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New Brunswick Institute for Research, Data and Training

THE COST OF OCCUPATIONAL CANCER IN NEW BRUNSWICK

Margaret Holland, MA
Adele Balram, MSc
Jonathan Boudreau, MSc
Ted McDonald, PhD

PROJECT TITLE
The cost of occupational cancer in New Brunswick

PRINCIPAL INVESTIGATORS
Margaret Holland, Data Analyst, NB-IRDT
Adele Balram, Data Analyst, NB-IRDT
Jonathan Boudreau, Data Analyst, NB-IRDT
Ted McDonald, Director, NB-IRDT

RESEARCH TEAM
Tanya Wilson, Health Information Platform Manager, NB-IRDT
Chandy Somayaji, Data Analyst, NB-IRDT
Kyle Rogers, Data Analyst, NB-IRDT
Edna Kalu, Research Assistant, NB-IRDT
Andrew Balcom, Research Assistant, NB-IRDT
Herb Emery, Vaughan Chair in Regional Economics, UNB

PARTNERS
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EXECUTIVE SUMMARY

The Firefighter's Compensation Act (2009)—which granted firefighters presumptive coverage for select sites of primary cancer (i.e., bladder, brain, colorectal, kidney, leukemia, lung, non-Hodgkin's lymphoma, oesophageal, testicular, and ureter) [1]—has both established precedent for workers in New Brunswick (NB) and liability for the Workers' Compensation (WC) system. While occupational cancer has been shown to exert health and economic burden in other jurisdictions, little research has examined the health and economic burden of occupational cancer in New Brunswick. The aim of this study is to help fill that gap. Specifically, the goal of this report is to use what data are available to characterize the costs of cancer generally, which are then useful for providing an estimate of a cost range for a number of occupationally-related cancers.

The study made use of administrative health data held at the New Brunswick Institute for Research, Data and Training (NB-IRDT) for the period from 2008-2013 (the most recent available). Cancer patients were identified from the New Brunswick Provincial Cancer Registry (NBPCR), a population-based cancer registry. An estimated 19,861 incident (new) cases of cancer were diagnosed during the study period. The most common incident cancers in the analytical sample were breast, prostate, lung, colon, and skin, comprising 66% of all incident cancers from 2008 to 2013.

Data on the cost and frequency of acute inpatient hospitalization were obtained from the New Brunswick Discharge Abstract Database (DAD). The DAD contains demographic, administrative, and clinical data on acute care institution separations in the province. The study utilized a phase-of-care based approach to costing: inpatient hospitalizations were assigned to one of two clinically-relevant phases of care: the treatment phase (the 18-month period following the date of cancer diagnosis) and the terminal phase (last 12 months of life). Acute inpatient hospitalization costs varied by cancer site, stage of disease, phase of care, and age group. Expected costs of acute inpatient hospitalizations during the treatment phase were lowest for breast cancer ($9,441) and highest for leukemia ($35,963). Expected costs of acute inpatient hospitalizations during the terminal phase were lowest for kidney cancer ($17,044) and highest for non-Hodgkin's lymphoma ($49,028).

More in-depth analysis of cancer care costs in New Brunswick is limited by the nature and availability of relevant health care service utilization and cost data. As cancer patients journey through the provincial healthcare system, they use a variety of outpatient and community-based health care services. However, New Brunswick data on these aspects of a cancer patient's journey (i.e., physician services, pharma care, diagnostic testing, emergency services, home care, long-term care, and hospice care) are limited. These components of cancer care have been shown to be important drivers of cost, accounting for anywhere from 36% to 62% of mean per patient cancer care cost in Ontario for patients who survived less or more than 12 months from diagnosis, respectively [2-5].

As outpatient- and community-based health cancer care can also be expected to be important cost drivers in New Brunswick, estimates including these components were simulated by site and stage of cancer for the 'typical' patient following 'standard treatment' under various scenarios (high, medium, and low cost) using available data (e.g., fee schedules, collective agreements, peer-reviewed scholarly articles, and clinical treatment guidelines). The simulated expected costs were lowest for prostate cancer ($20,894) and highest for brain cancer ($92,597). Simulated cost modeling creates a foundation to further understanding of and research on the nature of the cancer burden in the province. However, simulated cost estimates for the 'typical' patient are not a substitute for estimates based on real health care service utilization data. More information and real patient- and systems-level data are needed to fully appreciate the cost implications of a case of cancer in New Brunswick for health care and wellness planning and for evaluating the appropriateness and effectiveness of cancer care delivered throughout New Brunswick.

The study identifies other knowledge gaps in the cancer registry data. For example, while most cancer patients in New Brunswick begin involvement with the cancer care system via diagnostic tests that describe extent and severity (cancer staging) of their disease, limited staging information is reported to the provincial cancer registry (i.e., only breast, colon, lung, prostate, and rectal cancers are staged in the NBPCR). Research in other jurisdictions suggests that these disease distinctions are important to fully understand cancer burden. As such, staging information is important for evaluating the effectiveness of prevention programming and cancer care delivered throughout New Brunswick.

Another limitation of the existing cancer registry infrastructure is that the provincial and national cancer registries do not collect workplace and exposure information. This information gap has two noticeable effects. First, known (and suspected) cases of occupational cancer are not identifiable outside of insurance claims data. Second, it difficult to estimate the extent of occupational exposure to carcinogens and the impact(s) of such exposure in the province. Studies from other jurisdictions have suggested that up to 40% of the workforce may be exposed to carcinogenic agents at the workplace or in an occupation [6]. This data is essential for understanding the nature of the occupational cancer burden and for evaluating the effectiveness of workplace health and safety cancer prevention initiatives in the province.

SECTION 1. Study background and purpose

Many working-age New Brunswickers are diagnosed with cancer each year. Cancer affects employees across all demographics and industries, making it a priority for government, employers, and Workers' Compensation Boards regardless of jurisdiction or industry. There has been an increasing focus on identifying and preventing occupational (work-related) cancers in the province. The term occupational cancer refers to cases of cancer that are wholly or partially caused by exposure to carcinogenic agents in one's workplace or occupation. Many people work in occupations with a known risk of exposure to carcinogens. While no studies on occupational cancers have been undertaken in New Brunswick, research from other jurisdictions has estimated that three to 11% of all cancer deaths, and a higher share of cancer cases, may stem from occupational exposure to carcinogens [6-15].

Despite the connection between occupation and cancer described above, it has been estimated over the last decade that few (< 8%) occupational cancer cases have received compensation from the Workers' Compensation (WC) system [6, 8, 12, 14]. Reasons for this under-compensation are thought to include lack of awareness of occupational risk factors for cancer among workers and health professionals, cancer's long latency period, and difficulties in definitely assigning specific cases of cancer to an occupational cause [6, 8, 12, 14]. However, this is changing in New Brunswick. Recent legislation has granted firefighters presumptive coverage under the Firefighter's Compensation Act (2009) for select sites of primary cancer (i.e., bladder, brain, colorectal, leukemia, lung, kidney, non-Hodgkin's lymphoma, oesophageal, testicular, and ureter) [1].

Numerous studies from various jurisdictions have examined the links between occupational exposure to carcinogens pertinent to firefighting and cancer. Although the evidence on many exposures and risk of cancer is statistically significant[1,2,3], evidence demonstrating differences in risk and rates of cancer between firefighters and the general population remains inconclusive.[4] This makes estimating the nature of the occupational cancer burden in the New Brunswick firefighter population challenging. However, cancer projections for the fire service can be benchmarked against the general population. The cancers covered under the presumptive legislation are among the most prevalent cancers occurring in the Canadian population [1, 16]. Based on 2010 estimates, approximately one out of every two Canadians (49% of men and 45% of women) are expected to develop cancer during their lifetime [16]. Given the prevalence of the insured cancers in the overall population, and the assumption that firefighters will experience similar rates, it is likely the sub-population of New Brunswick firefighters will lodge claims under the legislation. Therefore, irrespective of the occupational cancer risk particular to firefighting in New Brunswick, the presumptive legislation has generated an important liability for the Workers' Compensation (WC) system.

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1 The World Health Organization's International Agency for Research on Cancer (IARC) publishes the best known and most comprehensive list of carcinogens. As evidence is constantly evolving, the IARC list is not exhaustive. To date, priority exposures include (1) a host of different chemicals, dusts, metals, and combustion products; (2) forms of radiation (e.g., ionizing or ultraviolet radiation); and (3) patterns of behavior (e.g., shift working).

2 CAREX Canada has developed profiles and estimates of occupational and environmental exposure for a known number of known, probable, and possible carcinogenic agents.

3 Studies from Australia have found that up to 40% of workers could be currently exposed to carcinogens at the workplace or in an occupation [6].

4 Difficulties stem from issues of the quality and availability of data; from small sample sizes and the limited statistical power resulting from this, especially for female firefighters and for uncommon tumours (e.g., benign brain tumours); and from possible confounding effects from the healthy worker effect and firefighter population (e.g., career or volunteer) [17-18].

The Workers' Compensation system is responsible for covering the costs of current and future liabilities on behalf of injured New Brunswick workers and their dependents. The WC system is funded via premiums assessed on employers, which are set on a cost-recovery basis, grouping employers by similar industry and level of occupational risk. As such, understanding the economic burden of occupational cancer will help in premium setting and the continued viability of the WC system.

To date, a full assessment of the cost of occupational cancer is hindered by the lack of historical claims data in New Brunswick. This study aims to help fill this information gap by providing an assessment of the cost of health care for a case of cancer covered by the presumptive legislation in New Brunswick (i.e., bladder, brain, colon, kidney, leukemia, lung, non-Hodgkin's lymphoma, oesophageal, rectum, testicular, and ureter), as well as other sites of cancers that have been suggested for expanded coverage under the legislation (i.e., breast, prostate, skin, and multiple myeloma). Finally, the report describes considerations relevant to projecting the cost of a case of occupational cancer in New Brunswick.

SECTION 2. Overview of study approach

This study received approval from the University of New Brunswick's Institutional Review Board (file #2016-141). This study was commissioned by Morneau Shepell Inc. to help inform WC business case development and to support the development of strategies that will enhance the health and wellness of the New Brunswick fire service and the province's workforce. The views expressed in this report are the views of the authors and do not necessarily reflect the views of Morneau Shepell Inc. or that of the University of New Brunswick.

For the purposes of this study, the research team adopted the perspective of the Workers' Compensation (WC) system and focused on the health care system costs of cancer care. While the financial implications of occupational cancer are pertinent to stakeholders in the WC system, it is important to note that this perspective does not fully capture the burden of occupational cancer in New Brunswick. The consequences of a cancer diagnosis result in myriad and profound costs for patients, their families, their employers, and New Brunswick as a whole. Such costs may include but are not limited to costs relating to pain and suffering, reduced productivity in the workplace, increased morbidity, premature mortality, financial losses, reduced quality of life, activity limitations, transportation and parking, home modifications, home care, help around the home, and help with activities of daily living.

A literature review was used to identify approaches that have been used to estimate the cost of a case of cancer, as well as relevant peer-reviewed publications, government reports, and sources of data. In addition, the research team held discussions with several subject-area experts to supplement the literature search. The methodology selection process took into account current standards of best practice, availability and quality of data, available timeframe, and other attributes relevant to cancer care in the New Brunswick health care system.

The conceptual framework adopted by this study is a paradigm that describes the relationship between the development, progression, and consequences of developing cancer. According to this approach to estimation, new cases of occupational cancer are conceptualized as stemming from on-the-job exposure to carcinogens and occupational cancer risk. After the onset of symptoms, a worker's experience with health care is shaped by their specific type (site) of cancer as well as disease severity, as defined by their stage of cancer at time of their diagnosis [2-5]. In keeping with findings in the literature, advancing stage of disease and age are assumed to be associated with a greater need for health care and a higher risk of morbidities and mortality [2-5, 25-31].

The study followed a phase-based approach to estimation. According to this framework, all patients are assumed to have a pre-diagnosis phase that includes the standard diagnostic testing necessary to establish the patient's cancer diagnosis. The pre-diagnosis phase has been defined in the literature as the 3-month period prior to the date of diagnosis [2-5, 26-27]. The second phase is the treatment phase, which has been defined in the literature as the 18-month period following the date of diagnosis [2-5, 26-27]. This phase would typically include surgery/primary therapy, neo-adjuvant therapy, adjuvant therapy, symptom treatment, side effect management, ongoing surveillance, and active follow-up treatment for cancer recurrence and/or new cancers. The third phase of care, the terminal phase, has been defined in the literature as the patient's last 12 months of life [2-5, 26-27]. In this phase, patients utilize a wide variety of health care services, including palliative therapies. For each site and stage of cancer, pattern of health care is conceptualized as corresponding to the natural history of cancer for the 'typical patient' with that site and stage of disease. This approach to estimation has been used by the seminal studies that have estimated the cost of cancer care in Canada and the United States [2-5, 26-27]. It has been noted that an important advantage of this approach to estimation is that it incorporates the natural progression of the disease and the associated pattern of health service utilization [2-5, 26-27]. In addition, this

methodology enables the estimation of long-term cost as patient survival is considered [2-5, 26-27].

Occupational history and cases of known, or suspected, occupational cancer are not identifiable using the administrative health data held at NB-IRDT. Therefore, it was assumed that access to and actual health care received are similar for occupational and non-occupational cancer patients in New Brunswick. Implicit in this assumption is the expectation that survival and the distribution of stage-at-diagnosis are the same across these two patient populations. However, this assumption may not hold true for the fire service for several reasons. First, as a group, firefighters show a healthy worker effect [17-20]. Further, evidence suggests this effect may vary between firefighter sub-populations (i.e., volunteer or career) [18]. Second, modifiable cancer risk factors may be more likely to be addressed in the firefighting population as workplace health and wellness initiatives affect health and lessen cancer risk in this firefighters [21-24]. Firefighters may benefit from heightened awareness, clear cancer screening protocols, targeted surveillance initiatives, and more general health and wellness programming that targets health behavioral opportunities to lessen cancer risk and engage in healthier living [24].

SECTION 3. Incident cancers in New Brunswick

Overview

The estimation of the number of incident (new) cancers in New Brunswick was foundational for all other analyses in this study.[5] This section presents information on the estimation of rates of incident cancers in the province by site, stage at diagnosis (where available), and age group, where sample size permitted reliable estimation and met NB-IRDT and RDC data disclosure requirements.[6,7]

Methods

Patient selection

Patients were identified from the New Brunswick Provincial Cancer Registry (NBPCR), a population-based cancer registry for the province of New Brunswick. The study included all patients aged 18 years and older who were first diagnosed with a primary cancer between the years 2008-2013 (inclusive). Inclusion criteria further required patients to have survived more than 30 days after date of diagnosis and to not have received a second cancer diagnosis within 90 days after initial cancer diagnosis. Cases of cancer were identified using the International Classification of Diseases-Oncology 3rd edition (ICD-O-3: Table A1-1, Appendix 1). All patients with a single, valid ICD-O-3 topography or histology code corresponding to a primary cancer of interest were assigned to one of the following categories of cancer: bladder, brain, breast, colon, kidney, leukemia, lung, multiple myeloma, non-Hodgkin's lymphoma, oesophageal, prostate, rectum, skin, testicular, and ureter. The NBPCR reports staging data for breast, colon, lung, prostate, and rectal cancer. Patients assigned to these cancer categories were further categorized according to American Joint Committee on Cancer (AJCC) stage at diagnosis; those missing valid staging information were excluded from the analytical sample [32-33].

Data

We made use of data from (1) the New Brunswick Provincial Cancer Registry (NBPCR), accessed through the New Brunswick Institute for Research, Data and Training (NB-IRDT); (2) Canadian Cancer Registry (CCR) data, assessed through the New Brunswick Research Data Centre (NB RDC); and (3) public use CANSIM population data from Statistics Canada [34]. The NBPCR compiles tumor-specific and patient demographic data (e.g., sex and age at diagnosis) on each tumor recorded in the province. It also contains data on American Joint Committee on Cancer (AJCC) stage at diagnosis for cancer of the breast, colon, lung, prostate, and rectum [32-33]. New Brunswick does not report staging information for the following sites of cancer: bladder, brain, kidney, leukemia, multiple myeloma, non-Hodgkin's lymphoma, oesophageal, skin, testicular, and ureter. In order to fill this information gap, we obtained additional data from the Canadian Cancer

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[5] The term cancer incidence describes the number of new cases of cancer during a specified period of time. Although not regularly reported at the provincial level, cancer rates are sometimes described in terms of prevalence, which refers to the number of people who have cancer at any given point in time. People with cancer typically live several years with the disease. Therefore, the prevalence rate is usually much greater than the incidence rate.

[6] For privacy purposes, data disclosure in the NB-IRDT requires satisfying the mandated minimum cell count.

[7] Several steps were taken at the New Brunswick Research Data Centre (NB RDC) to protect privacy, which included meeting the required minimum cell count and controlled random rounding. Results satisfying the minimum cell count requirement are control random rounded to the nearest 5. Random rounding is a technique to ensure confidentiality of aggregate statistics. Controlled random rounding is a form of random rounding that is constrained to have the sum of each row and column equal the respective margin totals. This technique avoids substantial discrepancies while still protecting confidentiality.

Registry (CCR), which compiles the data from all provincial and territorial cancer registries as part of the national cancer database (excluding Quebec).

Approach to estimation

The period of study analyzed cases with a primary diagnosis occurring during the period from 2008 to 2013. Cases of staged cancer diagnosed in 2008 through 2009 (inclusive) were staged in accordance to AJCC 6 [32]. Cases of staged cancer diagnosed in 2010 through 2013 (inclusive) were staged in accordance to AJCC 7 [33]. For the purposes of this study, it was assumed that AJCC 6 criteria was consistent with the criteria outlined in AJCC 7 [32-33].

There is not standard age cutoff in the health literature on cancer in adults. The age cutoffs used here (18 to 64 years and 65 years and older) were based on WC benefit claims and the traditional age of retirement in Canada. Further, the age groupings were structured to account for the fact that patterns of care have been reported to be more aggressive for younger cancer patients compared with elderly cancer patients in many health care settings [2-4, 25, 29]. Finally, prevalence of comorbid conditions and the level of medical care have been shown to increase with age, increasing cost of health care as well [2-5, 26-27, 29-30].

Crude incidence was estimated by age group using the NBPCR and CCR data. The distribution of stage at diagnosis was estimated by age group using NBPCR data for cancers with staging information (i.e., breast, colorectal, lung, and prostate). For those cancers without staging information in the NBPCR, distribution of stage at diagnosis was estimated by age group using data contained in CCR from other jurisdictions. Population denominators were obtained from Statistics Canada for incidence rates using age group population estimates during the study period [34]. Statistical analysis was conducted using SAS version 9.4 and Stata version 14.

Findings

New Brunswick Cancer Registry

There were 19,861 incident cases of cancer (8,846 females and 10,915 males) in the province from 2008-2013. Males had a higher crude incidence of cancer (666.4 per 100,000) than females (515.0 per 100,000) in the analytical sample. Table 1 describes analytical sample mean (with standard deviation) and median (with interquartile range (IQR)) age at diagnosis by site of cancer. With the exception of testicular cancer, which had a median age of diagnosis of 34.1 years (*IQR* = 26.8 to 45.0 years), all other cancers had a median age of diagnosis above 63.0 years. Crude incidence varied significantly by age group, ranging from 318.4 cases per 100,000 population aged 18 to 64 years and 1,575.7 per 100,000 population aged 65 years and older.

The incidence of cancer in NB between the years 2008 to 2013 varied according to site and stage of cancer at diagnosis. As shown in Table 2, the most common incident cancers were breast, prostate, lung, colon, and skin. Together, these cancers comprised approximately 66% of the total number incident cancers in the analytical sample during the study period. Table 3 gives crude incidence by site, decomposed by stage of disease (where available), and age category. Patients with lung cancer in New Brunswick were significantly more likely to be diagnosed at a later stage than patients with breast, colon, prostate, and rectal cancer.

