Increasing Healthcare Costs by Stage and Over Time among Patients Diagnosed with Cancer: 2008-2020

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INTRODUCTION

- Cancer represents significant disease burden
  - 1 in 2 men and 1 in 3 women in the US will develop cancer within their lifetime.[1]
  - Cancer is a leading cause of death worldwide[2] and the second leading cause of death in the US (2019).[3]
  - National medical care costs associated with cancer were $183 billion in 2015 and are projected to increase to $246 billion by 2030 (based on population growth).[4]
- Cancer diagnosis and treatment at earlier stages may be associated with improved outcomes, including decreased morbidity and mortality, as well as lower healthcare resource utilization and costs.[5-8]
- Development of innovative cancer treatments may contribute to increased costs over time.[9]
  - One area of considerable growth is the later-stage oncology pipeline, which has seen a 77% increase from 2008 to 2018.[10]
  - Later stage cancer is more difficult to treat and associated drug and therapy developments to address this need may be expensive.
  - Thus, cancers diagnosed at later stages may exhibit larger increases in cost over time in comparison to those diagnosed at earlier stages.

OBJECTIVE

- To better understand the economic burden by stage of cancer at diagnosis as well as temporal trends, we estimated the cost of care in the first year following a cancer diagnosis.

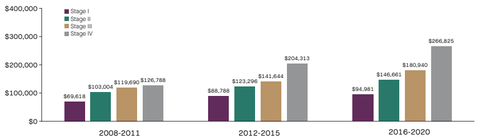
METHODS

- A retrospective analysis was conducted using Optum's de-identified Integrated Claims-Clinical dataset with Enriched Oncology, which includes electronic health record and claims data from Medicare and commercially insured members (1/1/2008-7/31/2020).
- Adult members identified with breast (BC), colorectal (CRC), lung (LC), or ovarian cancer (OC), cancer stage at diagnosis, and continuous enrollment for ≥1-month post-diagnosis were included.
- Mean standardized costs (2020 USD) were calculated in each month over a 1-year period post-cancer diagnosis.
- In each month, costs were calculated for those with continuous enrollment and no death reported in the month.
- Mean annual total cost per patient was estimated by summing post diagnosis month 1-12 mean costs and stratifying by stage at cancer diagnosis in the following time periods: 2008-2011, 2012-2015, and 2016-2020.

HEALTHCARE COSTS FOLLOWING CANCER DIAGNOSIS ARE GENERALLY HIGHER WITH LATER VERSUS EARLIER STAGE CANCER ACROSS CANCER TYPES AND TIME PERIODS.

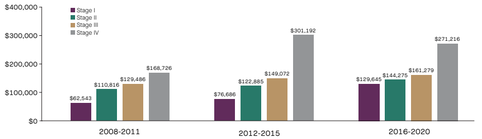
- 28,994 eligible members were identified from 2008-2020 for inclusion in this analysis: BC:18,249 (63%); CRC: 3,992 (14%); LC: 5,422 (19%), OC: 1,331 (5%) (**Table 1**).
- Across all diagnosis periods, 2008-2020, and cancers assessed (**Table 2**):
  - The mean age ranged from 52.9 to 68.3 years.
  - Among the cancers not predominately or exclusively among females (CRC and LC), the percentage female ranged from 44% to 60%.
  - The primary insurance coverage types most common were commercial (34% to 70%) and Medicare (19% to 60%).
  - Most individuals resided in the Midwest (28% to 45%) or Northeast (24% to 37%) geographic regions.
- Mean standard costs for cancer patients in the first-year post diagnosis demonstrated trends by stage and time across all cancers (**Figures 1a-1d**).
  - As expected, standard deviations are positively skewed and relatively large compared to the standard cost means as well as, with a few exceptions, increasing in value by stage.
  - This trend is likely reflective of wide variation in healthcare resource use by patients with cancer.

Figure 1a. Breast Cancer Mean Standard Cost by Diagnosis Time Period, Cancer Type, and Stage, 2008-2020*



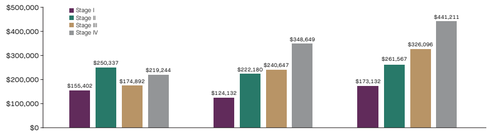
*Standard deviation (SD). In order stage I-IV SD, 2008-2011: $58,125, $70,760, $76,969, $74,020; 2012-2015: $73,791, $80,236, $89,763, $140,634; 2016-2020: $70,184, $101,858, $106,129, $150,294.

