustrative of the problem, is likely to be unrepresentative nationally both in terms of case mix and treatment styles of providers.

Table 3
Utilization of care among survivors[a]

	Physician visits	Laboratory tests	Imaging	Cystoscopy and intravesical	Surgical procedures	Chemotherapy and radiotherapy
Panel A: Localized bladder cancer						
1yr Post-Dx						
BC	3.94 (0.09)	4.70 (0.10)	1.40 (0.05)	3.59 (0.07)	3.33 (0.05)	1.37 (0.07)
Other	9.35 (0.19)	4.18 (0.09)	3.26 (0.08)	0.38 (0.02)	0.45 (0.02)	0.36 (0.05)
2yrs Post-Dx						
BC	2.14 (0.08)	3.14 (0.09)	0.65 (0.04)	2.57 (0.07)	1.05 (0.04)	0.83 (0.07)
Other	8.58 (0.20)	3.28 (0.09)	2.05 (0.08)	0.18 (0.01)	0.14 (0.01)	0.29 (0.06)
3yrs Post-Dx						
BC	1.70 (0.08)	2.44 (0.08)	0.57 (0.04)	1.89 (0.06)	0.72 (0.04)	0.58 (0.06)
Other	8.69 (0.20)	4.11 (0.11)	1.99 (0.08)	0.15 (0.01)	0.11 (0.01)	0.27 (0.05)
4yrs Post-Dx						
BC	1.45 (0.07)	2.20 (0.08)	0.52 (0.04)	1.59 (0.06)	0.59 (0.04)	0.53 (0.07)
Other	9.12 (0.21)	4.39 (0.13)	2.29 (0.09)	0.13 (0.01)	0.10 (0.01)	0.35 (0.07)
5yrs Post-Dx						
BC	1.26 (0.07)	2.04 (0.09)	0.46 (0.04)	1.40 (0.06)	0.50 (0.04)	0.40 (0.06)
Other	9.41 (0.23)	4.64 (0.15)	1.98 (0.08)	0.14 (0.01)	0.11 (0.01)	0.34 (0.07)
10yrs Post-Dx						
BC	1.01 (0.08)	1.50 (0.12)	0.34 (0.05)	0.86 (0.06)	0.29 (0.04)	0.21 (0.07)
Other	10.01 (0.33)	5.36 (0.24)	2.04 (0.12)	0.09 (0.01)	0.08 (0.02)	0.30 (0.08)
15yrs Post-Dx						
BC	0.93 (0.12)	1.32 (0.14)	0.29 (0.05)	0.59 (0.07)	0.21 (0.05)	0.16 (0.06)
Other	10.13 (0.48)	5.40 (0.33)	1.70 (0.15)	0.06 (0.02)	0.05 (0.02)	0.74 (0.13)
Panel B: Regional bladder cancer						
1yr Post-Dx						
BC	9.86 (0.44)	6.20 (0.29)	4.98 (0.26)	2.21 (0.15)	4.51 (0.14)	5.77 (0.46)
Other	9.58 (0.45)	4.18 (0.22)	5.84 (0.28)	0.34 (0.03)	0.31 (0.03)	0.33 (0.09)
2yrs Post-Dx						
BC	5.03 (0.42)	3.65 (0.26)	2.62 (0.23)	1.53 (0.17)	0.74 (0.10)	2.00 (0.43)
Other	7.43 (0.44)	2.81 (0.21)	2.97 (0.23)	0.11 (0.02)	0.05 (0.02)	0.44 (0.14)
3yrs Post-Dx						
BC	2.98 (0.30)	2.81 (0.24)	1.99 (0.23)	1.12 (0.14)	0.36 (0.08)	0.80 (0.28)
Other	7.85 (0.56)	3.26 (0.28)	2.41 (0.24)	0.06 (0.02)	0.06 (0.02)	0.37 (0.14)
4yrs Post-Dx						
BC	2.81 (0.39)	2.75 (0.30)	1.81 (0.26)	0.88 (0.12)	0.28 (0.07)	0.88 (0.29)
Other	7.93 (0.61)	3.61 (0.34)	2.46 (0.25)	0.09 (0.03)	0.05 (0.02)	0.39 (0.16)
5yrs Post-Dx						
BC	1.93 (0.24)	2.12 (0.29)	1.39 (0.19)	0.82 (0.13)	0.19 (0.07)	0.41 (0.16)
Other	8.39 (0.65)	3.23 (0.28)	2.24 (0.25)	0.07 (0.02)	0.02 (0.01)	0.24 (0.14)
10yrs Post-Dx						
BC	1.55 (0.27)	1.24 (0.26)	0.77 (0.22)	0.39 (0.09)	0.08 (0.04)	0.15 (0.15)
Other	9.48 (1.03)	4.96 (0.53)	2.38 (0.39)	0.08 (0.07)	0.17 (0.09)	0.03 (0.03)
15yrs Post-Dx						
BC	1.90 (0.71)	1.62 (0.83)	0.38 (0.19)	0.14 (0.08)	0.00 (0.00)	0.00 (0.00)
Other	9.72 (1.67)	5.28 (1.11)	2.69 (0.74)	0.00 (0.00)	0.00 (0.00)	0.21 (0.14)
Panel C: Distant bladder cancer						
1yr Post-Dx						
BC	16.63 (3.76)	7.50 (1.98)	8.56 (1.86)	0.94 (0.25)	3.00 (0.71)	11.13 (2.57)
Other	12.31 (3.08)	6.94 (1.63)	8.00 (1.56)	0.50 (0.33)	0.38 (0.18)	3.56 (2.40)

[a] Mean (Standard Error).

We acknowledge several study limitations. We only measured cost incurred by Medicare. Identifying units of care from claims data is a complex process with many trade-offs to be made *vis-à-vis* the sensitivity and specificity of the ascertainment algorithm. We chose a consistently conservative approach. Hence, even if the values are biased, they should underestimate benefits of improved BC diagnosis and treatment, and would still provide comparable estimates across initial stages and follow-up years and relative patterns of use by initial BC stage. Beneficiaries under age 66 at diagnosis or enrolled in Medicare Advantage were excluded. The large standard errors for cost reflected the substantial heterogeneity in care patterns and case mix although we stratified the sample by initial

diagnosis. While distinguishing between BC-related and other care is a strength, we considered a service to be BC-related if BC was mentioned anywhere on the claim. This criterion resulted in more BC services than would have resulted if only a primary diagnosis had been used. However, there may be instances in which a provider failed to mention BC although care was for a BC complication, e.g., treatment of erectile dysfunction following cystectomy. Our data only extended through 2013, i.e., before the widespread availability of newer more expensive treatments (e.g., immunotherapies, augmented endoscopy, robotic surgery). Newer costlier treatments are likely to boost cost of regional and distant BC relative to localized BC. Finally, SEER only recorded stage at BC diagnosis thus precluding explicit analysis of upstaging during follow-up. However, upstaging was reflected in the cost and use estimates.

5. Conclusions

Preventing BC, especially regional and distant BC, would lead to savings in Medicare payments for this disease, but extra spending on other care attributable to increased longevity would at least partly offset such savings. Medicare spends much per beneficiary with BC, more than a third of their total Medicare costs on average. However, our study showed that the marginal cost of extending the life of a person initially diagnosed with localized BC is much lower than the average cost. Thus, the additional Medicare cost of increasing BC survivorship is not the lifetime cost/year but a number substantially lower than this.

Conflict of interest

The authors have no conflicts of interest or financial disclosures to report.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urolonc.2019.10.016.

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