Table 1: Characteristics of patients diagnosed with cancer in New Brunswick by type and stage of cancer (where available), 2008-2013

	Sex		Age at diagnosis				
Cancer	**Females**	**Males**	**Mean**	**SD**	**Median**	**IQR: 25th**	**IQR: 75th**
Bladder	347	1,123	71.0	12.3	71.8	63.0	80.4
Brain	161	204	62.7	16.5	63.2	53.4	74.5
Breast							
Stage I	1,551	11	64.1	11.8	64.2	55.9	72.3
Stage II	1,158	15	63.5	14.4	63.2	52.4	74.6
Stage III	417	5	63.3	14.5	63.0	51.7	74.3
Stage IV	209	5	66.3	14.5	65.5	56.9	77.3
Colon							
Stage I	203	217	70.8	11.6	70.9	63.1	79.5
Stage II	320	325	72.6	10.8	73.5	65.7	80.5
Stage III	272	248	71.0	12.5	72.2	62.7	79.9
Stage IV	227	275	70.7	12.7	71.3	61.7	80.9
Kidney	403	624	64.2	12.1	64.0	56.3	72.5
Leukemia	351	486	67.5	15.2	68.7	58.8	78.2
Lung							
Stage I	319	373	71.4	9.5	71.6	64.8	78.4
Stage II	122	149	71.0	9.5	71.4	64.9	77.5
Stage III	257	324	69.5	10.6	69.4	62.2	77.6
Stage IV	512	743	70.4	10.9	70.7	62.7	78.3
Myeloma	160	209	71.0	11.3	70.7	63.1	80.3
Non-Hodgkin's	495	486	65.5	14.0	66.5	56.4	75.7
Oesophageal	56	228	68.6	12.4	69.1	59.7	78.1
Prostate							
Stage I	n/a	884	65.2	7.8	65.3	59.8	70.4
Stage II	n/a	1,799	67.0	8.9	66.8	61.0	72.7
Stage III	n/a	221	63.7	7.2	64.0	59.3	68.4
Stage IV	n/a	230	74.0	11.2	74.2	64.5	83.3
Rectal							
Stage I	181	87	68.6	11.6	69.4	60.8	77.4
Stage II	96	204	67.7	11.8	67.7	59.4	76.8
Stage III	104	206	64.8	11.9	64.4	57.0	73.7
Stage IV	74	156	67.7	12.3	67.2	59.5	76.6
Skin	827	914	64.5	14.9	65.1	54.2	76.0
Testicular	n/a	128	38.4	15.7	34.4	26.8	45.1
Ureter	24	36	71.9	10.1	73.1	64.7	78.8

Notes

1. Data source: New Brunswick Provincial Cancer Registry (NBPCR), Statistics Canada CANSIM Table 051-0001
2. Analysis: NB-IRDT

Table 2: Patients diagnosed with cancer in New Brunswick, by site and stage of cancer (where available), 2008-2013

Cancer	Percentage of total cases of incident cancers in N.B.	Number of cases	Crude rate per 100,000
Total	100.0%	19,861	591.9
Bladder	7.4%	1,470	43.8
Brain	1.8%	365	10.9
Breast	17.0%	3,371	100.5
Stage I	7.9%	1,562	46.5
Stage II	5.9%	1,173	35.0
Stage III	2.1%	422	12.6
Stage IV	1.1%	214	6.4
Colon	10.5%	2,087	62.2
Stage I	2.1%	420	12.5
Stage II	3.2%	645	19.2
Stage III	2.6%	520	15.5
Stage IV	2.5%	502	15.0
Kidney	5.2%	1,027	30.6
Leukemia	4.2%	837	24.9
Lung	14.1%	2,799	83.4
Stage I	3.5%	692	20.6
Stage II	1.4%	271	8.1
Stage III	2.9%	581	17.3
Stage IV	6.3%	1,255	37.4
Myeloma	1.9%	369	11.0
Non-Hodgkin's	5.4%	1,081	32.2
Oesophageal	1.4%	284	8.5
Prostate	15.8%	3,134	93.4
Stage I	4.5%	884	26.3
Stage II	9.1%	1,799	53.6
Stage III	1.1%	221	6.6
Stage IV	1.2%	230	6.9
Rectal	5.6%	1,108	33.0
Stage I	1.3%	268	8.0
Stage II	1.5%	300	8.9
Stage III	1.6%	310	9.2
Stage IV	1.2%	230	6.9
Skin	8.8%	1,741	51.9
Testicular	0.6%	128	3.8
Ureter	0.3%	60	1.8

Notes

1. Data source: New Brunswick Provincial Cancer Registry (NBPCR) and Statistics Canada CANSIM Table 051-0001
2. Analysis: NB-IRDT

Table 3: Patients diagnosed with cancer in New Brunswick, by site and stage of cancer (where available), 2008-2013

	Share of total cases in NB		Share of stage, by age			Number of cases		Crude rate per 100,000	
Cancer	**18-64**	**65 +**	**18-64**	**65 +**	**All**	**18-64**	**65 +**	**18-64**	**65 +**
Total	42.1%	57.9%				8,359.0	11,502.0	318.4	1,575.7
Bladder	31.1%	68.9%				457.0	1,013.0	17.4	138.8
Brain	55.3%	44.7%				202.0	163.0	7.7	22.3
Breast	53.9%	46.1%				1,817.0	1,554.0	69.2	212.9
Stage I	52.4%	47.6%	45.0%	47.9%	46.3%	818.0	744.0	31.2	101.9
Stage II	55.8%	44.2%	36.0%	33.4%	34.8%	654.0	519.0	24.9	71.1
Stage III	56.6%	43.4%	13.2%	11.8%	12.5%	239.0	183.0	9.1	25.1
Stage IV	49.5%	50.5%	5.8%	6.9%	6.3%	106.0	108.0	4.0	14.8
Colon	28.6%	71.4%				597.0	1,490.0	22.7	204.1
Stage I	29.5%	70.5%	20.8%	19.9%	20.1%	124.0	296.0	4.7	40.5
Stage II	23.3%	76.7%	25.1%	33.2%	30.9%	150.0	495.0	5.7	67.8
Stage III	30.6%	69.4%	26.6%	24.2%	24.9%	159.0	361.0	6.1	49.5
Stage IV	32.7%	67.3%	27.5%	22.7%	24.1%	164.0	338.0	6.2	46.3
Kidney	52.9%	47.1%				543.0	484.0	20.7	66.3
Leukemia	38.8%	61.2%				325.0	512.0	12.4	70.1
Lung	30.5%	69.5%				854.0	1,945.0	32.5	266.4
Stage I	25.6%	74.4%	20.7%	26.5%	24.7%	177.0	515.0	6.7	70.6
Stage II	25.1%	74.9%	8.0%	10.4%	9.7%	68.0	203.0	2.6	27.8
Stage III	34.8%	65.2%	23.7%	19.5%	20.8%	202.0	379.0	7.7	51.9
Stage IV	32.4%	67.6%	47.7%	43.6%	44.8%	407.0	848.0	15.5	116.2
Myeloma	31.2%	68.8%				115.0	254.0	4.4	34.8
Non-Hodgkin's	45.8%	54.2%				495.0	586.0	18.9	80.3
Oesophageal	39.8%	60.2%				113.0	171.0	4.3	23.4
Prostate	43.2%	56.8%				1,355.0	1,779.0	51.6	243.7
Stage I	48.0%	52.0%	31.3%	25.9%	28.2%	424.0	460.0	16.1	63.0
Stage II	41.4%	58.6%	54.9%	59.3%	57.4%	744.0	1,055.0	28.3	144.5
Stage III	56.1%	43.9%	9.2%	5.5%	7.1%	124.0	97.0	4.7	13.3
Stage IV	27.4%	72.6%	4.6%	9.4%	7.3%	63.0	167.0	2.4	22.9
Rectal	43.8%	56.2%				485.0	623.0	18.5	85.3
Stage I	35.4%	64.6%	19.6%	27.8%	24.2%	95.0	173.0	3.6	23.7
Stage II	44.3%	55.7%	27.4%	26.8%	27.1%	133.0	167.0	5.1	22.9
Stage III	52.9%	47.1%	33.8%	23.4%	28.0%	164.0	146.0	6.2	20.0
Stage IV	40.4%	59.6%	19.2%	22.0%	20.8%	93.0	137.0	3.5	18.8
Skin	49.7%	50.3%				866.0	875.0	33.0	119.9
Testicular	93.0%	7.0%				119.0	9.0	4.5	1.2
Ureter	26.7%	73.3%				16.0	44.0	0.6	6.0

Notes

1. Data source: New Brunswick Provincial Cancer Registry (NBPCR), Statistics Canada CANSIM Table 051-0001
2. Analysis: NB-IRDT

Canadian Cancer Registry

This portion of the analysis examined the distribution of stage at diagnosis for the following cancers, which are not presently reported in the NBPCR: bladder, brain, colon, oesophageal, kidney, leukemia, lung, non-Hodgkin's lymphoma, oesophageal, rectum, testicular, and ureter. The data were drawn from Alberta, Manitoba, Newfoundland, Nova Scotia, the Northwest Territories, Prince Edward Island, and Saskatchewan. The population from which the analytical sample was drawn varied by site of cancer, as not all jurisdictions reported staging these cancers (N=34,940). Table 4 gives crude incidence and distribution of cases by site, stage, and age category.

Table 4: Canadian Cancer Registry (CCR) patients by type and stage of cancer (where available), 2008-2013

	Number of cases		Share of stage, by site	
Type of cancer	**18-64 years**	**65 + years**	**18-64 years**	**65 + years**
Total	17,360	17,580		
Bladder	1,080	3,050		
Stage I	500	1,505	12.1%	36.4%
Stage II	180	680	4.4%	16.5%
Stage III	135	300	3.3%	7.3%
Stage IV	265	565	6.4%	13.7%
Brain	65	80		
Stage I	55	60	37.9%	41.4%
Stage II	^	^	^	^
Stage III	0	0	0.0%	0.0%
Stage IV	10	20	6.9%	13.8%
Kidney	3,420	3,090		
Stage I	2,075	1,650	31.9%	25.3%
Stage II	280	210	4.3%	3.2%
Stage III	525	495	8.1%	7.6%
Stage IV	540	735	8.3%	11.3%
Leukemia	95	120		
Stage I	10	25	4.7%	11.6%
Stage II	20	30	9.3%	14.0%
Stage III	30	40	14.0%	18.6%
Stage IV	35	25	16.3%	11.6%
Non-Hodgkin's	3,575	4,185		
Stage I	905	1040	11.7%	13.4%
Stage II	580	680	7.5%	8.8%
Stage III	705	775	9.1%	10.0%
Stage IV	1,385	1,690	17.8%	21.8%
Oesophageal	905	1045		
Stage I	100	200	5.1%	10.3%
Stage II	130	180	6.7%	9.2%
Stage III	240	230	12.3%	11.8%

Stage IV	435	435	22.3%	22.3%
Skin	6,970	5,780		
Stage I	4,760	3,185	37.3%	25.0%
Stage II	970	1,585	7.6%	12.4%
Stage III	910	655	7.1%	5.1%
Stage IV	330	355	2.6%	2.8%
Testicular	1,205	55		
Stage I	895	35	71.0%	2.8%
Stage II	155	15	12.3%	1.2%
Stage III	155	0	12.3%	0.0%
Stage IV	0	5	0.0%	0.4%
Ureter	45	175		
Stage I	20	55	9.1%	25.0%
Stage II	10	35	4.5%	15.9%
Stage III	5	40	2.3%	18.2%
Stage IV	10	45	4.5%	20.5%

Notes
1. ^ denotes count suppressed (less than 5 cases)
2. Counts are generated by controlled random rounding to nearest 5
3. Data source: Canadian Cancer Registry (CCR)
4. Analysis: NB-IRDT

Considerations for cost projections

The total cost of occupational cancer to the WC system is influenced by the number of cases, and cancer incidence is projected to increase in New Brunswick over the next two decades [16]. It is estimated that 89% of all cancers occur in Canadians aged 50 years and older, while 45% of cancers occur in Canadians aged 70 years and older [16]. The impact of the aging population is expected to affect the incidence of cancer, which is forecasted to increase by 40% in Canada over the next 15 years [16].

The incidence of many cancers is also increasing, due in part to increased public awareness and changes in the use of and advancements in cancer screening tests (Canadian Cancer Society, 2017). For a discussion on screening behavior in the province and its relation to cancer incidence, see [36]. Changes in levels of risk and exposures can also impact upon the incidence of cancer in either direction.

Very little research has examined firefighter uptake and compliance with known best practices to reduce occupational exposure to carcinogens (e.g., prompt and frequent washing of protective clothing, prompt showering after exposure, proper fitting protecting equipment and clothing at volunteer fire stations, etc.). It should be noted that with coverage under legislation for other occupations, certain practices and measures might become regulated requirements at the workplace. With respect to personal cancer risk factors, New Brunswick presently ranks lower than other jurisdictions on numerous measures of modifiable cancer risk (e.g., healthy eating, obesity, physical activity, alcohol consumption, and smoking). For a discussion on modifiable cancer risk factors, and their relation to cancer incidence, see [36].

SECTION 4. Estimating the cost of a case of occupational cancer in New Brunswick

Overview

This section describes the methods, data, and assumptions used to quantify the costs associated with a case of cancer in New Brunswick.

Methods

Patient selection

Patients were identified according to the criteria outlined in Section 3. In order to link cancer registry and health administrative data at the patient level, the sample was further restricted to patients with a valid New Brunswick Medicare number and at least one acute inpatient hospitalization in the treatment or terminal phase of care, as determined by the patient date of diagnosis or death.

Data

Measuring health care costs requires two components: utilization of service (i.e., quantity of resources) and unit cost data (i.e., cost of resources). Patient-level data on the cost and frequency of acute inpatient hospitalizations was obtained from the New Brunswick Discharge Abstract Database (DAD) for the most recent years available (2008-2013). The DAD captures administrative, clinical, and demographic information on all hospital discharges in the province and was accessed through NB-IRDT.

Each acute inpatient hospitalization in the DAD is assigned a Case Mix Group (CMG), Resource Intensity Weight (RIW), and Cost Per Weighted Case (CPWC) by the Canadian Institute for Health Information (CIHI).[8] The CMG is a classification used to categorize patients into statistically and clinically homogeneous groups based on clinical profile (i.e., health condition, most responsible diagnosis, pattern of resource utilization, age, comorbidity level, intervention events, and out-of-hospital interventions).

RIW conveys the relative resources used by a patient compared to the 'typical' patient in that patient's CMG (i.e., one who received the normal and expected course of treatment). A RIW takes on the value of 1 if the resources used by the patient are the same as the 'typical patient' in the CMG. It takes on a value of less than 1 if the patient used less resources than the 'typical patient' and is greater than 1 if the patient used more resources. Inpatient hospitalization cost is obtained by multiplying RIW by CPWC. CPWC is a financial indicator that provides a measure of the relative average cost to provide care to the standard hospital patient. CPWC is obtained by dividing total hospital inpatient expenditures by the sum of the RIWs in a province.[9] Note that CPWC reflects only the hospital cost portion of the patient's stay—it does not reflect the cost of a given intervention, *per se* (e.g., physician fees are not included in the CPWC).

The New Brunswick DAD does not capture emergency room care, outpatient and community-based treatments (including day surgery and chemo- and radiotherapy conducted on a non-admission basis), prescription drugs consumed after discharge/outside the hospital, and physician

[8] For more information, refer to the Canadian Institute for Health Information (https://www.cihi.ca/en/pce_methnotes_en.pdf).

[9] CPWC can also be measured at multiple levels, including individual hospital, hospital type, and Regional Health Authority (RHA).

services. These components have been determined to be important cost drivers, representing between 36% and 62% of the mean cost of cancer care in Ontario for patients who survived less or more than 12 months from the initial date of diagnosis, respectively [2-5]. Since these components represent important aspects of cancer care, their cost was estimated for the 'typical' New Brunswick patient following the 'standard' treatment and diagnostic path.

Data on cancer treatment protocols was obtained from the BC Cancer Agency, Cancer Care Ontario, and the Canadian Cancer Society [38-59]. Data on physician services was obtained from the New Brunswick Physicians' Manual (2017) and the Ontario Health Insurance Plan (OHIP) fee schedule (Ministry of Health and Long-Term Care, 2017) [60-61]. Data on other health care professional services was obtained from the New Brunswick collective agreement [62]. Data on chemo- and biological therapies was obtained from the BC Cancer Agency, Canadian Agency for Drugs and Technologies in Health (CADTH) pan-Canadian Oncology Drug Review (pCODR), Cancer Care Ontario, and Canadian Cancer Society [37-59, 63-117]. Data on radio-therapy was obtained from the Cancer Care Ontario, Canadian Cancer Society, and Yong et al. [38-59, 118]. Data on laboratory and diagnostic interventions was obtained from the British Columbia Ministry of Health, Ontario Ministry of Health and Long-Term Care, Mittmann et al., and Demeter et al. [119-122]. Emergency room data was obtained from the New Brunswick Health Council, Cancer Quality Council of Ontario, de Oliveira et al., and Pataky [123-125, 2-5]. All cost data were initially adjusted to 2009 CAD for comparison with other reports, and finally to 2013 CAD. These comparisons were done using Statistics Canada data on consumer price index for health and personal care [126].

Approach to estimation

As described in Section 2, it was assumed that care protocols and access to care were similar for occupational and non-occupational cancer patients in New Brunswick. Implicit in this assumption is the inference that survival and distribution of stage at diagnosis are the same across the two patient populations.

The study followed the phase-based approach to estimation described in Section 2, which divides patterns of care into phase 1 (3 months prior to diagnosis), phase 2 (treatment: 18 months following diagnosis), and phase 3 (terminal: 12 months prior to death). For patients who did not die during the study period, phase of care was assigned prospectively according to the patients' date of diagnosis. For patients who died during the study period, phase of care was assigned retrospectively from the patient's date of death, with the patient's date of diagnosis serving as a lower bound on time of care. Patients who died had a maximum of 12 months first assigned to the terminal phase. Any remaining time was then assigned to the treatment phase (up to a maximum of 18 months). For example, Patient A, B, and C survived 17, 12, and 8 months, respectively, from their date of diagnosis. Patient A had their last 12 months of life assigned to the terminal phase and the remaining 5 months assigned to the treatment phase. Patient B had 12 months assigned to the terminal phase and 0 months assigned to the treatment phase. Patient C had 8 months assigned to the terminal phase and 0 months to the treatment phase.

Conservative (floor) and relaxed (ceiling) estimation approaches were used to estimate the cost of acute inpatient hospitalizations. The conservative estimate included all hospitalizations assigned to a phase that had a primary diagnostic code matching the patient's assigned cancer category. The relaxed approach included all hospitalizations assigned to a phase, irrespective of patients' primary diagnostic codes.

Total cost of acute inpatient hospitalization was then estimated for each patient according to phase of care, site of cancer, and stage of diagnosis (where available). Mean and median cost of acute inpatient hospitalizations were computed for each phase of care by site of cancer, age category, and stage of disease. Trimmed (95%) means and medians were also derived in order to

investigate cost when removing the most extreme observations in the cost distributions. Expected costs were calculated using weighted costs (with weights proportional to the distribution of stage at diagnosis and age group). Expected total costs were obtained using weights based on previously published 5-year survival rates from Statistics Canada for 2006-2008 [16].

For comparison to British Columbia and Ontario estimates, all cost estimates were initially adjusted to 2009 CAD using Statistics Canada data on consumer price index for health and personal care [2-5, 26, 126] then updated to 2013 CAD for reporting. Statistical analysis was conducted using SAS version 9.4 and Stata version 14. Costing worksheets were compiled in Excel 2016.

Findings

Acute inpatient hospitalization

The sample size varied considerably by method of estimation (*N relaxed* = 13,587, *N conservative* = 8,808), and site of cancer. Patients diagnosed with prostate and breast cancer, especially those diagnosed at an earlier stage, were less likely to be hospitalized than other cancer patients. Tables 10 and 11, located in Appendix 1, detail sample size by method of estimation, age, and cancer category (i.e., site of cancer and stage at diagnosis).

The expected total cost of acute inpatient hospitalization per case of cancer in New Brunswick, from 2008-2013, was substantial and varies significantly according to method of estimation (i.e., relaxed or conservative approach). The distributions of the total cost of acute inpatient hospitalization in New Brunswick are depicted graphically by age and cancer category in the figures contained in Appendix 2 (18-month treatment phase, untrimmed), Appendix 3 (12-month terminal phase, untrimmed), Appendix 4 (18-month treatment phase, 95% trimmed), and Appendix 5 (12-month terminal phase, 95% trimmed). Mean and median cost are given at the bottom of each figure for each approach to estimation, age, and cancer site.

Table 5 gives expected cost by method of estimation and cancer category. Estimates based on the relaxed approach to estimation are more consistent with estimates from other Canadian jurisdictions [2-5]. Figure 1 depicts the expected total cost of acute inpatient hospitalization for a case of cancer in New Brunswick, using the relaxed estimation. Expected total acute inpatient hospitalization cost obtained using the relaxed approach was highest for brain ($68,606), oesophageal ($58,951), leukemia ($56,616), and myeloma ($56,316), and lowest for prostate ($12,253) and breast ($15,454) cancer.

The cost of acute inpatient hospitalization in New Brunswick varies by phase of care and cancer category. Figure 2 depicts the mean cost of acute inpatient hospitalization in New Brunswick per case of cancer during the treatment phase by approach to estimation and site of cancer. Table 6 presents mean cost during the treatment phase by method of estimation and age and cancer category. Inpatient hospitalization costs were highest for leukemia ($35,962) and oesophageal ($34,685) and brain cancer ($34,206). Inpatient hospitalization costs were lowest for cases diagnosed at an earlier stage of disease for breast ($9,440) and prostate cancer ($10,544).