Figure 1b. Colorectal Cancer Mean Standard Cost by Diagnosis Time Period, Cancer Type, and Stage, 2008-2020*



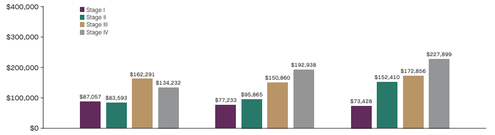
*Standard deviation (SD). In order stage I-IV SD, 2008-2011: $78,318, $120,148, $62,035, $93,646; 2012-2015: $62,035, $93,646, $108,179, $186,537; 2016-2020: $113,327, $107,510, $118,925, $131,685.

Figure 1c. Lung Cancer Mean Standard Cost by Diagnosis Time Period, Cancer Type, and Stage, 2008-2020*



*Standard deviation (SD). In order stage I-IV SD, 2008-2011: $189,701, $135,677, $107,663, $104,092; 2012-2015: $124,480, $167,120, $137,726, $181,291; 2016-2020: $149,691, $165,417, $263,404, $195,764.

Figure 1d. Ovarian Cancer Mean Standard Cost by Diagnosis Time Period, Cancer Type, and Stage, 2008-2020*



*Standard deviation (SD). In order stage I-IV SD, 2008-2011: $125,966, $51,423, $161,119, $83,419; 2012-2015: $58,230, $66,001, $93,696, $123,542; 2016-2020: $73,244, $110,488, $106,888, $133,766.

SUPPORTING DATA

Trends in Cost by Stage

- Mean year 1 costs generally increased by stage at diagnosis across cancers and diagnosis periods (mean cost difference stage I to IV, all cancers: p<0.001).
- For example, in the 2016-2020 period, absolute mean cost in stage I OC was $73K and by stage IV was $228K, a difference of +$154K, reflecting a 3.1x increase from stage I to IV.
- Comparatively, at the other end of spectrum, CRC demonstrated a 2.1x increase ($130K to $271K) (**Figure 2**).

Trends in Cost Over Time by Diagnosis Period

- In addition, mean year 1 costs increased over time for all cancers, most markedly among those diagnosed in stage IV (mean cost difference 2008-2011 to 2016-2020, all stage IV cancers: p<0.001).
- For instance, the difference in mean costs among patients diagnosed with stage IV BC between the 2008-2011 and 2016-2020 periods was +$140K, a 2.1x increase over time ($127K to $267K).
- On the lowest end, stage IV CRC had a 1.6x increase ($169K to $271K) (**Figure 3**).

Figure 2. Stage I vs Stage IV Mean Standard Cost, 2016-2020 Diagnosis Period

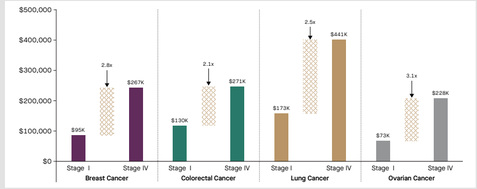


Figure 3. Stage IV Mean Standard Cost, 2008-2011 Diagnosis Period vs 2016-2020 Diagnosis Period

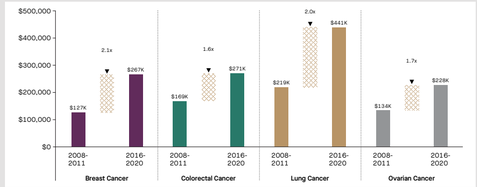


Table 1. Patients in Year 1 Post-diagnosis by Diagnosis Time Period, Cancer Type, and Stage, 2008-2020

Stage	2008-2011				2012-2015				2016-2020			
	N=28,994											
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Breast Cancer, N=18,249, n (%)	N=2,837				N=5,524				N=9,888			
	1,427 (50%)	942 (33%)	236 (8%)	232 (8%)	2,746 (50%)	1,844 (33%)	466 (8%)	468 (8%)	5,060 (51%)	3,373 (34%)	805 (8%)	650 (7%)
Colorectal Cancer N=3,992, n (%)	N= 426				N=1,159				N=2,407			
	43 (10%)	136 (32%)	139 (33%)	108 (25%)	111 (10%)	295 (25%)	426 (37%)	327 (28%)	269 (11%)	581 (24%)	914 (38%)	643 (27%)
Lung Cancer N=5,422, n (%)	N=388				N=1,575				N=3,459			
	101 (26%)	53 (14%)	70 (18%)	164 (42%)	329 (21%)	193 (12%)	304 (19%)	749 (48%)	793 (23%)	483 (14%)	711 (21%)	1,472 (43%)
Ovarian Cancer N=1,331, n (%)	N=169				N=439				N=723			
	38 (22%)	15 (9%)	91 (54%)	25 (15%)	131 (30%)	52 (12%)	172 (39%)	84 (19%)	247 (34%)	79 (11%)	270 (37%)	127 (18%)

Table 2. Baseline Patient Demographics, 2008-2020 Diagnosis Period

Stage		Breast Cancer				Colorectal Cancer				Lung Cancer				Ovarian Cancer			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
n (%)		9,233 (51%)	6,159 (34%)	1,507 (8%)	1,350 (7%)	423 (11%)	1,012 (25%)	1,479 (37%)	1,078 (27%)	1,223 (23%)	729 (13%)	1,085 (20%)	2,385 (44%)	416 (31%)	146 (11%)	533 (40%)	236 (18%)
Age, mean (SD), years		58.7 (11.4)	56.3 (12.2)	55.3 (12.4)	56.4 (12.5)	63.1 (12.6)	61.8 (13.4)	60.9 (12.7)	58.9 (13.3)	68.3 (9.7)	66.3 (10.0)	66.2 (9.9)	64.9 (10.4)	52.9 (14.3)	58.2 (12.7)	59.0 (12.7)	61.8 (11.2)
Female Gender, n (%)*		9,210 (100%)	6,118 (99%)	1,501 (100%)	1,343 (99%)	198 (47%)	445 (44%)	691 (47%)	500 (46%)	728 (60%)	378 (52%)	512 (47%)	1,200 (50%)	416 (100%)	146 (100%)	533 (100%)	236 (100%)
Insurance Type, n (%)*	Commercial	6,035 (65%)	4,110 (67%)	1,032 (68%)	939 (70%)	216 (51%)	550 (54%)	841 (57%)	664 (62%)	416 (34%)	268 (37%)	425 (39%)	1197 (50%)	292 (70%)	94 (64%)	325 (61%)	142 (60%)
	Medicaid	218 (2%)	217 (4%)	56 (4%)	54 (4%)	8 (2%)	34 (3%)	57 (4%)	50 (5%)	42 (3%)	27 (4%)	58 (5%)	73 (3%)	17 (4%)	9 (6%)	12 (2%)	4 (2%)
	Medicare Advantage	2,532 (27%)	1,456 (24%)	324 (21%)	283 (21%)	180 (43%)	399 (39%)	500 (34%)	299 (28%)	729 (60%)	406 (56%)	558 (51%)	1014 (43%)	81 (19%)	41 (28%)	164 (31%)	77 (33%)
	Multiple	16 (0%)	9 (0%)	4 (0%)	3 (0%)	0 (0%)	2 (0%)	1 (0%)	0 (0%)	2 (0%)	2 (0%)	1 (0%)	8 (0%)	1 (0%)	0 (0%)	2 (0%)	0 (0%)
	Unknown	432 (5%)	367 (6%)	91 (6%)	71 (5%)	19 (4%)	27 (3%)	80 (5%)	65 (6%)	34 (3%)	26 (4%)	43 (4%)	93 (4%)	25 (6%)	2 (1%)	30 (6%)	13 (6%)
Geographic Region, n (%)	Midwest	3,993 (43%)	2,726 (44%)	611 (41%)	492 (36%)	178 (42%)	405 (40%)	589 (40%)	428 (40%)	459 (38%)	304 (42%)	486 (45%)	972 (41%)	184 (44%)	41 (28%)	198 (37%)	71 (30%)
	Northeast	3,332 (36%)	2,077 (34%)	479 (32%)	416 (31%)	123 (29%)	307 (30%)	485 (33%)	255 (24%)	457 (37%)	218 (30%)	293 (27%)	655 (27%)	144 (35%)	50 (34%)	153 (29%)	59 (25%)
	South	965 (10%)	713 (12%)	215 (14%)	279 (21%)	73 (17%)	187 (18%)	249 (17%)	257 (24%)	186 (15%)	128 (18%)	196 (18%)	472 (20%)	54 (13%)	34 (23%)	122 (23%)	55 (23%)
	West	743 (8%)	481 (8%)	149 (10%)	130 (10%)	38 (9%)	78 (8%)	104 (7%)	106 (10%)	81 (7%)	47 (6%)	78 (7%)	228 (10%)	23 (6%)	15 (10%)	45 (8%)	41 (17%)
	Unknown	200 (2%)	162 (3%)	53 (4%)	33 (2%)	11 (3%)	35 (3%)	52 (4%)	32 (3%)	40 (3%)	32 (4%)	32 (3%)	58 (2%)	11 (3%)	6 (4%)	15 (3%)	10 (4%)

* Due to rounding, some percentages are listed as 0% or 100%, when there are a relatively small or large n for the category in comparison to the total, respectively.

CONCLUSIONS

- Mean annual costs of care per patient during the first-year post cancer diagnosis were significantly higher among those diagnosed at later versus earlier cancer stages.
- Additionally, these costs were significantly higher in the most recent versus earlier diagnosis time periods.
- Earlier cancer diagnosis may enable more efficient treatment and reduce healthcare costs.

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