Our estimates in 2009 CAD were lower on average than those for British Columbia and Ontario [2-5]. However, it should be noted that meaningful interprovincial comparison is challenging due to differences in the organization of health care systems and because data collection and reporting is not nationally standardized (e.g., day surgeries are in the Ontario DAD but not New Brunswick).[10]

[10] See [2] for a discussion on the challenges of making interprovincial comparisons in the cost of a case of cancer in British Columbia and Ontario.

Table 5: Expected total cost (2013 CAD) of acute inpatient hospitalization per case of cancer in New Brunswick, by approach to estimation, 2008-2013

Cancer	Floor	Ceiling
Bladder	20,459	33,591
Brain	43,254	68,606
Breast	8,466	15,454
Stage I	8,413	14,583
Stage II	7,597	14,090
Stage III	8,102	17,300
Stage IV	13,988	21,828
Colon	25,619	40,523
Stage I	24,848	42,259
Stage II	25,221	38,962
Stage III	26,593	38,330
Stage IV	26,578	42,973
Kidney	16,335	18,993
Leukemia	47,039	56,617
Lung	26,255	36,476
Stage I	29,598	49,362
Stage II	26,869	49,895
Stage III	26,333	43,125
Stage IV	23,734	42,918
Myeloma	55,707	56,316
Non-Hodgkin's	37,391	46,412
Oesophageal	47,824	58,951
Prostate	10,297	12,254
Stage I	--	13,411
Stage II	10,488	15,615
Stage III	--	11,360
Stage IV	10,992	25,836
Rectal	28,647	45,398
Stage I	19,903	33,603
Stage II	42,024	64,220
Stage III	23,796	41,761
Stage IV	27,159	39,471
Skin	10,896	21,479
Testicular	--	28,642
Ureter	--	41,786

Notes

1. -- denotes estimate suppressed due to cell count (i.e., <5 cases)
2. Data source: New Brunswick Hospital Discharge Abstract Database (NB DAD), 2008 to 2013.
3. Analysis: NB-IRDT

Figure 1: Expected total cost (2013 CAD) of acute inpatient hospitalization per case of cancer in New Brunswick, 2008-2013 (ceiling approach)

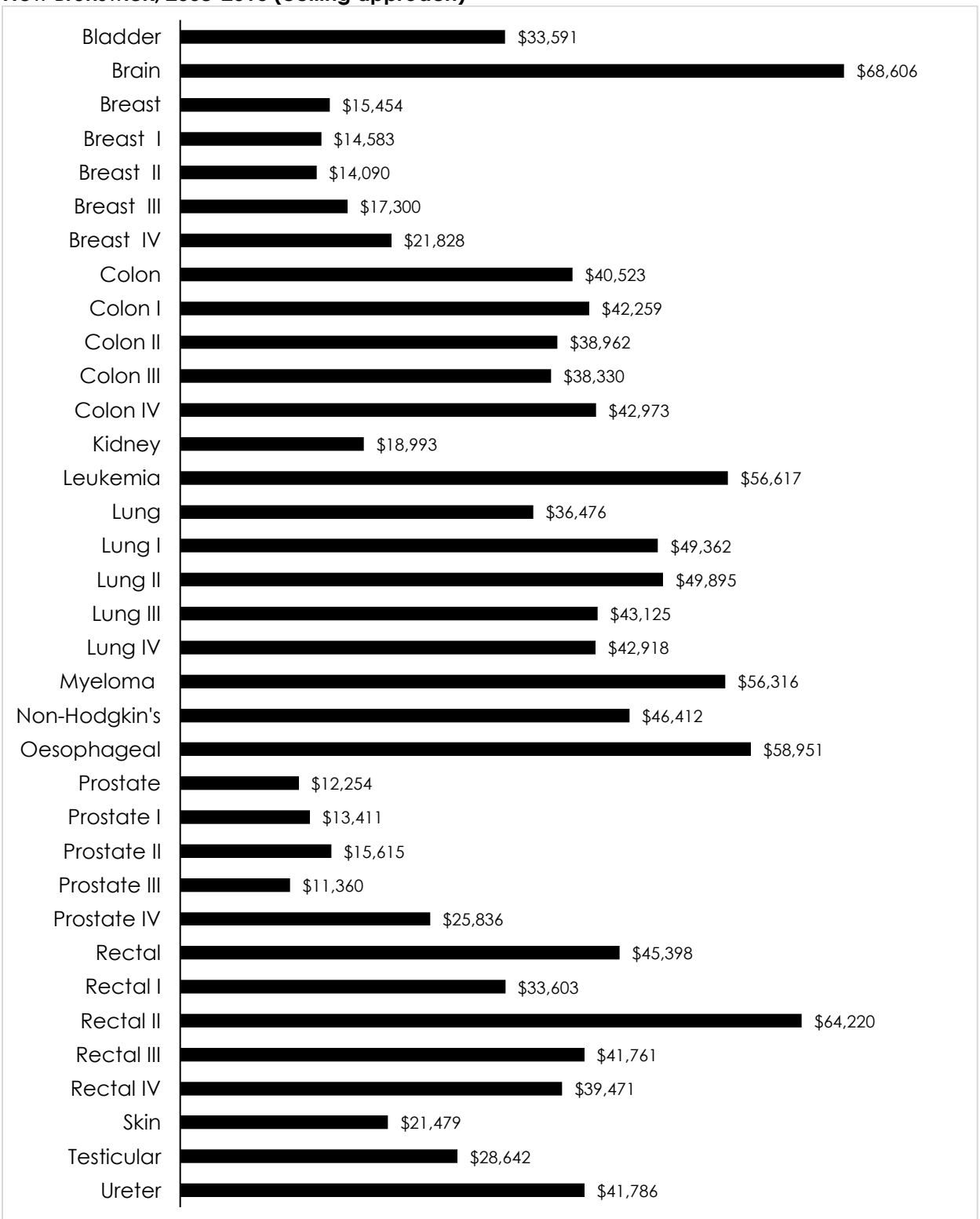


Figure 2: Expected cost (2013 CAD) of acute inpatient hospitalization for a case of cancer in New Brunswick during the treatment phase of care, by cancer site, 2008-2013

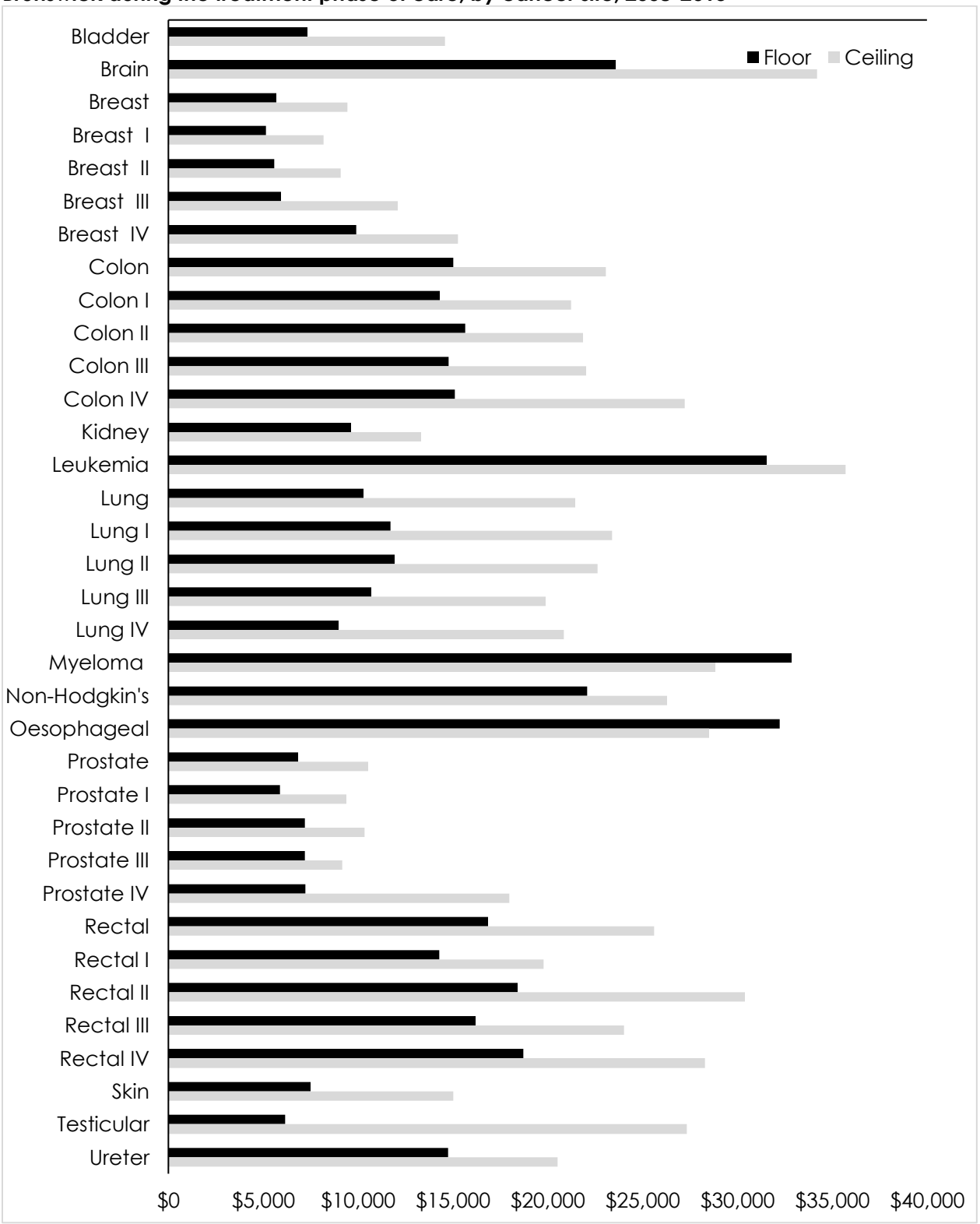


Table 6: Expected cost (2013 CAD) of inpatient hospitalization in New Brunswick during the treatment phase, for selected cancers, by type and stage of cancer (where available), 2008-2013

Cancer	Expected Cost		Mean Cost			
			18-64 years		65 + years	
	Floor	Ceiling	Floor	Ceiling	Floor	Ceiling
Bladder	7,347	14,598	8,492	13,079	6,829	15,283
Brain	23,598	34,206	18,697	26,571	29,672	43,667
Breast	5,702	9,441	5,560	7,953	5,869	11,178
Stage I	5,146	8,184	5,179	6,822	5,109	9,681
Stage II	5,596	9,093	5,544	7,510	5,661	11,087
Stage III	5,935	12,097	5,166	9,462	6,941	15,539
Stage IV	9,898	15,269	9,494	16,013	10,293	14,539
Colon	15,031	23,067	15,474	20,802	14,855	23,974
Stage I	14,317	21,230	15,090	19,518	13,992	21,947
Stage II	15,650	21,872	14,280	17,794	16,065	23,107
Stage III	14,764	22,029	14,392	18,123	14,929	23,750
Stage IV	15,113	27,214	17,908	27,120	13,758	27,259
Kidney	9,620	13,330	8,894	10,837	10,436	16,126
Leukemia	31,541	35,699	32,687	44,072	30,814	30,384
Lung	10,298	21,450	9,489	21,439	10,653	21,456
Stage I	11,711	23,408	11,438	14,882	11,805	26,339
Stage II	11,922	22,624	12,194	18,991	11,831	23,841
Stage III	10,697	19,887	10,697	24,998	10,697	17,163
Stage IV	8,982	20,841	7,588	22,933	9,650	19,837
Myeloma	32,862	28,832	35,283	27,838	31,766	29,282
Non-Hodgkin's	22,076	26,310	19,006	23,608	24,669	28,593
Oesophageal	32,234	28,518	22,135	28,295	38,907	28,664
Prostate	6,838	10,544	7,170	8,431	6,586	12,154
Stage I	5,891	9,381	7,170	7,440	4,712	11,170
Stage II	7,210	10,333	7,170	8,606	7,239	11,552
Stage III	7,206	9,169	7,173	8,811	7,250	9,625
Stage IV	7,219	17,983	7,170	12,272	7,239	20,138
Rectal	16,862	25,606	15,117	21,581	18,220	28,740
Stage I	14,279	19,781	12,926	16,779	15,023	21,430
Stage II	18,420	30,404	15,672	25,694	20,609	34,154
Stage III	16,209	24,014	16,163	21,393	16,261	26,959
Stage IV	18,716	28,283	14,716	20,935	21,432	33,273
Skin	7,506	15,031	6,395	13,439	8,605	16,607
Testicular	6,153	27,341	6,153	27,139	--	29,992
Ureter	14,756	20,534	8,555	8,633	17,012	24,863

Notes

1. -- denotes estimate suppressed due to cell count (i.e., <5 cases)
2. Data source: New Brunswick Hospital Discharge Abstract Database (NB DAD), 2008 to 2013.
3. Analysis: NB-IRDT

Figure 3: Expected cost (2013 CAD) of acute inpatient hospitalization for a case of cancer in New Brunswick during the terminal phase of care, by cancer site, 2008-2013

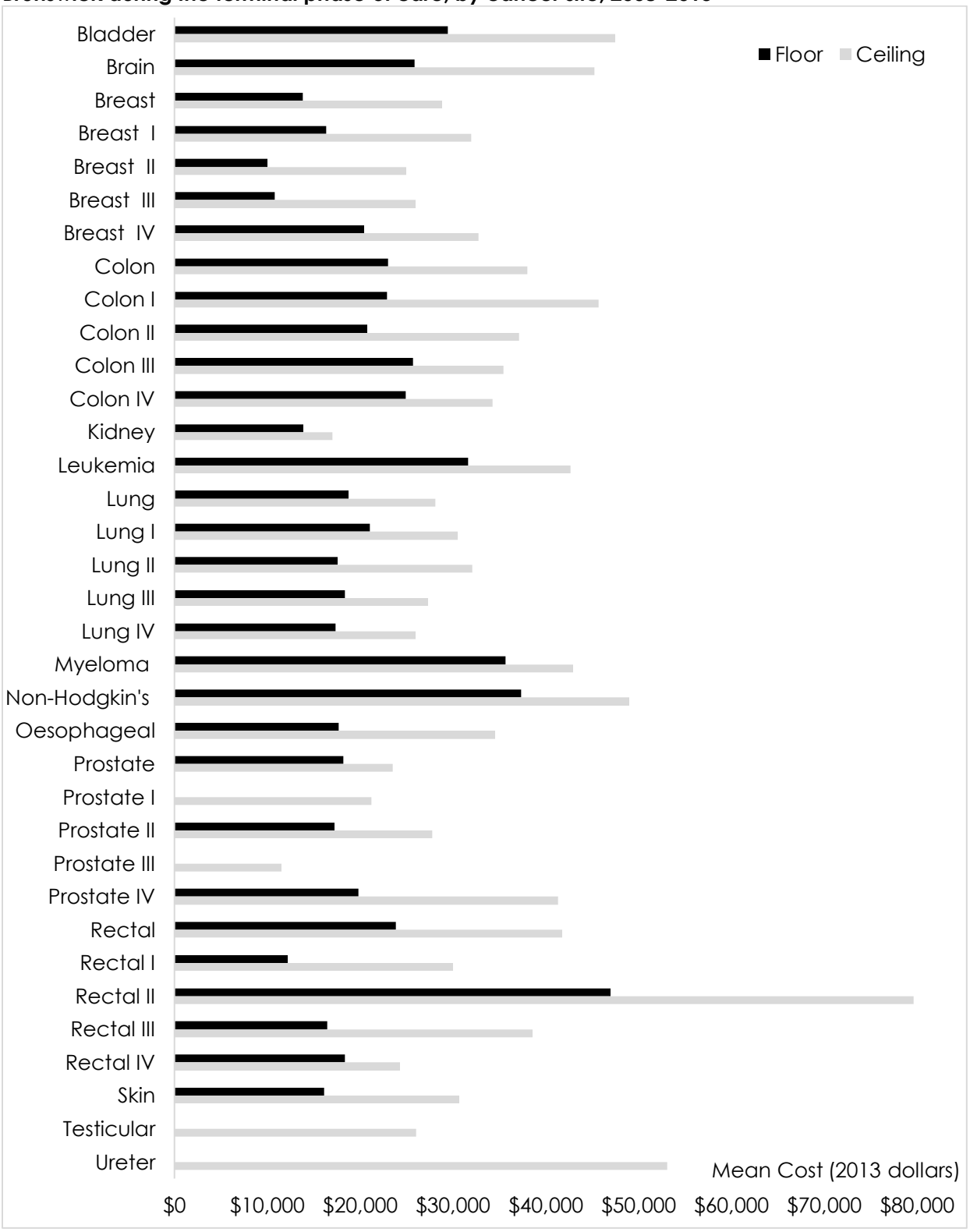


Table 7: Expected cost (2013 CAD) of inpatient hospitalization in New Brunswick during the terminal phase for selected cancers, by type and stage of cancer (where available), 2008-2013

Cancer	Expected Cost		Age Group			
			18 to 64 years		65 years and older	
	Floor	Ceiling	Floor	Ceiling	Floor	Ceiling
Bladder	29,437	47,482	33,364	61,637	27,664	41,752
Brain	25,862	45,264	21,505	41,609	26,770	45,960
Breast	13,815	28,847	14,063	27,044	14,438	32,599
Stage I	16,339	31,996	--	34,226	16,339	30,862
Stage II	10,006	24,985	--	17,727	10,006	32,241
Stage III	10,829	26,011	13,202	26,449	8,852	25,849
Stage IV	20,453	32,794	23,477	30,440	18,942	34,067
Colon	23,016	38,028	16,823	37,695	25,497	38,162
Stage I	22,894	45,714	--	--	20,792	45,714
Stage II	20,806	37,154	13,915	32,506	22,894	38,445
Stage III	25,713	35,437	17,376	44,870	29,385	34,480
Stage IV	24,922	34,259	15,944	29,420	29,278	35,066
Kidney	13,868	17,044	19,356	21,690	12,275	15,362
Leukemia	31,627	42,691	42,956	67,612	24,075	32,089
Lung	18,773	28,139	19,236	30,070	8,647	13,115
Stage I	21,044	30,534	--	34,348	21,044	28,841
Stage II	17,584	32,084	24,455	45,323	16,631	30,272
Stage III	18,395	27,339	21,748	35,359	17,937	26,078
Stage IV	17,355	25,972	16,334	25,432	17,812	26,178
Myeloma	35,696	42,944	39,212	53,016	33,977	37,212
Non-Hodgkin's	37,354	49,028	53,870	70,364	33,792	44,180
Oesophageal	17,715	34,582	18,904	30,997	17,272	36,129
Prostate	18,197	23,509	18,710	3,317	9,008	12,457
Stage I	--	21,213	--	--	--	21,213
Stage II	17,252	27,796	--	--	17,252	27,796
Stage III	--	11,534	--	2,144	--	15,445
Stage IV	19,854	41,331	18,710	27,377	20,999	41,331
Rectal	23,886	41,767	10,407	36,371	34,379	45,968
Stage I	12,226	30,049	15,338	40,586	10,359	25,479
Stage II	46,970	79,664	13,487	56,661	80,453	89,135
Stage III	16,491	38,582	7,373	33,098	23,004	41,163
Stage IV	18,354	24,320	11,401	24,257	20,671	24,341
Skin	16,145	30,703	--	38,469	16,145	27,125
Testicular	--	26,031	138,255	--	--	26,031
Ureter	--	53,128	--	--	--	53,128

Notes

1.-- denotes estimate suppressed due to cell count (i.e., <5 cases)

2. Data source: New Brunswick Hospital Discharge Abstract Database (NB DAD), 2008 to 2013.

3. Analysis: NB-IRDT

'Typical' patient cost estimates

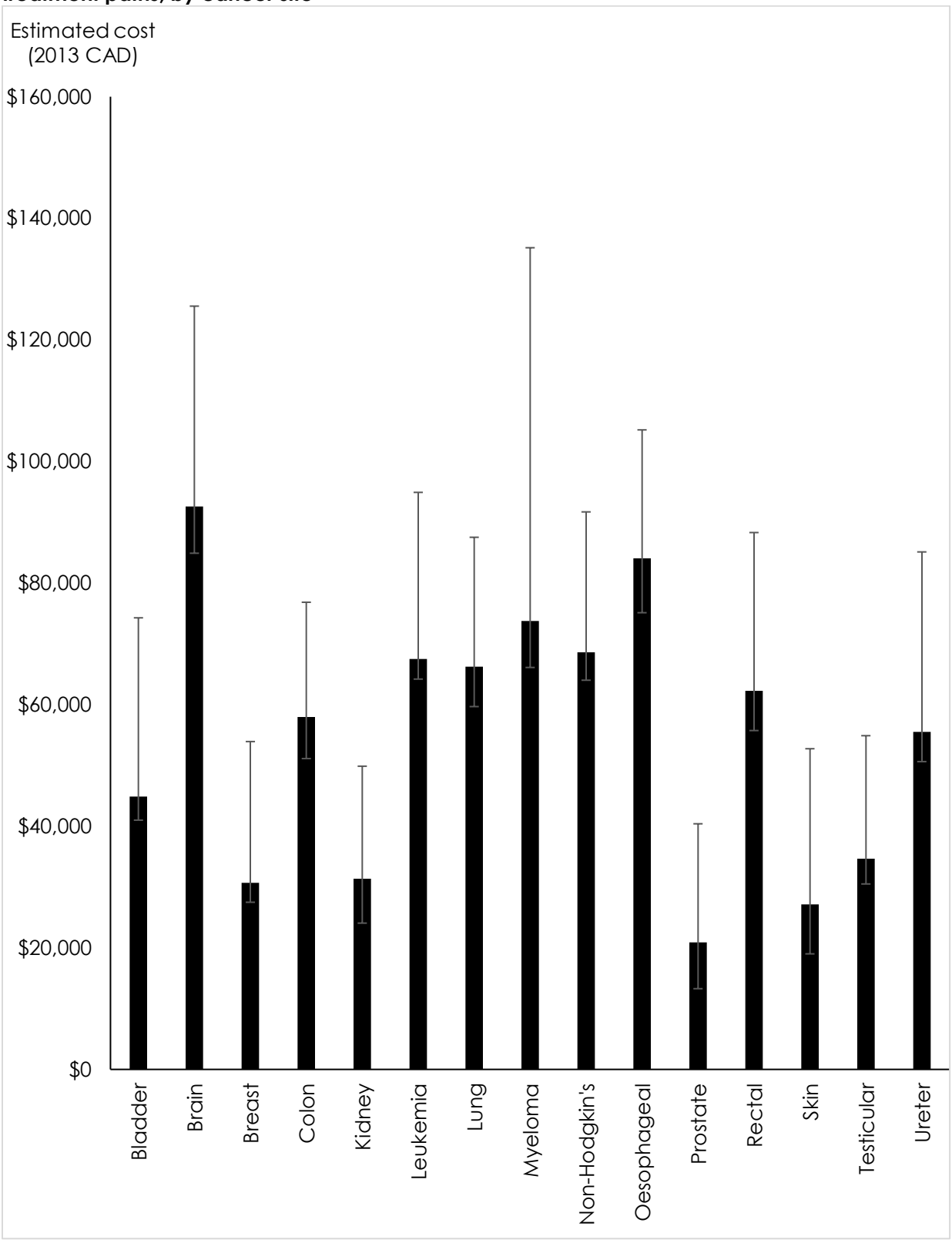
The previous estimates do not account for the cost of emergency room care, outpatient and community-based treatments (including many laboratory and diagnostic procedures, day surgery, and chemo- and radiotherapy conducted on a non-admission basis), prescription drugs consumed after discharge/outside the hospital, and physician services. These are important cost components of cancer care in New Brunswick; therefore, estimates that included these components were compiled for the 'typical' patient following the 'standard' treatment path using available data in the literature (e.g., fee schedules, collective agreements, and peer-reviewed scholarly articles) by site and stage of cancer. Table 8 below presents these estimates (all estimates are in 2013 dollars). The estimated costs were lowest for prostate cancer ($19,527) and highest for brain cancer ($86,540).

Table 8: Simulated expected cost (2013 CAD) for 'typical' patients following the 'standard' treatment paths, by selected cancer

Cancer	Expected	Lower	Upper
Bladder	44,843	41,000	74,279
Brain	92,598	84,905	125,550
Breast	30,695	27,498	53,926
Colon	57,994	51,131	76,842
Kidney	31,405	24,061	49,875
Leukemia	67,532	64,203	94,913
Lung	66,279	59,680	87,528
Myeloma	73,771	66,111	135,155
Non-Hodgkin's Lymphoma	68,643	64,017	91,704
Oesophageal	84,084	75,120	105,192
Prostate	20,894	13,279	40,400
Rectal	62,254	55,737	88,306
Skin	27,169	19,003	52,750
Testicular	34,668	30,504	54,894
Ureter	55,499	50,631	85,122

Notes
1. Data source: See data description in Section 4 of this report.
2. Analysis: NB-IRDT

Figure 4: Simulated expected cost (2013 CAD) for 'typical' patients following the 'standard' treatment paths, by cancer site



Cost modelling undertaken from a limited evidence base generates a high degree of uncertainty in estimates.[11] The 'typical' patient cost estimates are based on some assumptions that are highly uncertain due to scientific advancements in cancer care, the lack of New Brunswick patient- and health systems-level data, and potential variation in clinical practice and care throughout the province. Although efforts were made to identify, define, and measure all pertinent variables in a consistent manner, the potential for bias remains from measurement error and omission. From the onset of symptoms to treatment, each patient's experience with cancer care is shaped by a multitude of factors. The course of treatment is determined not only by the site and stage of cancer, but also by the treatments selected by physicians and chosen by cancer patients. Consequently, 'typical' patient (simulated) cost modelling is not a substitute for estimates based on actual patient-level data. More information and real patient-level data is needed to fully appreciate the cost implications of outpatient- and community-based cancer treatment in New Brunswick. However, this modeling approach creates a foundation to stimulate further understanding of the nature of the cancer burden in the province once more complete health data becomes available.

Limitations

The cost estimates presented in this report are subject to several limitations. First, all of the estimates rely on assumptions made about generalizability and transferability of incomplete or imperfect data. For instance, the estimation of average total cost per case of cancer is complicated by the fact that some patients are lost to follow-up and censored.[12] Although actual survival and subsequent cost is unknown for these patients, it is assumed that they have similar survival prospects and cost as uncensored patients.

Another limitation is that this study could not consider the cost of symptom and side-effect management that occurs outside the acute inpatient hospital setting (i.e., in the DAD). Cancer patients undergoing certain cancer therapies are at increased risk for a wide range of costly complications and side effects that are likely to be treated on an outpatient basis or in the community. These treatments represent another potential liability for the Workers' Compensation system (e.g., cancer, hearing loss, heart problems, transfusions, infertility, hair loss, reconstructive surgeries, etc.) [127-129]. To date, little is known about the average total cost of symptom and side effect care for cancer patients.

Considerations for cost projections

The cancer care landscape is complex and evolving, making prediction of future costs difficult. Advancements in early detection and disease prevention have the potential to reduce the cost of a case of occupational cancer in the near future. Not only is the cost of treating cancer care typically much lower in earlier stages of disease, but workers may be able to remain in the workforce during or after their treatment. Further, scientific advances are expected to generate new treatment options (e.g., personalized medicine and the use of gene expression profiling) that have the potential to be cost-saving for an expanded number of cancer patients [3].

In contrast to advances in detection and therapy acting to reduce the economic burden of cancer, research has shown cancer care costs in Canada are rising. A recent study of the cost of cancer care in Ontario found that the per patient cost for most cancers doubled or tripled from 1997 to 2007 [26]. Further, cancer drugs are also expected to have a significant impact on the cost of a case of occupational cancer in the province. Multiple new cancer drugs and personalized therapies (e.g., biologics) are being adopted in New Brunswick, and this area

[11] Most of the uncertainty stemmed from a lack of recent data on chemo-, radio-, and biological therapy utilization.

[12] The censor date in this study was the end of the 2013 fiscal year.

continues to be the main focus of the cancer care research and development pipeline [131-132]. Over 20 tumor types are now being treated with new medicines or treatment protocols that have been launched in the past five years [131].

Per patient cost of chemotherapy has increased over the past decade at a much higher rate than other cost components of actively treated cancer patients [26, 131-132]. Purchases of cancer drugs have increased more than five times (16.5%) as fast as the growth in cancer incidence in Canada (~3%) [132]. This increase in cost is attributed to increases in demand and higher drug costs for new drugs in particular [132]. Increases in demand are attributed, in large part, to the increasing use of complex chemotherapeutic cocktails, which are used to combat tumour treatment resistance. In some cases, treatment can produce a cure response,[13] eradicating a patient's cancer [133-134]. However, at present, nearly all cancer treatments will ultimately stop working at some point [134]. This problem is known as treatment or drug resistance [134], and it is the most challenging problem facing oncologists and patients [134].

The high cost of cancer drugs in Canada is related to numerous factors [131-132, 134-136]. As a class, the cost of oncology therapeutics has increased by over 10% annually since 2014 [131]. Treatment costs for new drugs and therapies remain high, ranging from $6,000 to as much as $150,000 for a normal single course of treatment [63-118, 131-132, 135-136].

[13] At present, the list of 'fully curable' cancers includes testicular cancer and certain stage and blood cancers (e.g., large cell lymphoma and childhood leukemia) [129].

SECTION 5. Conclusions

This report describes cancer incidence and the cost of acute inpatient hospitalization care associated with select cancers (i.e., bladder, brain, breast, colon, kidney, leukemia, lung, multiple myeloma, non-Hodgkin's lymphoma, oesophageal, prostate, rectum, skin, testicular, and ureter). The study made use of the most recent administrative health data (2008-2013) available at the New Brunswick Institute for Research, Data and Training (NB-IRDT). Cancer patients were identified from the New Brunswick Provincial Cancer Registry (NBPCR), the population-based cancer registry for the province.

Crude rates of incident cancers increased with age, ranging from 318.4 cases per 100,000 population aged 18 to 64 years to 1,575.7 cases per 100,000 population aged 65 years and older. The most common incident cancers in the analytical sample were breast, prostate, lung, colon, and skin. Combined, these five cancers comprised 66% of the total number of incident cancers in the analytical sample. Cases of lung cancer were more likely to be diagnosed at an advanced stage than cancer of the breast, colon, prostate, or rectum.

Data on the cost and frequency of acute inpatient hospitalization were obtained from the New Brunswick Discharge Abstract Database (DAD), which contains demographic, administrative, and clinical data on acute care institution separations in the province. The study utilized a phase-of-care approach to costing: inpatient hospitalizations were assigned to one of two clinically-relevant phases of care – the treatment phase (18 months following the date of diagnosis) or terminal phase (last 12 months of life).

The expected cost of acute inpatient hospitalization when ignoring sub-groups was substantial (from prostate stage III: $11,360 to brain: $68,606). Further, the cost was shown to vary by cancer site, stage of disease, phase of care, and age group. Mean cost of inpatient hospitalizations was generally higher for older patients and for patients diagnosed at advanced stages of disease.

Finally, phase-specific mean costs of inpatient hospitalizations varied by type of cancer and were generally lower during the treatment phase. For example, stage I breast cancer had a mean cost of $8,184, and leukemia had a mean cost of $35,962, compared to terminal phase mean costs of stage I breast cancer: $31,996 and leukemia: $42,691. In 2009 CAD, phase-specific costs were found to be lower than estimates from Ontario and British Columbia, although making a meaningful interprovincial comparison is complicated due to differences in the organization of health care systems and also because data are not recorded in a standardized method across provinces (e.g., day surgeries are captured in the Ontario DAD but not in New Brunswick) [2-5].

These hospitalization cost estimates can be used to develop a more refined estimate of the future cost of the presumptive legislation to the Worker's Compensation system. However, there are significant gaps in the availability of New Brunswick-specific data that presently hinder the estimation of the cost of a case of cancer in New Brunswick (and occupational cancer, specifically). As cancer patients journey through the healthcare system, they typically require different diagnostic, treatment, and supportive care services, often in outpatient and community-based settings. Administrative data on these components of a cancer patient's journey are not available at the patient level for New Brunswick. These components have been determined to be important cost drivers, representing between 62% and 36% of the mean cost of cancer care in Ontario for patients who survived more and less than 12 months from the initial date of diagnosis, respectively [2-5].

Another important knowledge gap pertains to cancer registry data. Although almost all cancer patients in New Brunswick begin their involvement with the cancer care system through a series of diagnostic tests that describe the extent and severity of their disease, limited staging information

is reported to the provincial cancer registry (i.e., only breast, colon, lung, prostate, and rectal cancers are staged in the NBPCR). Another limitation of the existing cancer registry infrastructure is that the provincial and national cancer registries do not routinely collect workplace information. Consequently, cases of occupational cancer are not identifiable outside of WC claims data.

Occupational cancers are thought to be numerous and costly. Although considerable strides have been made in terms of understanding, diagnosing, and treating cancer, the most durable and cost effective strategies for controlling this disease are programs raising awareness of the risk factors in combination with cancer screening and cancer prevention strategies.

There is a critical need to understand occupational exposure to carcinogens in the province. Exposure information specific to New Brunswick is almost completely lacking at this time, meaning that we have little understanding of what proportion of the New Brunswick workforce is exposed to carcinogens on-the-job, which carcinogens they are exposed to, and what sort of protective equipment or measures are being taken. This information is critical for both improving estimates of the occupational cancer burden in the province and, more importantly, for developing appropriate intervention strategies that will provide a return on investment. Finally, from a systems performance perspective, population-level data on cancer and cancer care is necessary to inform health care system planning and surveillance in the province. It is also vital for guiding and attracting research and evaluating the appropriateness and effectiveness of cancer care delivered throughout New Brunswick (e.g., prevention/early detection, treatment/survivorship, and end-of-life care).

Future work that builds on this report could be developed in a number of dimensions. First, overall cost estimates could be determined based on estimates of cancer incidence and proportions of the population employed in relevant occupations as well as identification of what treatments and costs are likely to be covered under legislation. Second, cost estimates could be expanded to include indirect costs of cancer such as potential life years lost, lost productivity, and reduced income, as well as death benefits where relevant. These calculations would require that estimates of survival rates by site, age at diagnosis, and stage at diagnosis be computed.

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APPENDIX 1. Supplementary tables

Table 9: Inclusionary International Classification of Diseases-Oncology (3rd edition, ICD-O-3) and histology codes for selected cancer sites

Cancer	ICD-O code(s)	Histology codes
Bladder	C67.0, C67.1, C67.2, C67.3, C67.4, C67.5, C67.6, C67.7, C67.8, C67.9	
Brain	C71.0, C71.1, C71.2, C71.3, C71.4, C71.5, C71.6, C71.7, C71.8, C71.9	
Breast	C50.0, C50.1, C50.2, C50.3, C50.4, C50.5, C50.6, C50.7, C50.8, C50.9	
Colon	C18.0, C18.1, C18.2, C18.3, C18.4, C18.5, C18.6, C18.7, C18.8, C18.9	
Kidney	C64.9	
Leukemia	--	9733, 9742, 9800, 9801, 9805, 9806, 9807, 9808, 9809, 9811, 9812, 9813, 9814, 9815, 9816, 9817, 9818, 9820, 9823, 9826, 9827, 9831, 9832, 9833, 9834, 9835, 9836, 9837, 9840, 9860, 9861, 9863, 9865, 9866, 9867, 9869, 9870, 9871, 9872, 9873, 9874, 9875, 9876, 9891, 9895, 9896, 9897, 9898, 9910, 9911, 9920, 9930, 9931, 9940, 9945, 9946, 9948, 9963, 9964
Lung	C34.0, C34.1, C34.2, C34.3, C34.4, C34.5, C34.6, C34.7, C34.8, C34.9	
Myeloma	--	9731, 9732, 9734
Non-Hodgkin's Lymphoma	--	9591, 9596, 9670, 9671, 9673, 9675, 9678, 9679, 9680, 9684, 9687, 9688, 9689, 9690, 9691, 9695, 9698, 9699, 9700, 9701, 9702, 9705, 9708, 9709, 9712, 9714, 9716, 9717, 9718, 9719, 9724, 9725, 9726, 9727, 9728, 9729
Oesophageal	C15.0, C15.1, C15.2, C15.3, C15.4, C15.5, C15.6, C15.7, C15.8, C15.9	
Prostate	C61.9	
Rectal	C19.9, C20.9	
Skin	C44.0, C44.1, C44.2, C44.3, C44.4, C44.5, C44.6, C44.7, C44.8, C44.9	

Testicular	C62.0, C62.1, C62.9
Ureter	C66.9

Table 10: Sample size for lower bound of cost (floor), by site of cancer, stage at diagnosis, and age group, 2008-2013

Cancer	Total	18 months			12 months			No linkage to DAD
		18-64	65+	Total	18-64	65+	Total	
Any	8,808	3,058	3,664	6,722	603	1,483	2,086	11,053
Bladder	622	141	365	506	20	96	116	848
Brain	240	61	12	73	79	88	167	125
Breast	1,379	653	640	1,293	29	57	86	1,992
Stage I	554	264	285	549	0	5	5	1,008
Stage II	496	244	246	490	0	6	6	677
Stage III	231	118	92	210	7	14	21	191
Stage IV	96	27	17	44	21	31	52	118
Colon	1,459	394	825	1,219	36	204	240	628
Stage I	284	85	188	273	0	11	11	136
Stage II	491	112	343	455	^	36	36	154
Stage III	374	124	217	341	^	33	33	146
Stage IV	310	73	77	150	36	124	160	192
Kidney	726	364	257	621	42	63	105	301
Leukemia	279	81	46	127	52	100	152	558
Lung	1,454	284	470	754	205	495	700	1,345
Stage I	438	143	259	402	^	36	36	254
Stage II	190	44	96	140	6	44	50	81
Stage III	263	59	68	127	42	94	136	318
Stage IV	563	38	47	85	157	321	478	692
Myeloma	184	58	64	122	11	51	62	185
Non-Hodgkin's	531	145	154	299	63	169	232	550
Oesophageal	147	26	19	45	43	59	102	137
Prostate	959	514	403	917	0	42	42	2,175
Stage I	100	47	53	100	0	0	0	784
Stage II	587	335	240	575	0	12	12	1,212
Stage III	187	109	78	187	0	0	0	34
Stage IV	85	23	32	55	^	30	30	145
Rectum	758	298	376	674	24	60	84	350
Stage I	110	0	110	110	0	^	0	158
Stage II	247	113	127	240	0	7	7	53
Stage III	258	141	102	243	^	15	15	52
Stage IV	143	44	37	81	24	38	62	87
Skin	14	5	9	14	^	^	0	1,727
Testicular	26	26	0	26	^	0	0	102
Ureter	32	8	24	32	0	0	0	28

Table 11: Sample size for upper bound of cost (ceiling), by site of cancer, stage at diagnosis, and age group, 2008-2013

Cancer	Total	18 months			12 months			No linkage to DAD
		18-64	65+	Total	18-64	65+	Total	
Total	13,587	4,317	5,412	9,729	1,099	2,759	3,858	6,274
Bladder	998	226	547	773	36	189	225	472
Brain	362	99	26	125	108	129	237	3
Breast	2,071	962	856	1,818	92	161	253	1,300
Stage I	823	393	394	787	9	27	36	739
Stage II	742	368	322	690	14	38	52	431
Stage III	332	159	116	275	20	37	57	90
Stage IV	174	42	24	66	49	59	108	40
Colon	1,968	462	998	1,460	105	403	508	119
Stage I	356	104	234	338	^	18	18	64
Stage II	601	127	398	525	7	69	76	44
Stage III	494	136	260	396	14	84	98	26
Stage IV	517	95	106	201	84	232	316	-15
Kidney	960	444	325	769	57	134	191	67
Leukemia	498	134	126	260	60	178	238	339
Lung	2,342	389	694	1,083	387	872	1,259	457
Stage I	594	154	332	486	13	95	108	98
Stage II	239	50	108	158	11	70	81	32
Stage III	512	92	133	225	79	208	287	69
Stage IV	997	93	121	214	284	499	783	258
Myeloma	303	81	114	195	20	88	108	66
Non-Hodgkin's	689	259	284	543	44	102	146	392
Oesophageal	269	40	44	84	70	115	185	15
Prostate	1,488	636	710	1,346	11	131	142	1,646
Stage I	249	96	142	238	0	11	11	635
Stage II	872	396	422	818	^	54	54	927
Stage III	198	111	87	198	0	^	0	23
Stage IV	169	33	59	92	11	66	77	61
Rectum	1,102	401	463	864	72	166	238	6
Stage I	242	78	140	218	7	17	24	26
Stage II	287	118	144	262	8	17	25	13
Stage III	321	154	127	281	10	30	40	-11
Stage IV	252	51	52	103	47	102	149	-22
Skin	426	126	186	312	37	77	114	1,315
Testicular	55	45	5	50	^	5	5	73
Ureter	56	13	34	47	^	9	9	4

APPENDIX 2. 18-month trimmed graphs

Bladder

Figure 5: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with bladder cancer (2013 dollars)

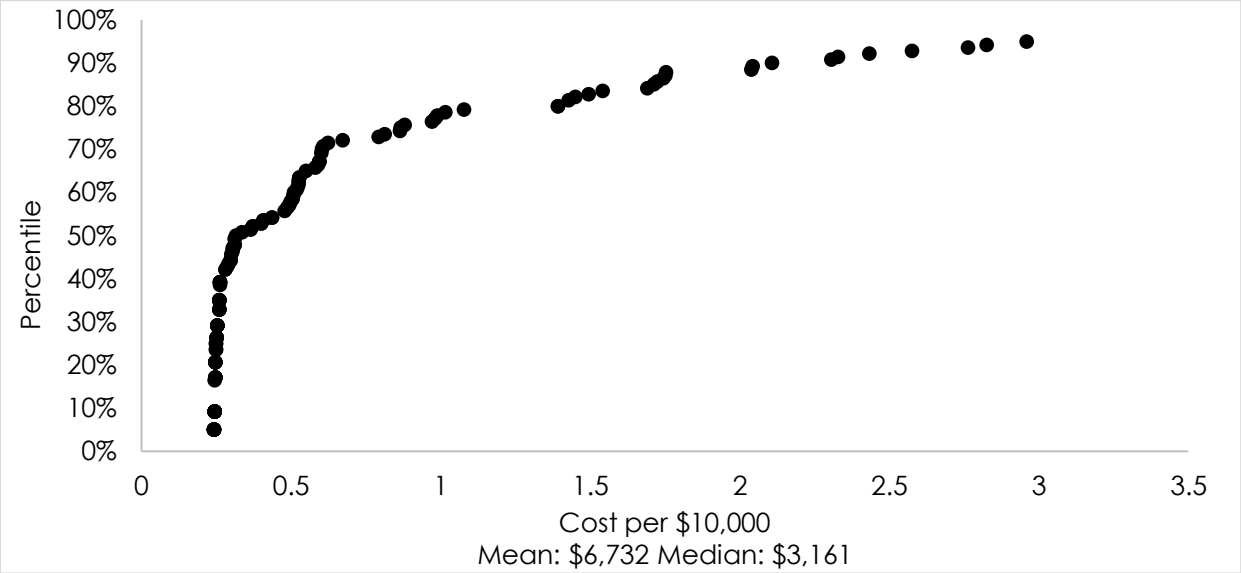


Figure 6: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with bladder cancer (2013 dollars)

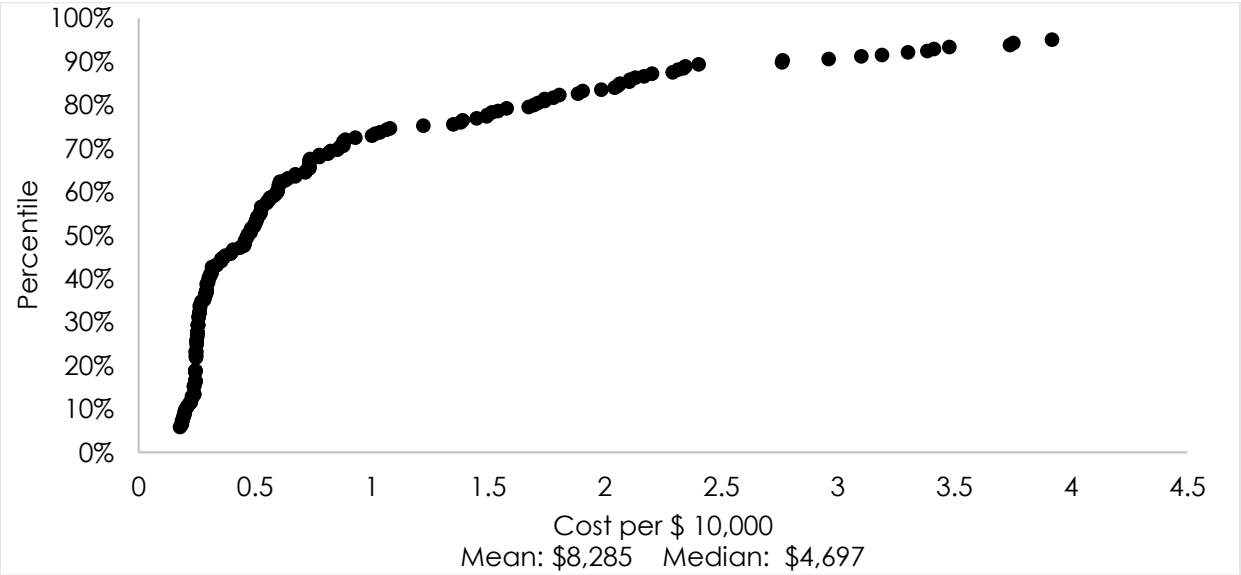


Figure 7: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with bladder cancer (2013 dollars)

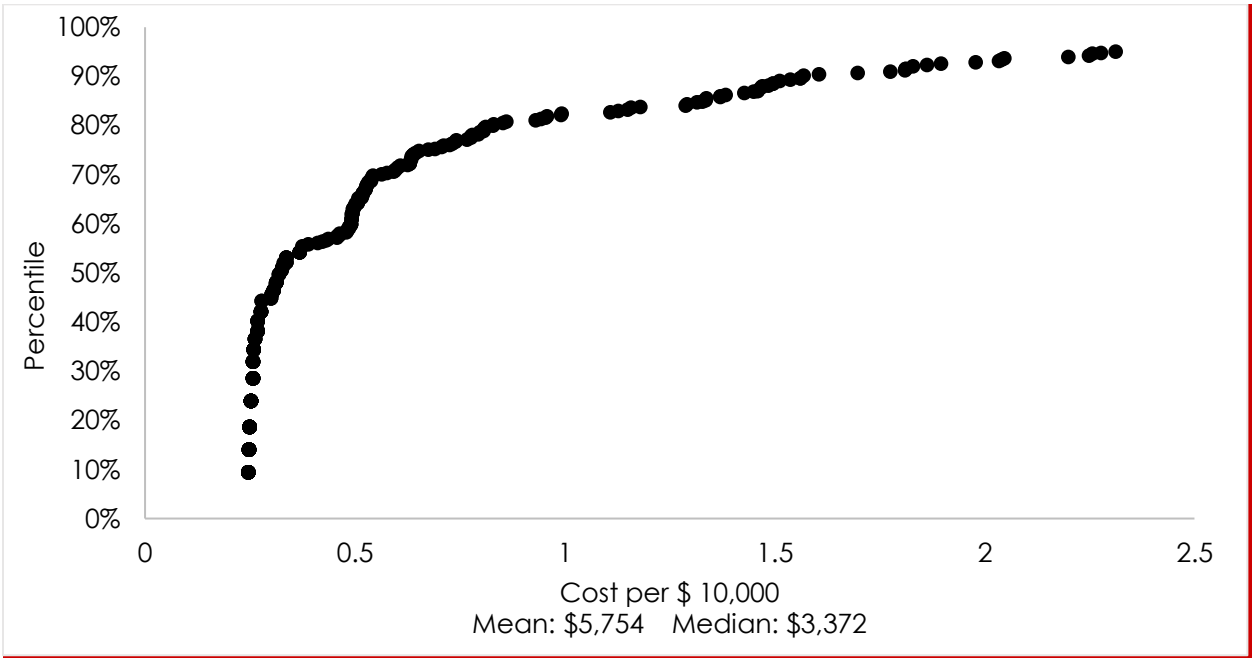
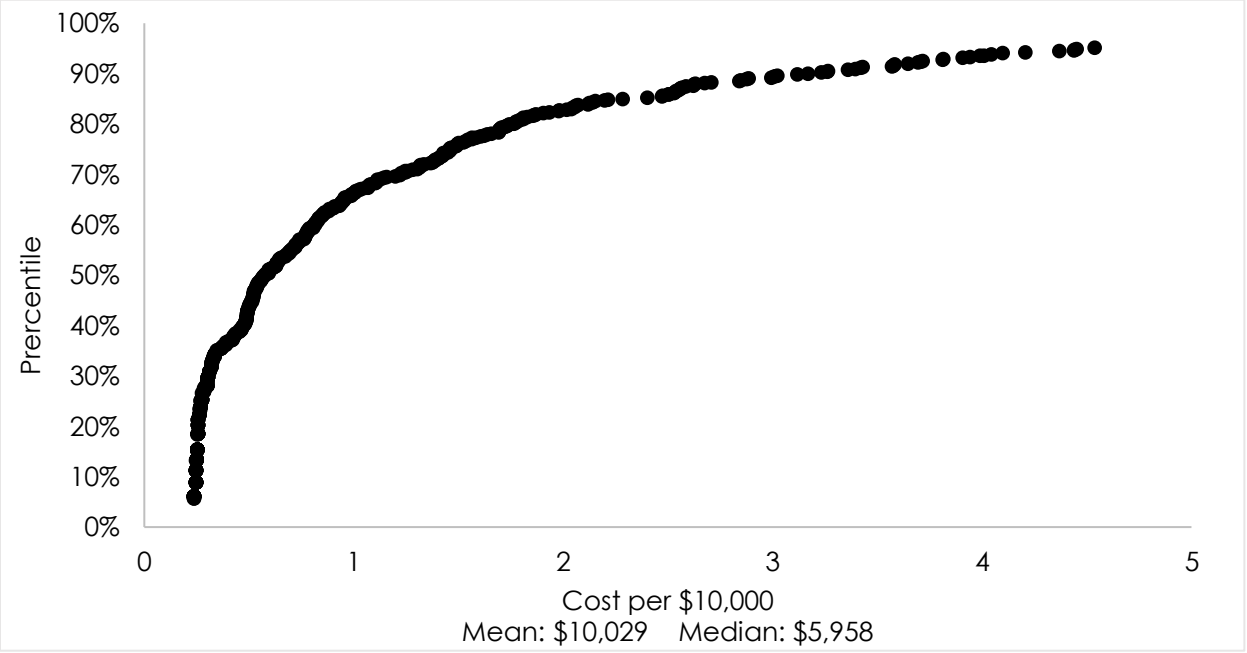


Figure 8: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with bladder cancer (2013 dollars)



Brain cancer

Figure 9: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with brain cancer (2013 dollars)

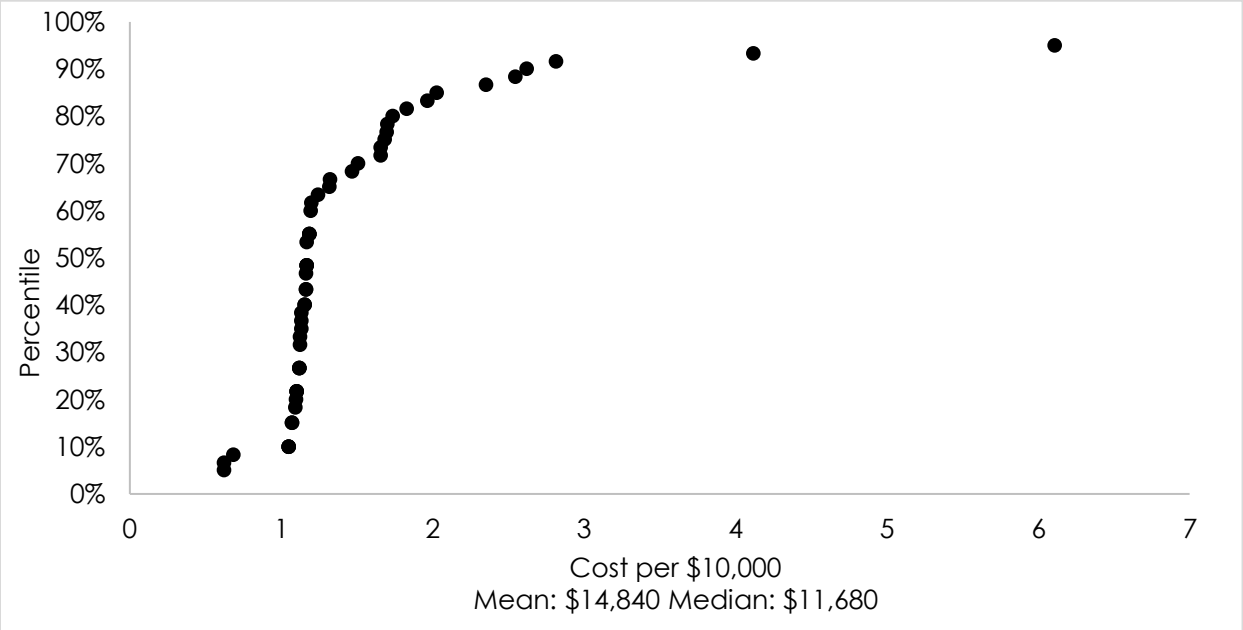


Figure 10: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with brain cancer (2013 dollars)

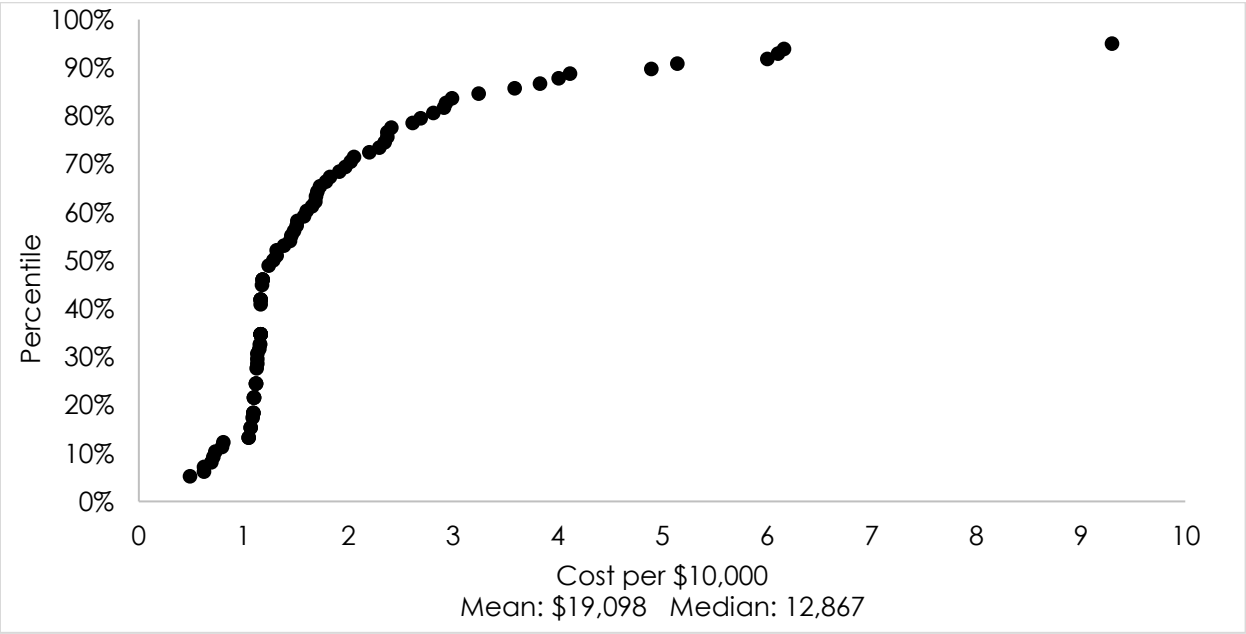


Figure 11: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with brain cancer (2013 dollars)

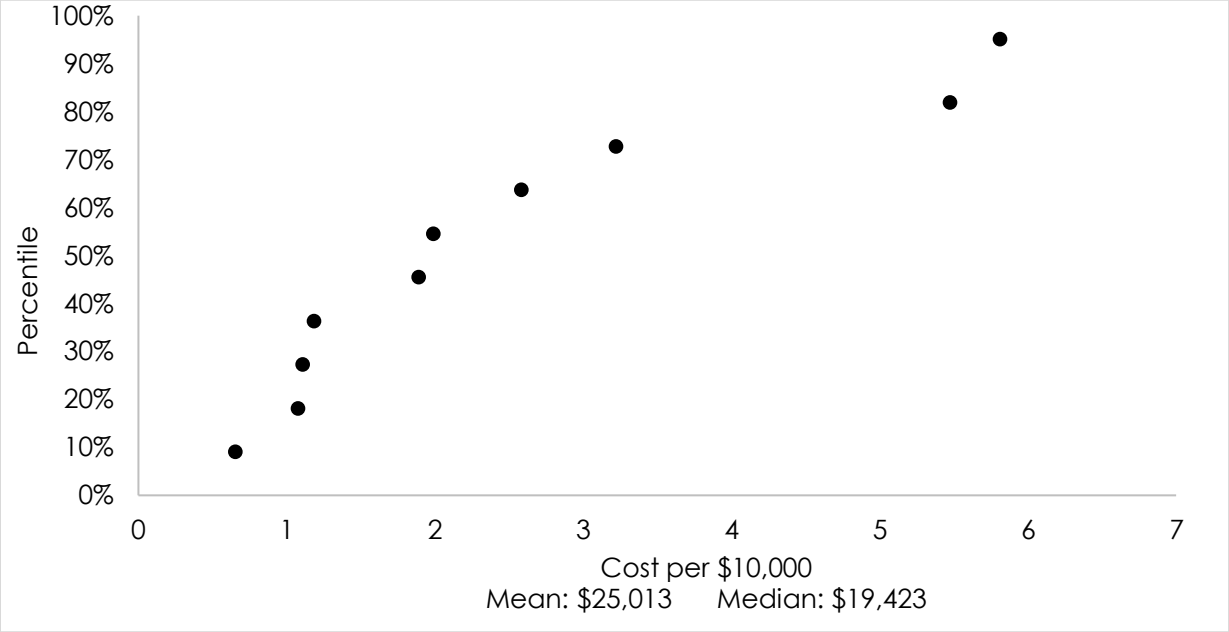


Figure 12: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with brain cancer (2013 dollars)

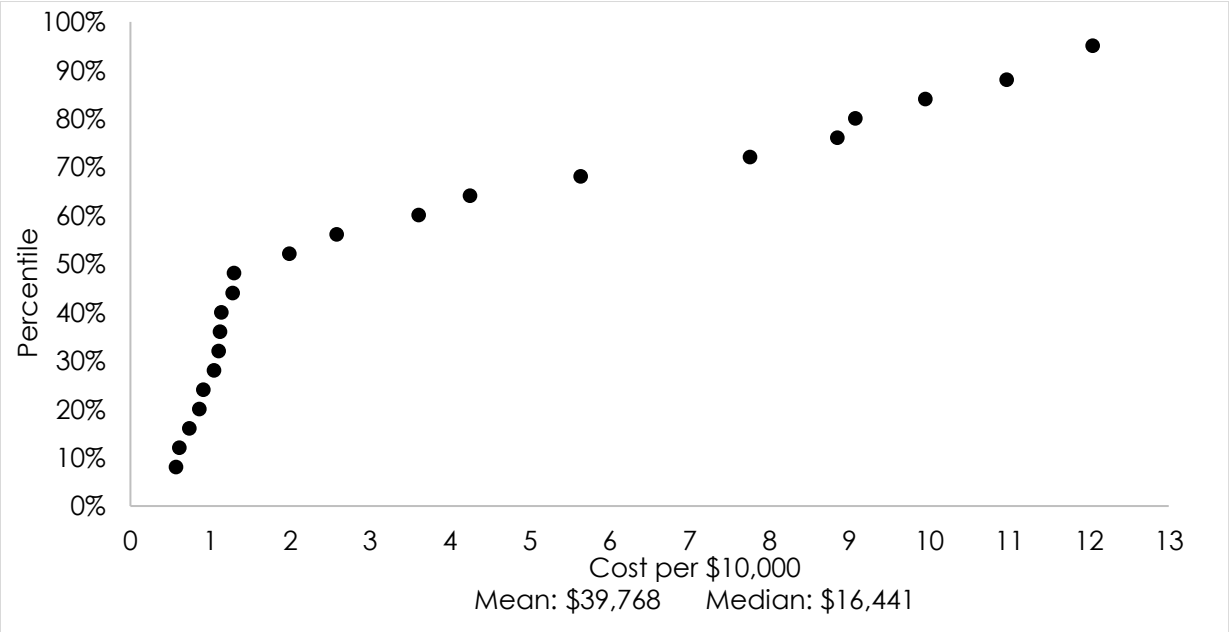


Figure 13: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with breast cancer (2013 dollars)

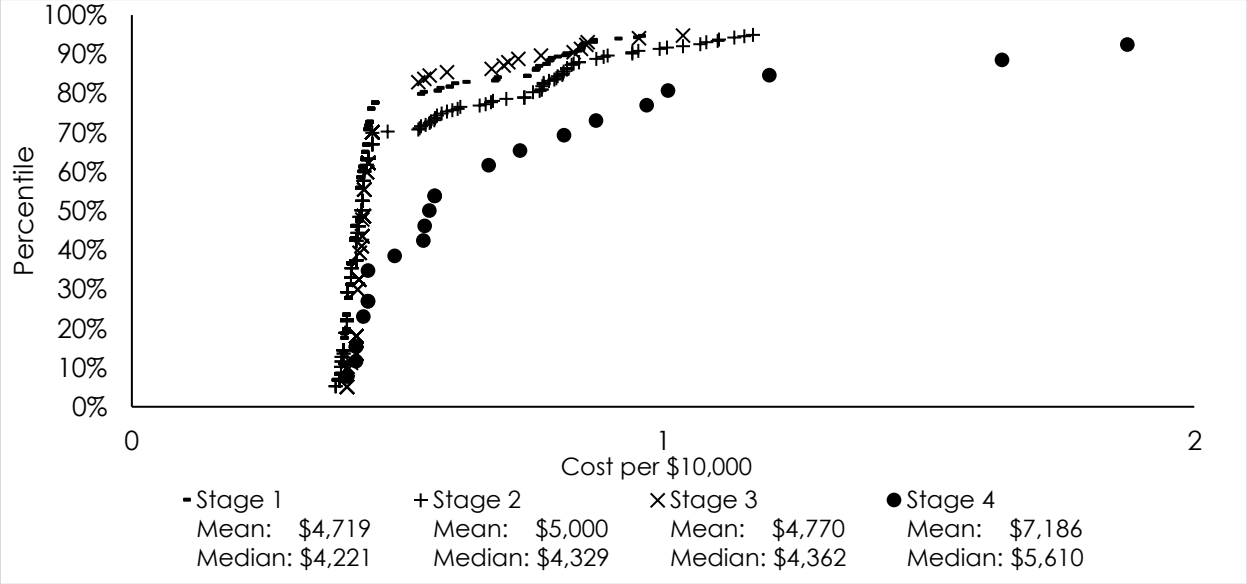


Figure 14: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with breast cancer (2013 dollars)

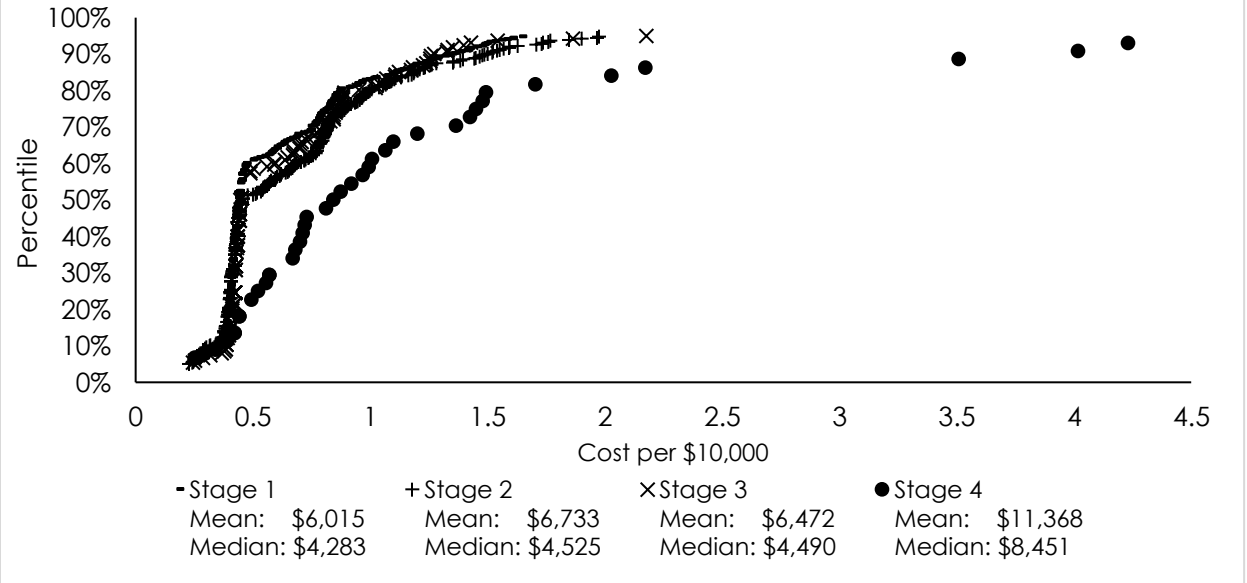


Figure 15: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with breast cancer (2013 dollars)

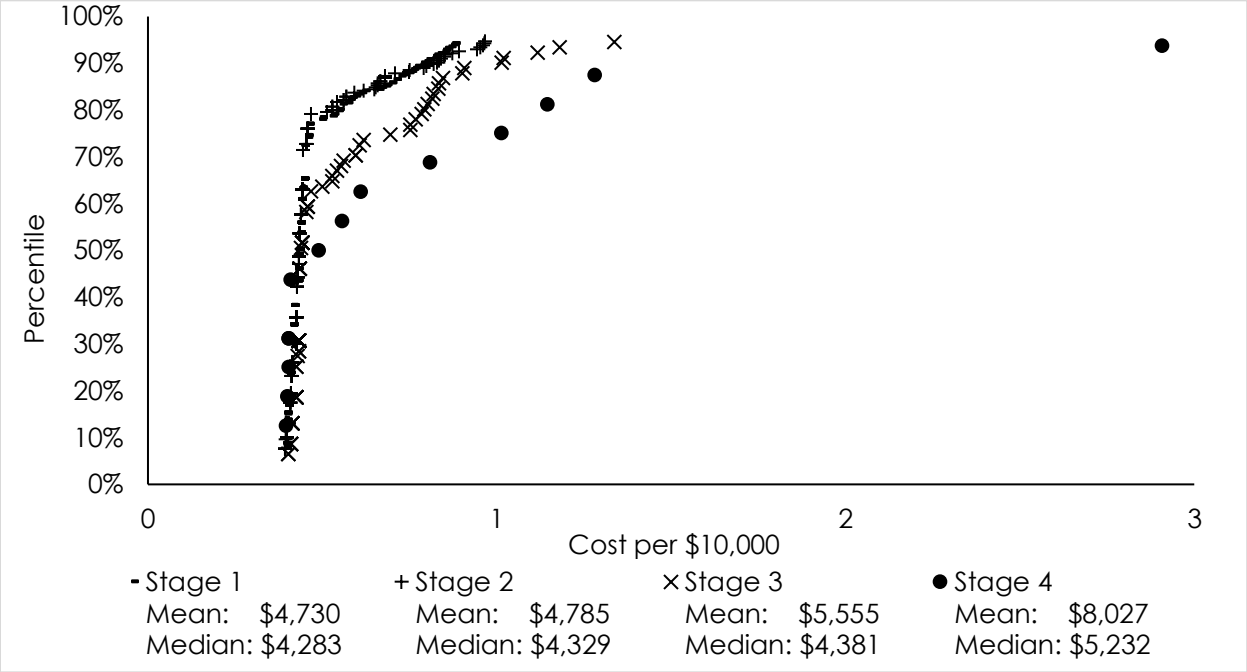


Figure 16: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with breast cancer (2013 dollars)

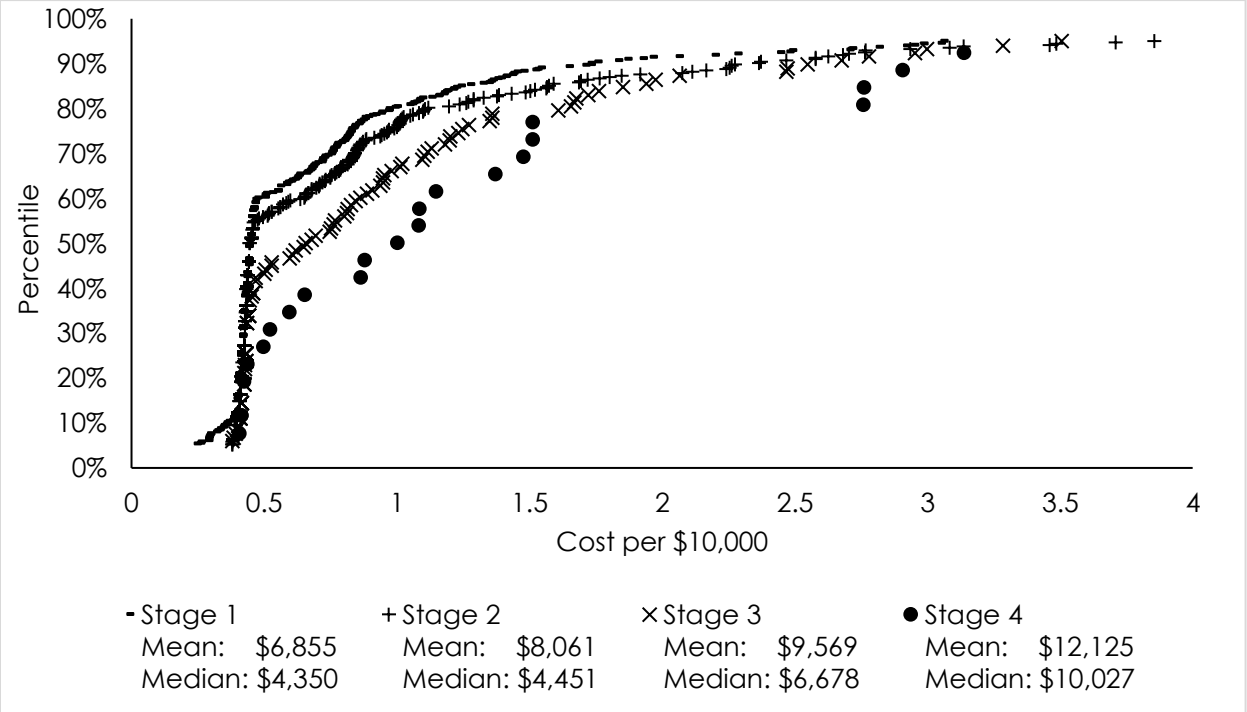


Figure 17: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with colon cancer (2013 dollars)

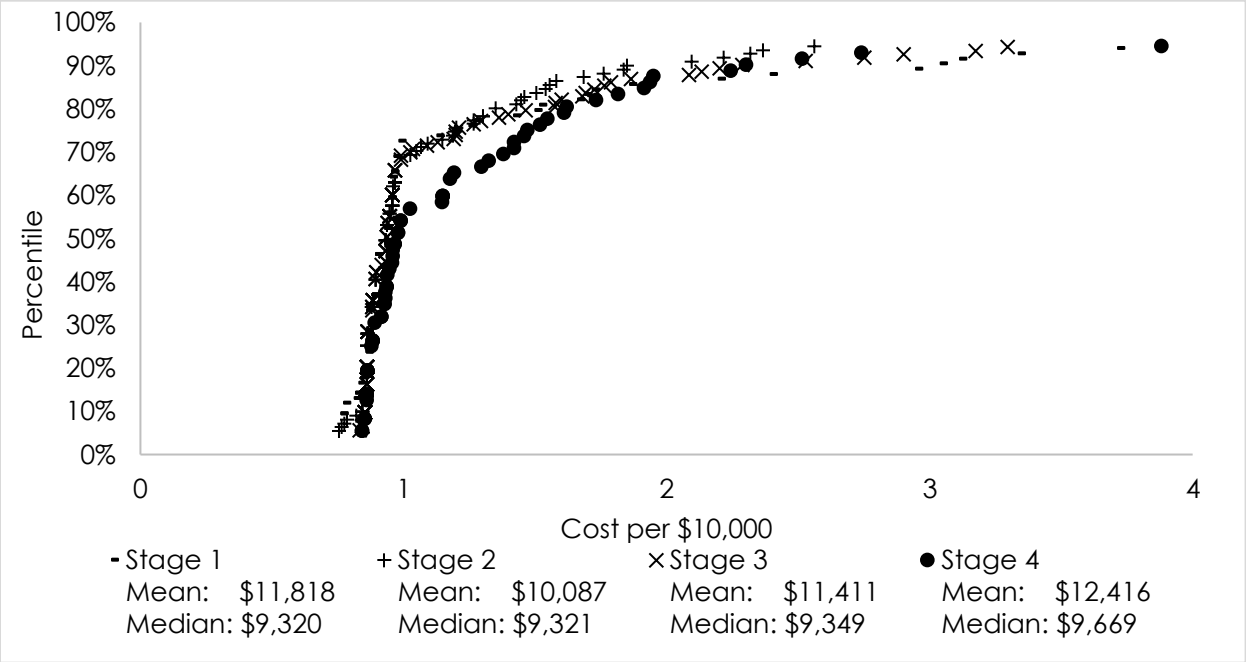


Figure 18: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with colon cancer (2013 dollars)

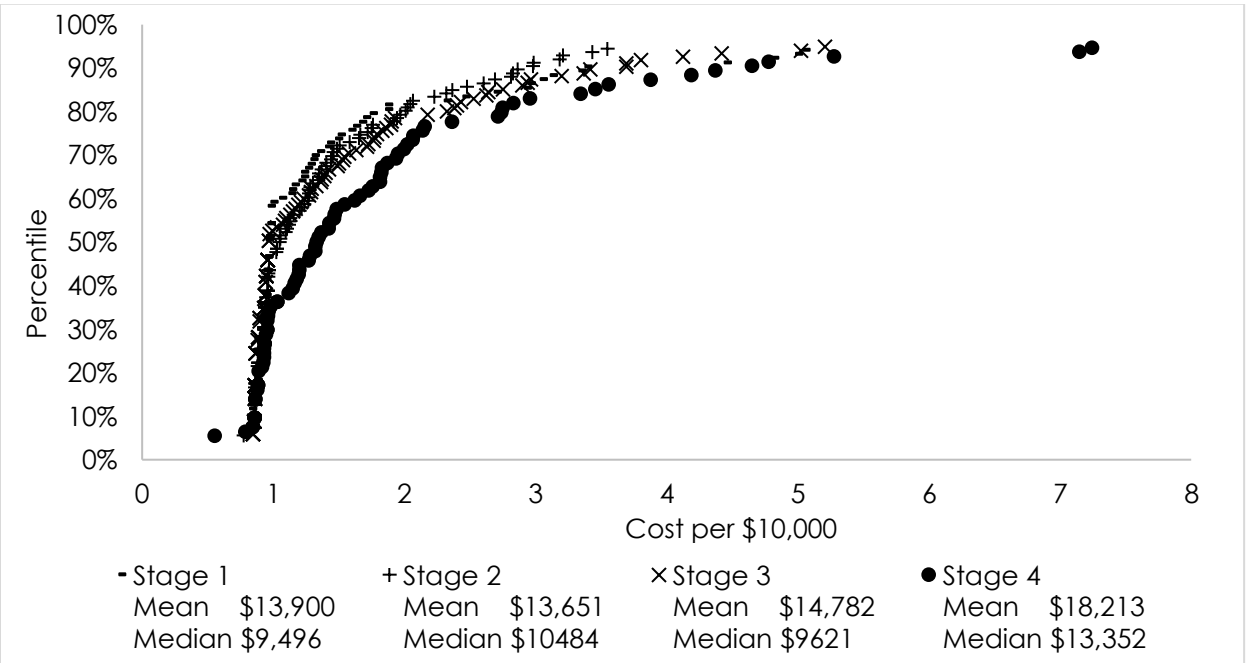


Figure 19: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with colon cancer (2013 dollars)

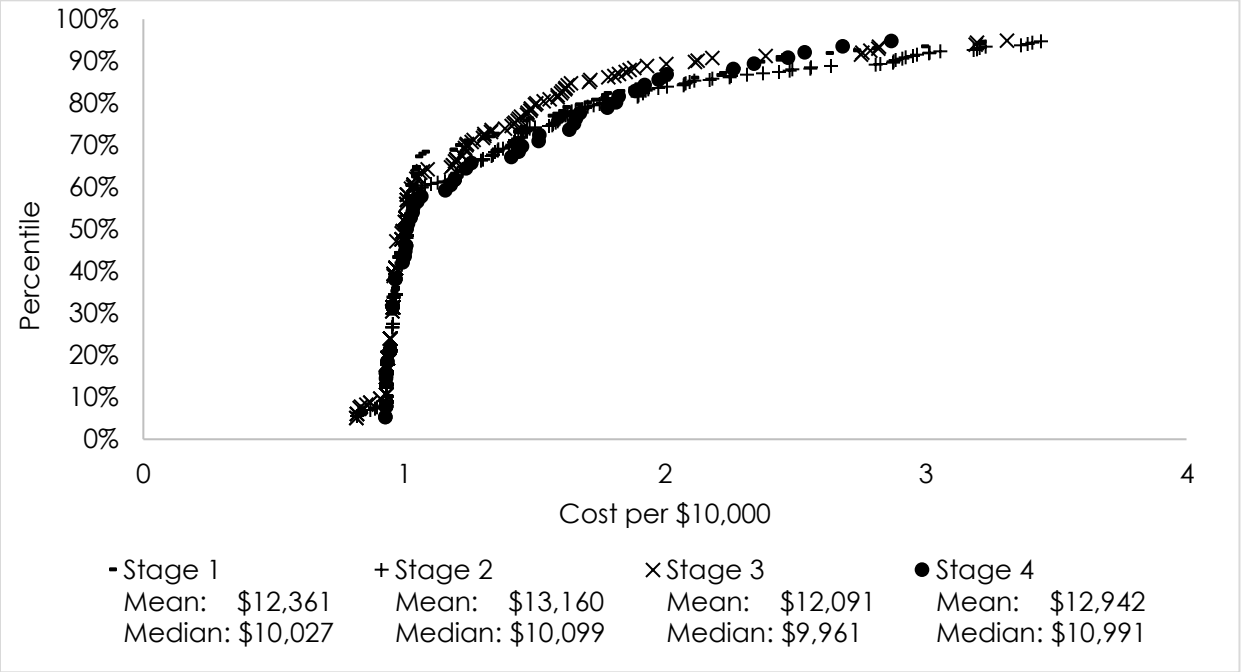


Figure 20: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with colon cancer (2013 dollars)

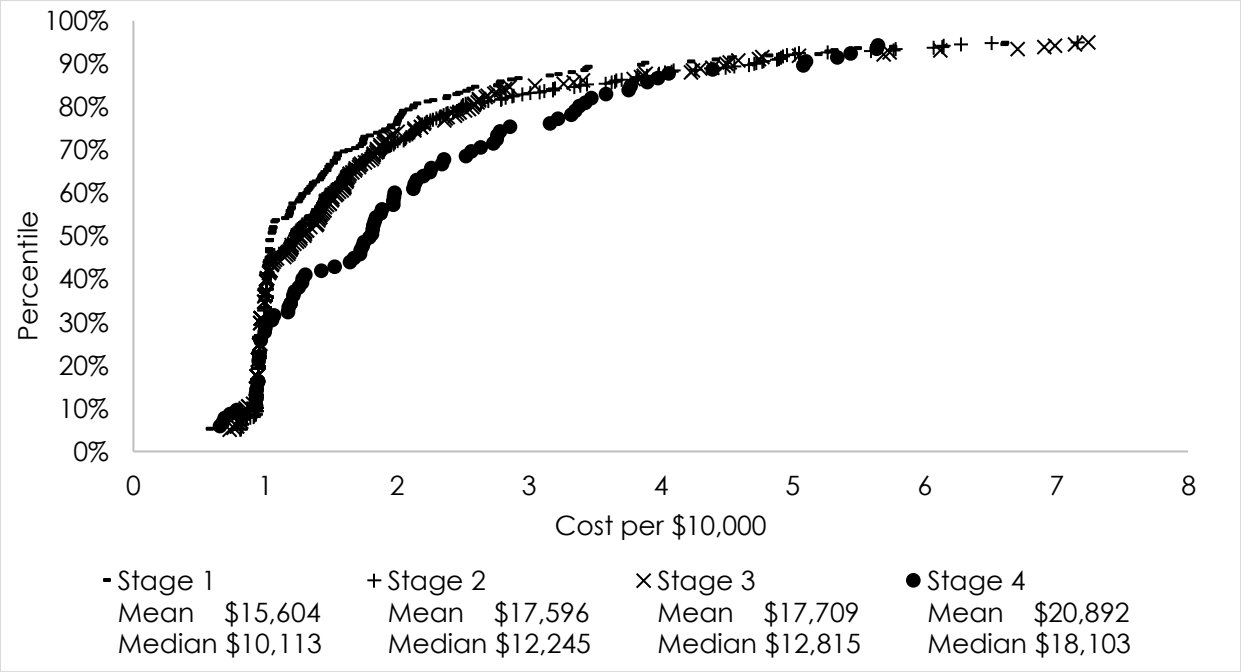


Figure 21: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with kidney cancer (2013 dollars)

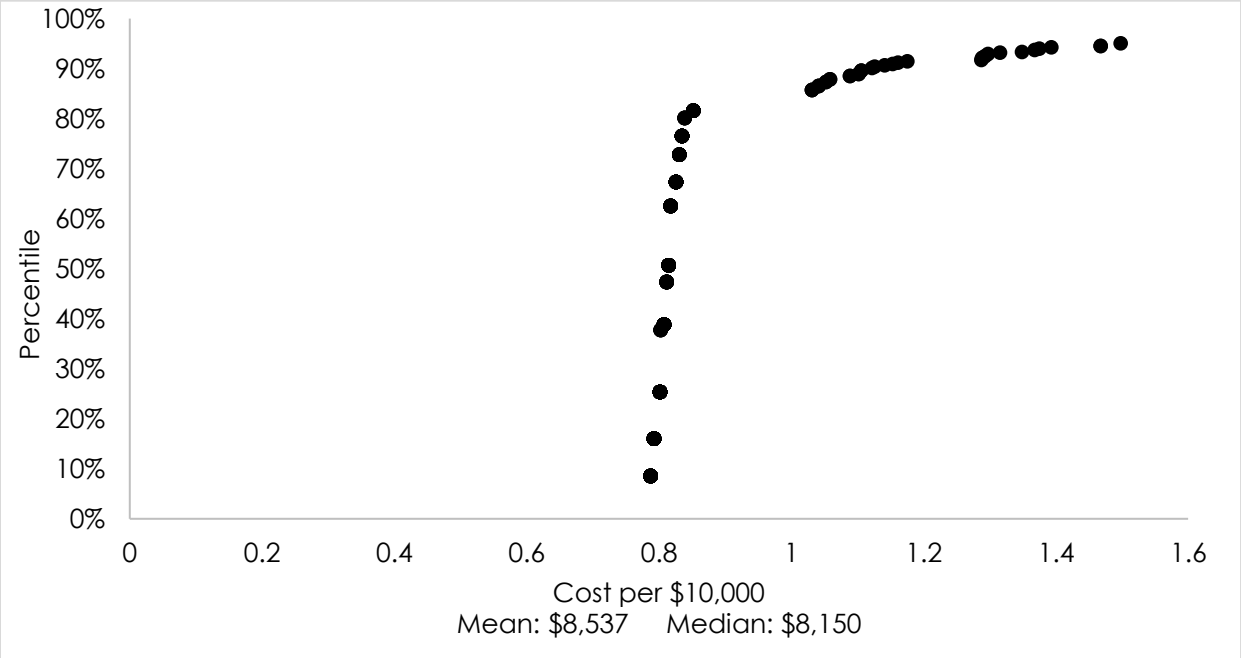


Figure 22: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with kidney cancer (2013 dollars)

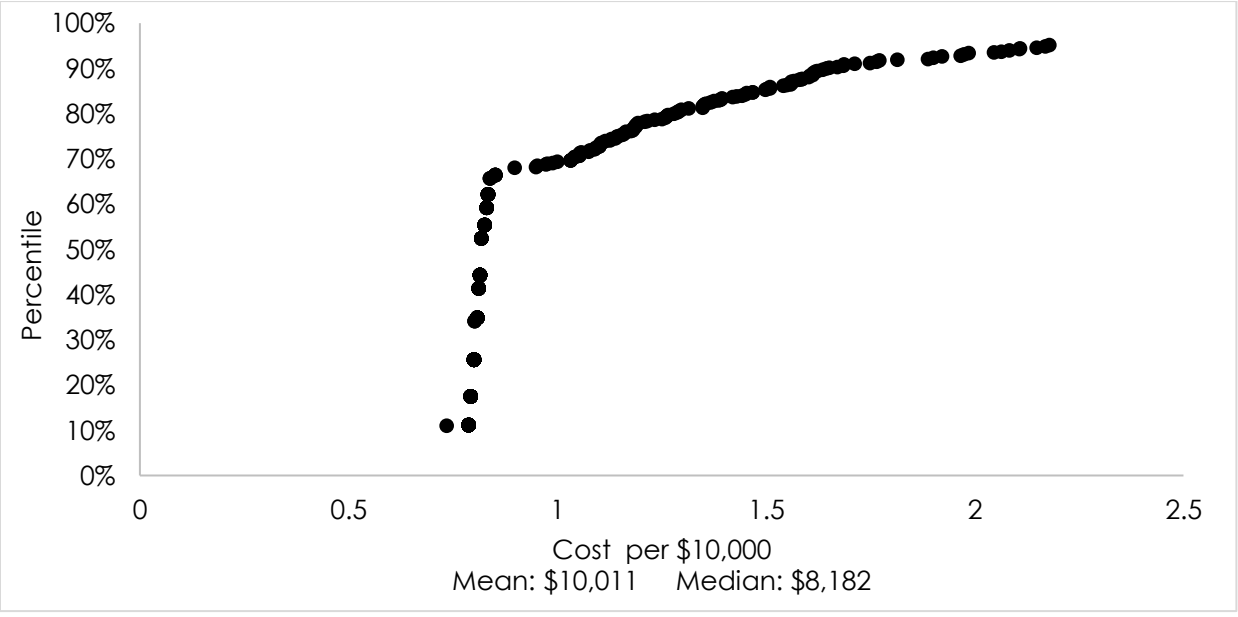


Figure 23: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with kidney cancer (2013 dollars)

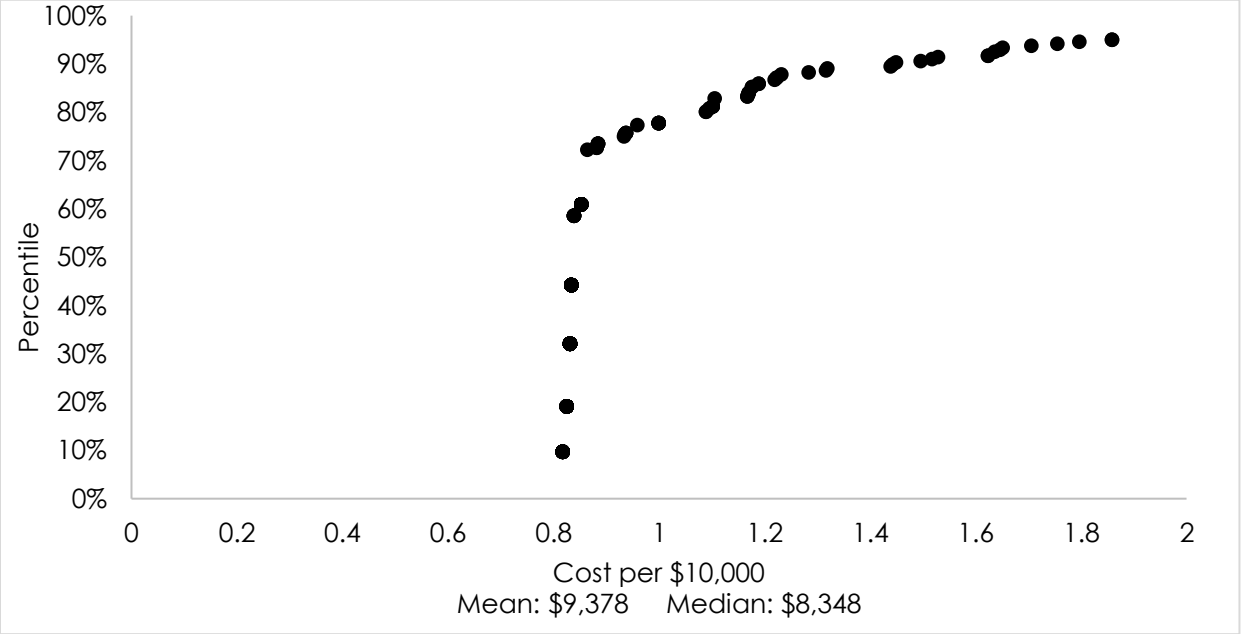
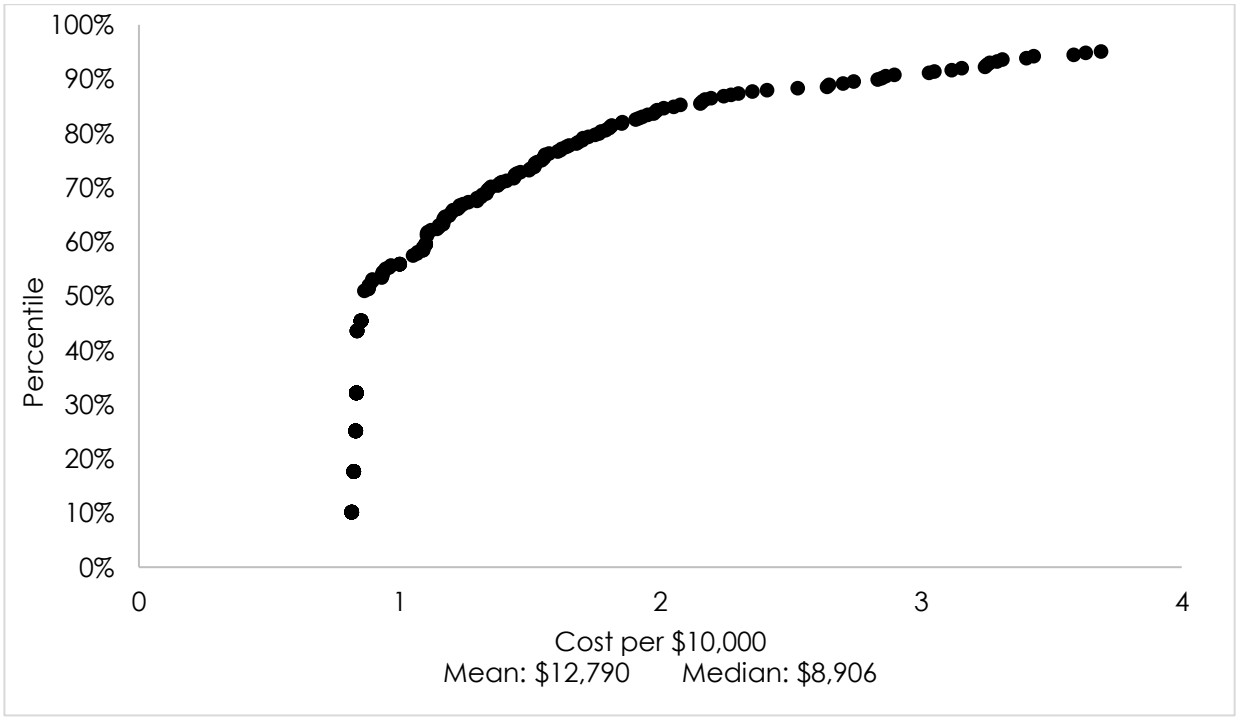


Figure 24: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with kidney cancer (2013 dollars)



Leukemia

Figure 25: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with leukemia (2013 dollars)

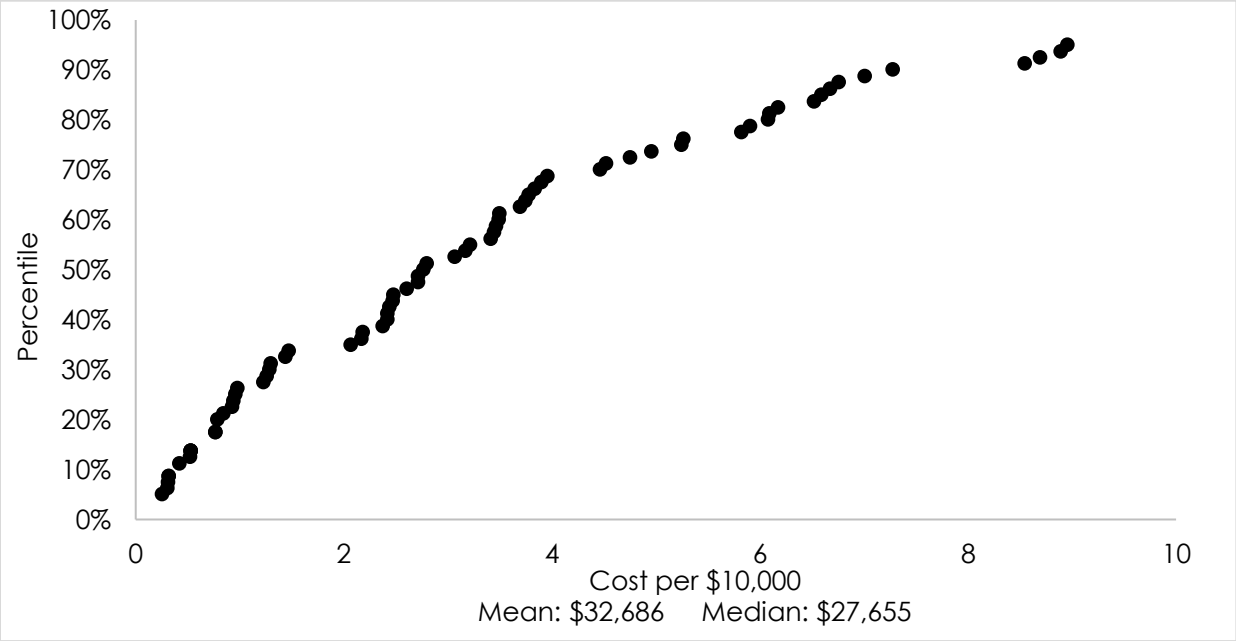


Figure 26: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with leukemia (2013 dollars)

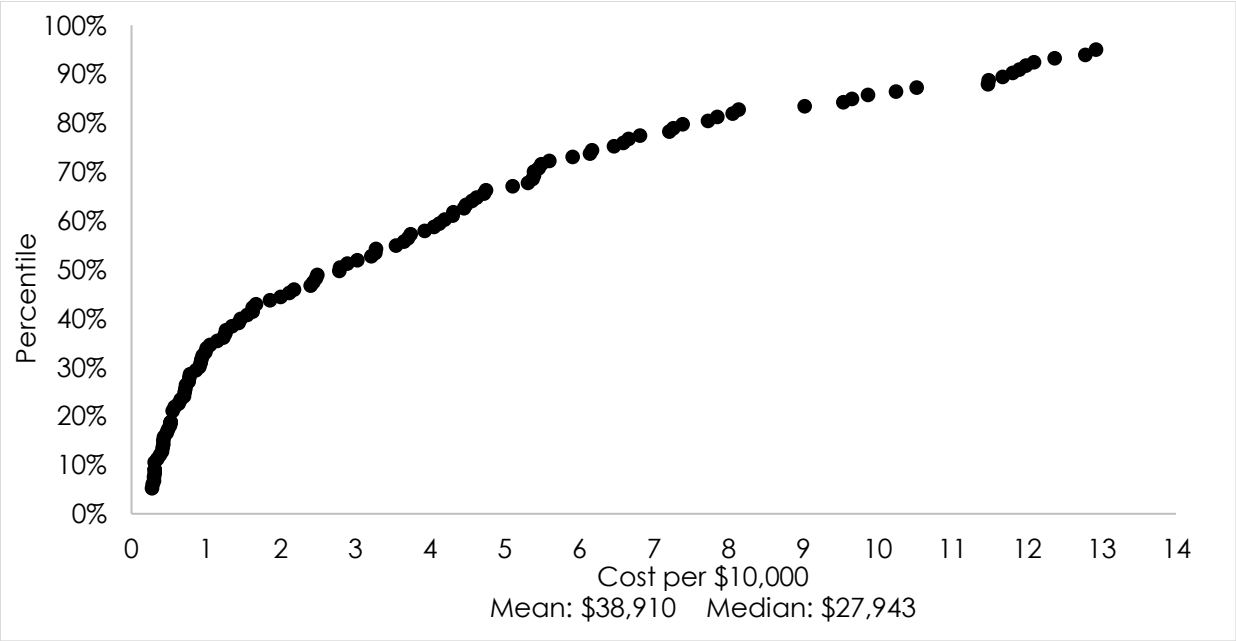


Figure 27: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with leukemia (2013 dollars)

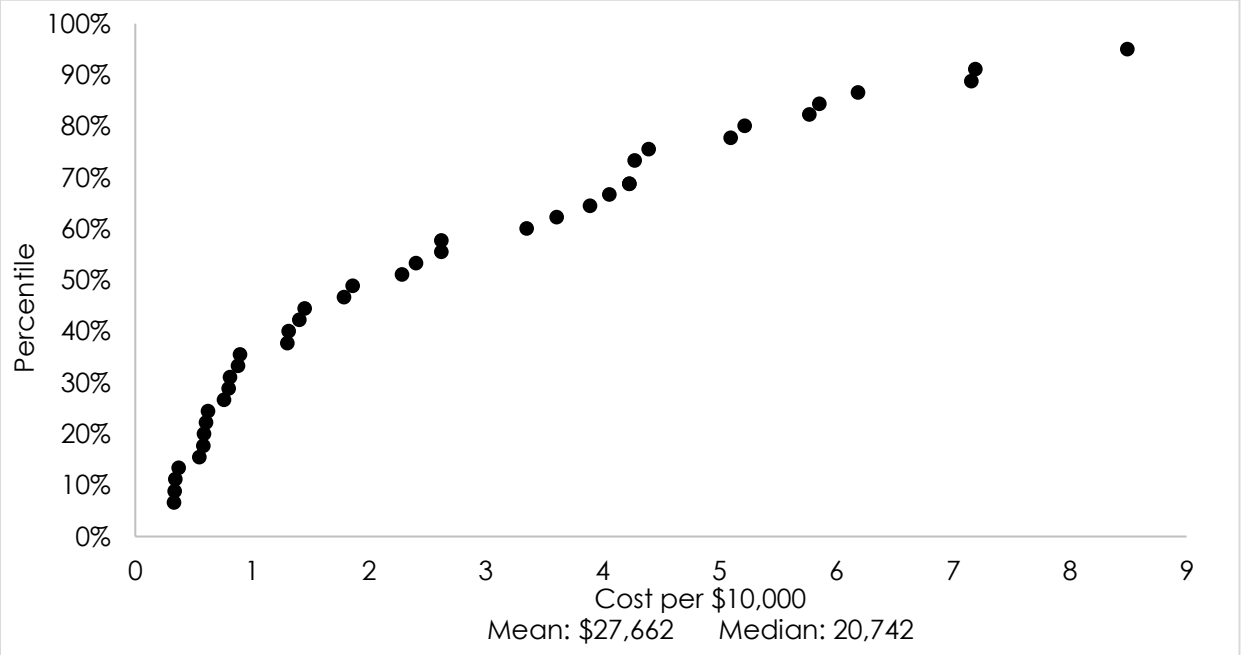


Figure 28: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with leukemia (2013 dollars)

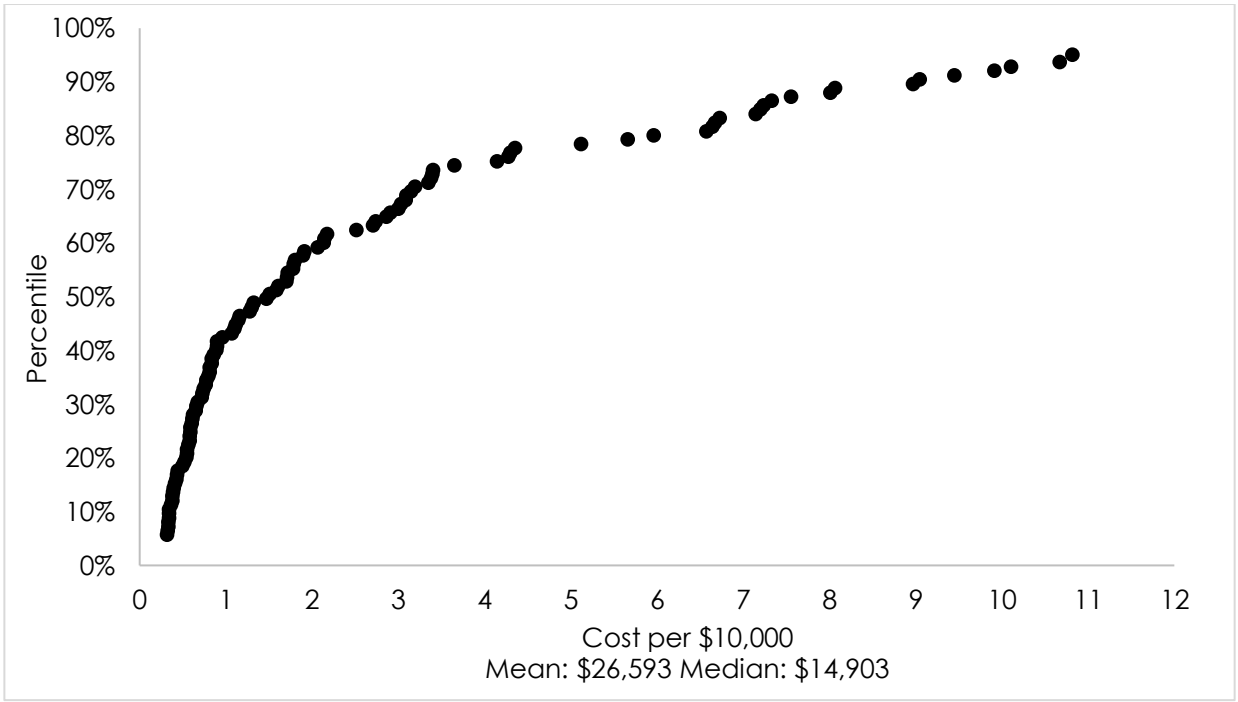


Figure 29: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with lung cancer (2013 dollars)

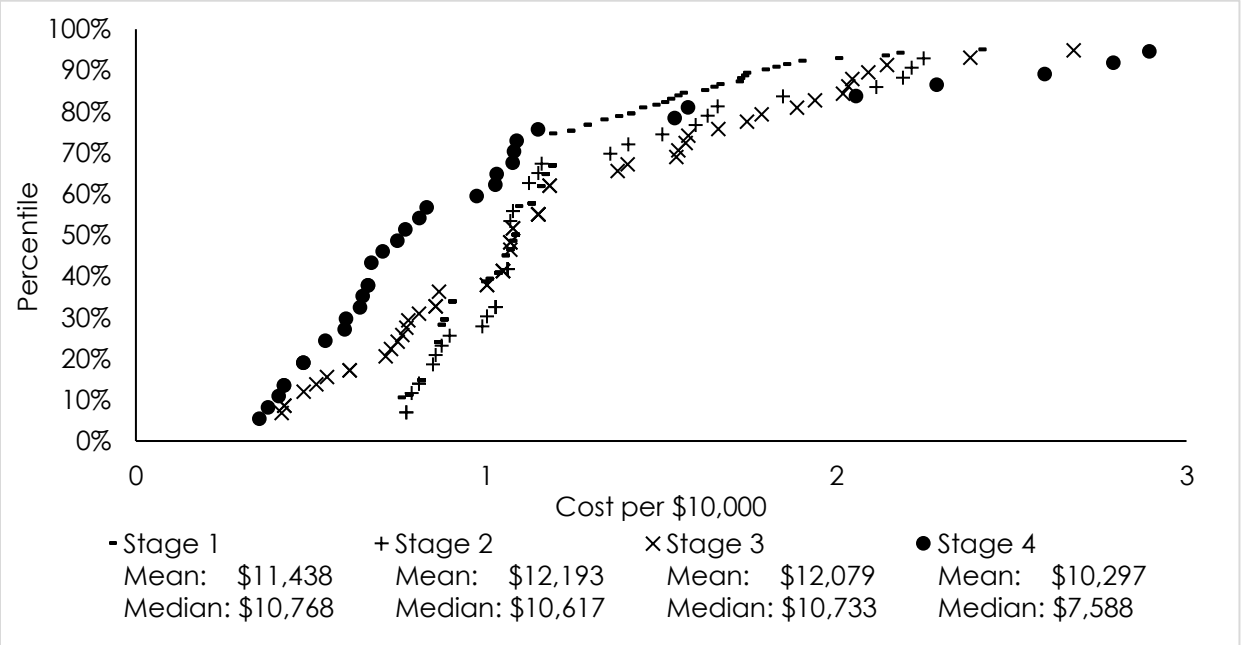


Figure 30: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with lung cancer (2013 dollars)

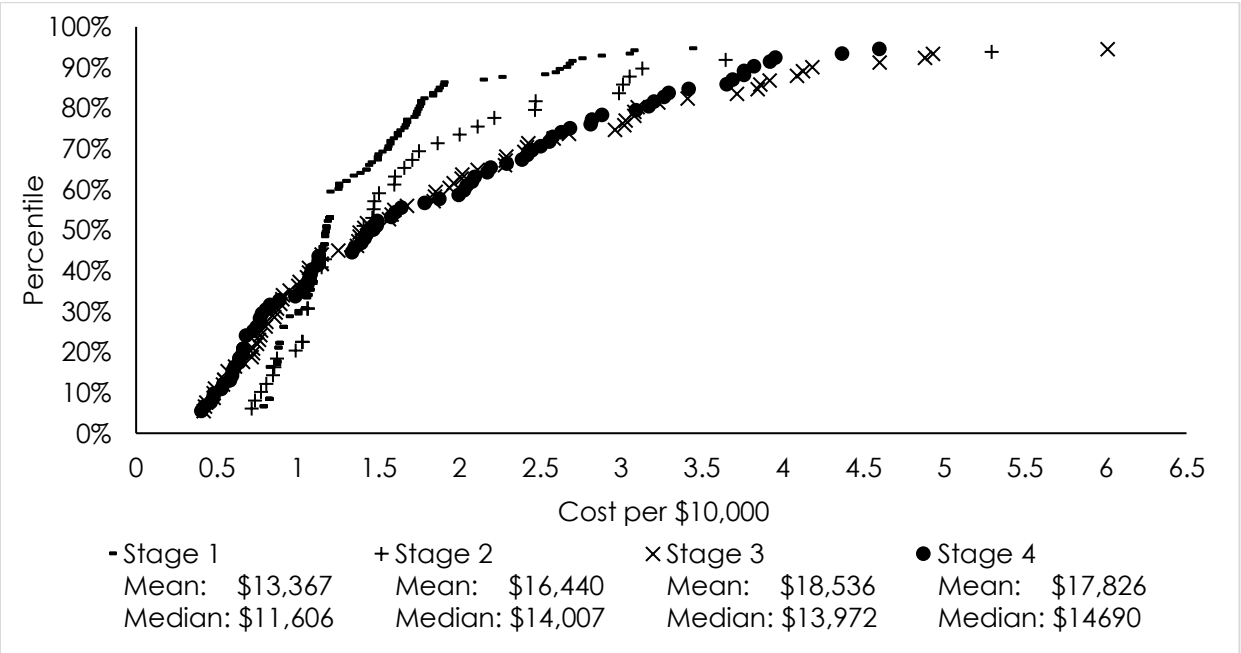


Figure 31: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with lung cancer (2013 dollars)

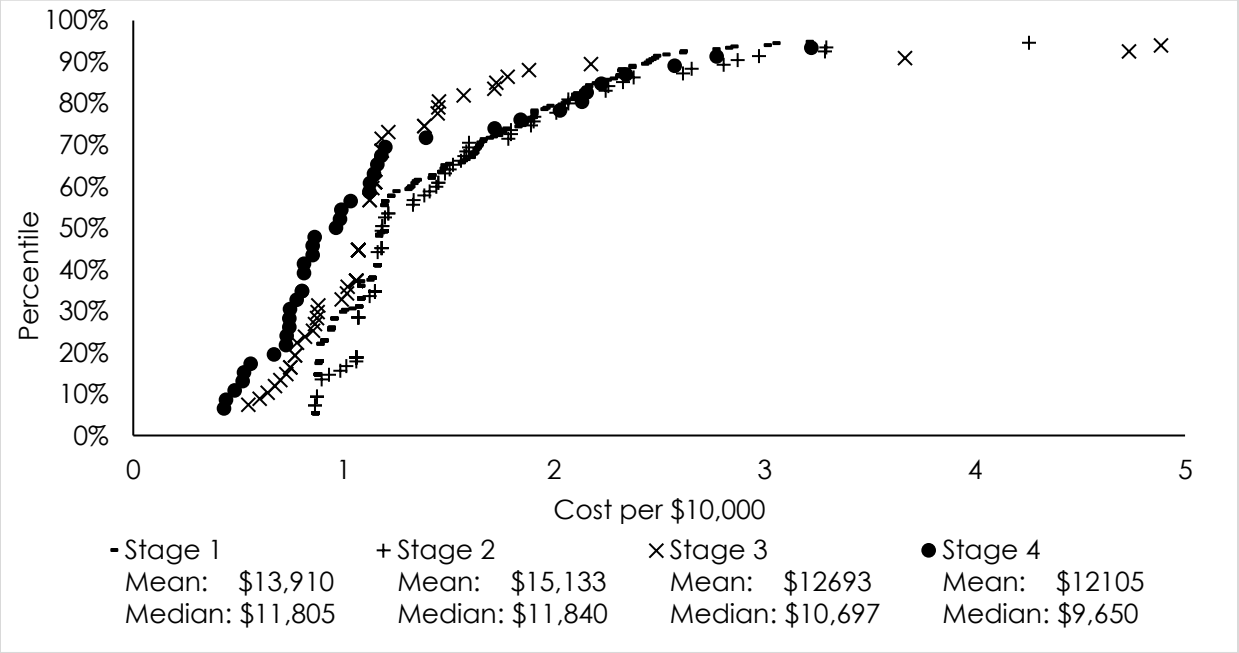


Figure 32: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with lung cancer (2013 dollars)

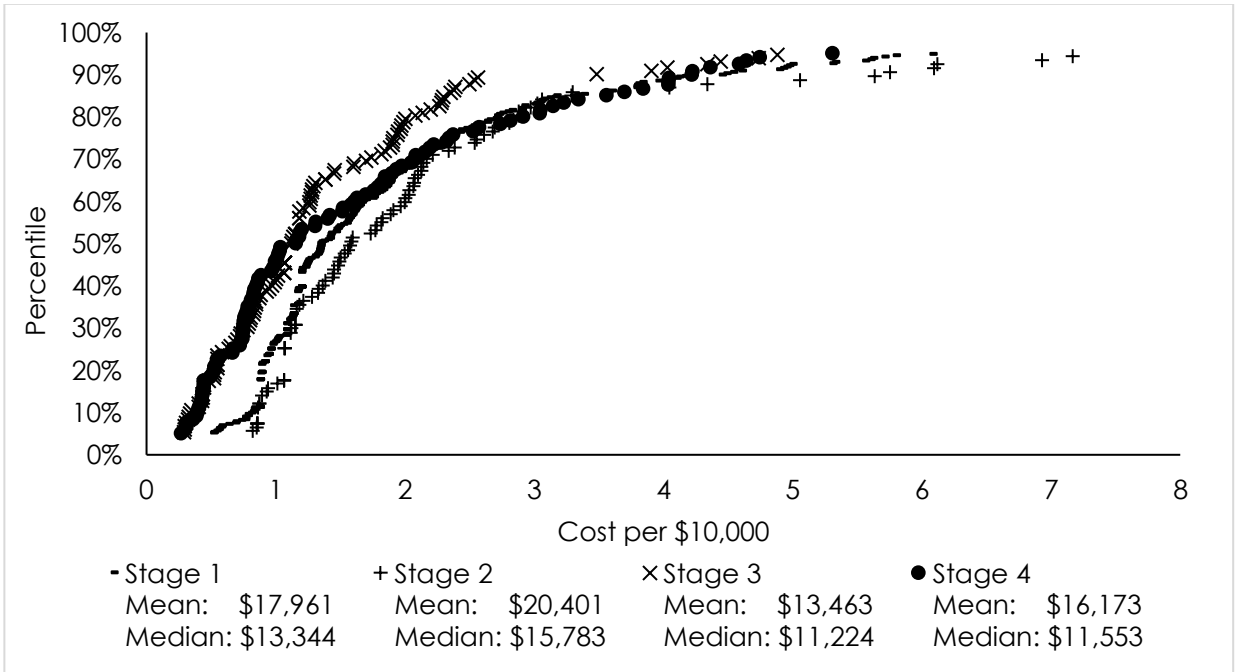


Figure 33: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with myeloma (2013 dollars)

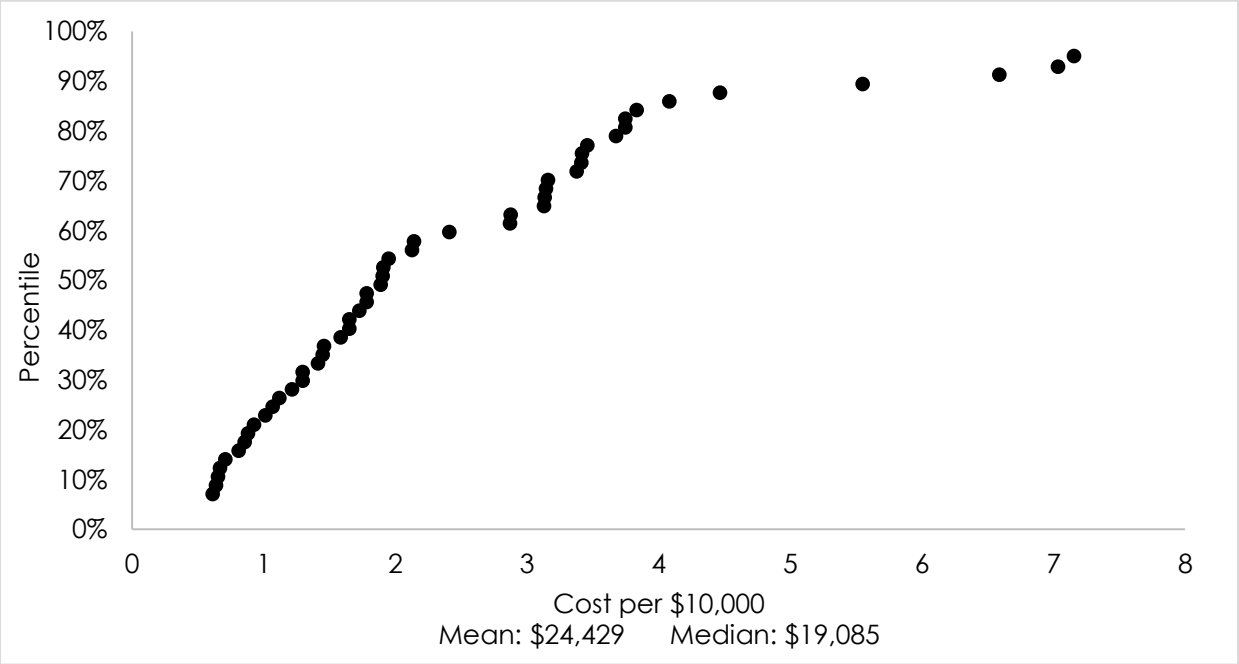


Figure 34: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with myeloma (2013 dollars)

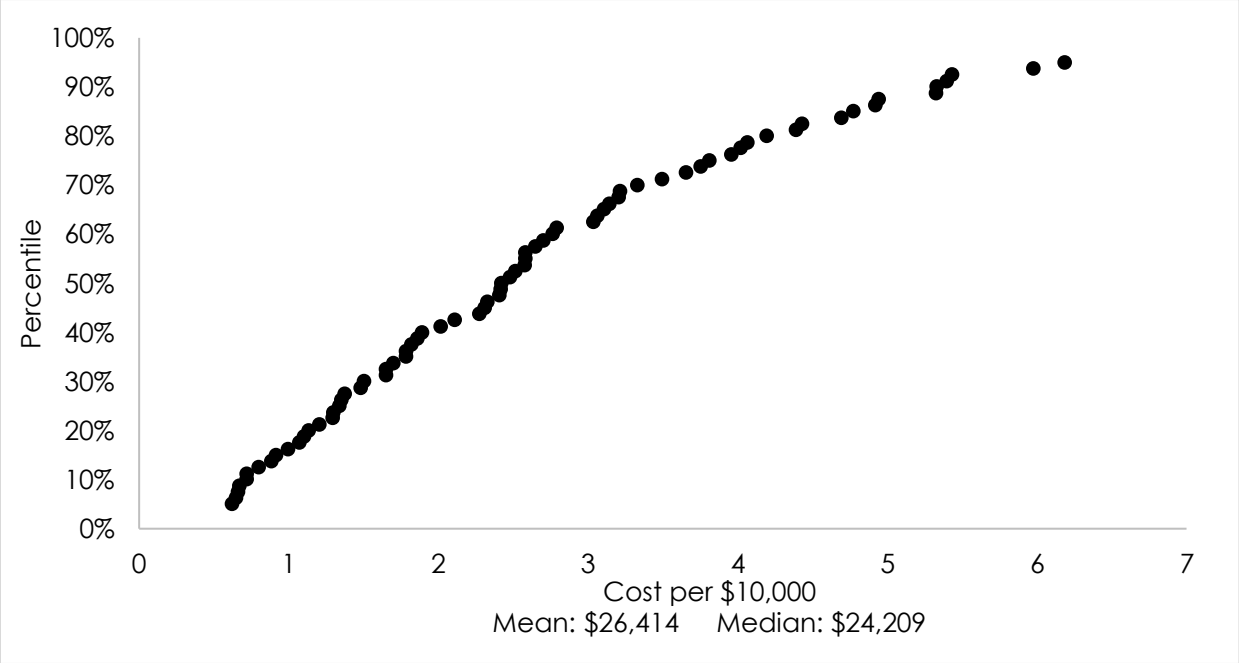


Figure 35: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with myeloma (2013 dollars)

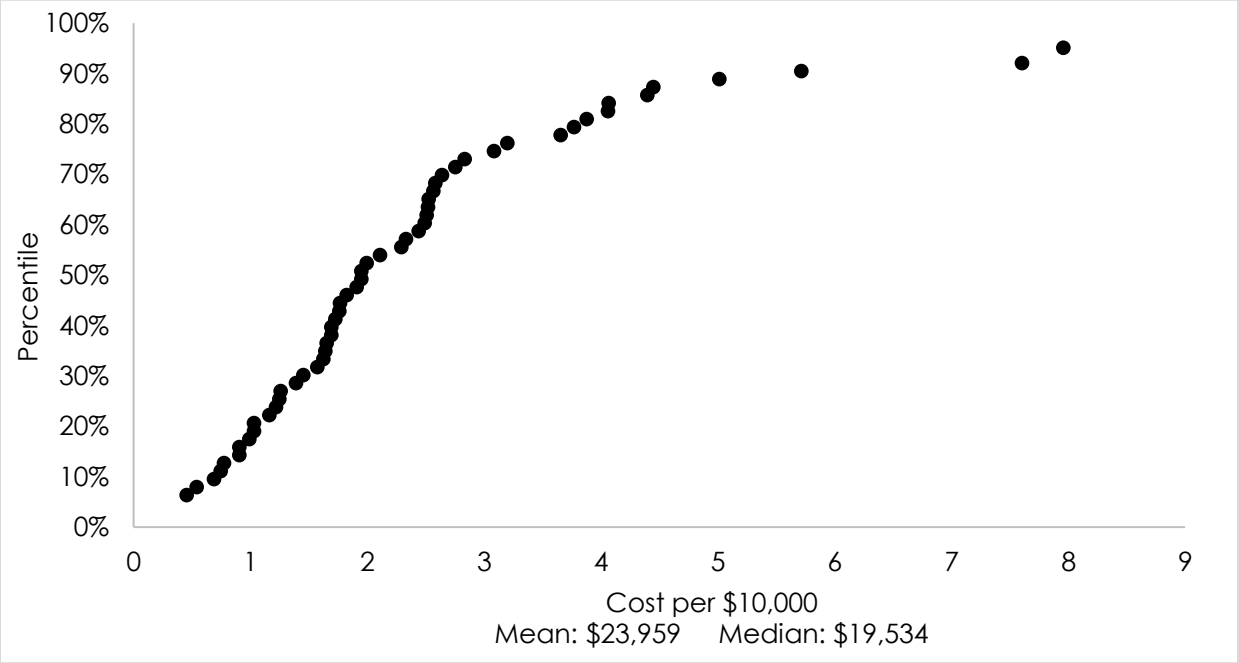


Figure 36: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with myeloma (2013 dollars)

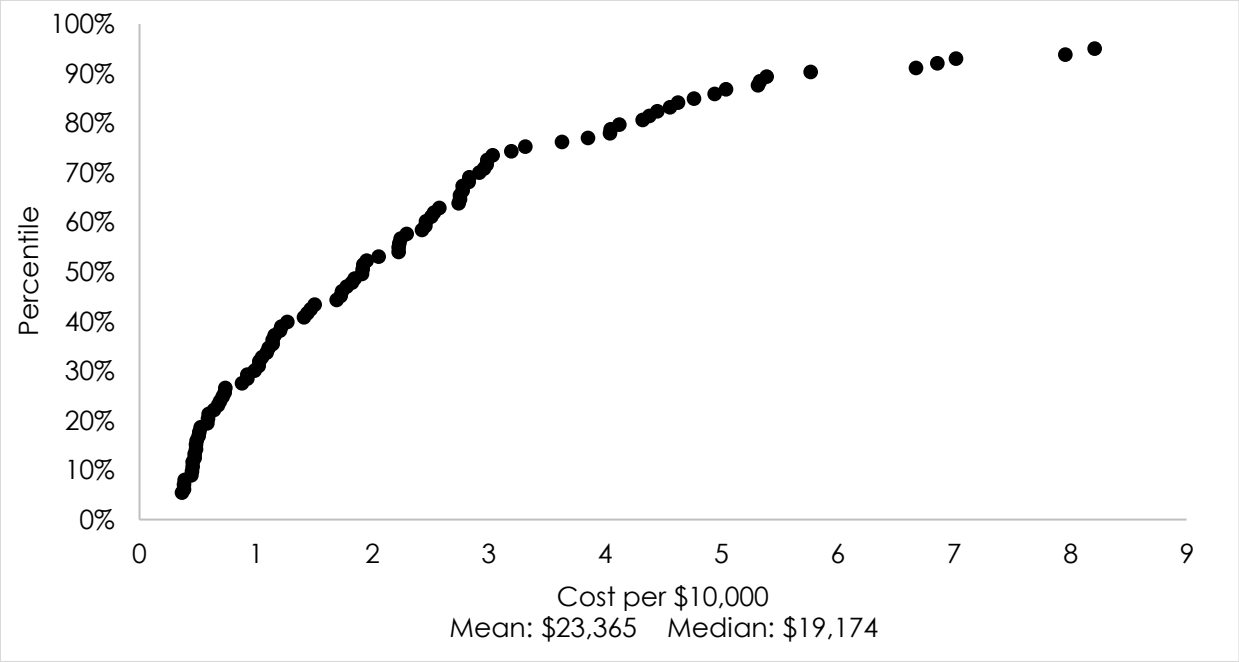


Figure 37: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with non-Hodgkin's lymphoma (2013 dollars)

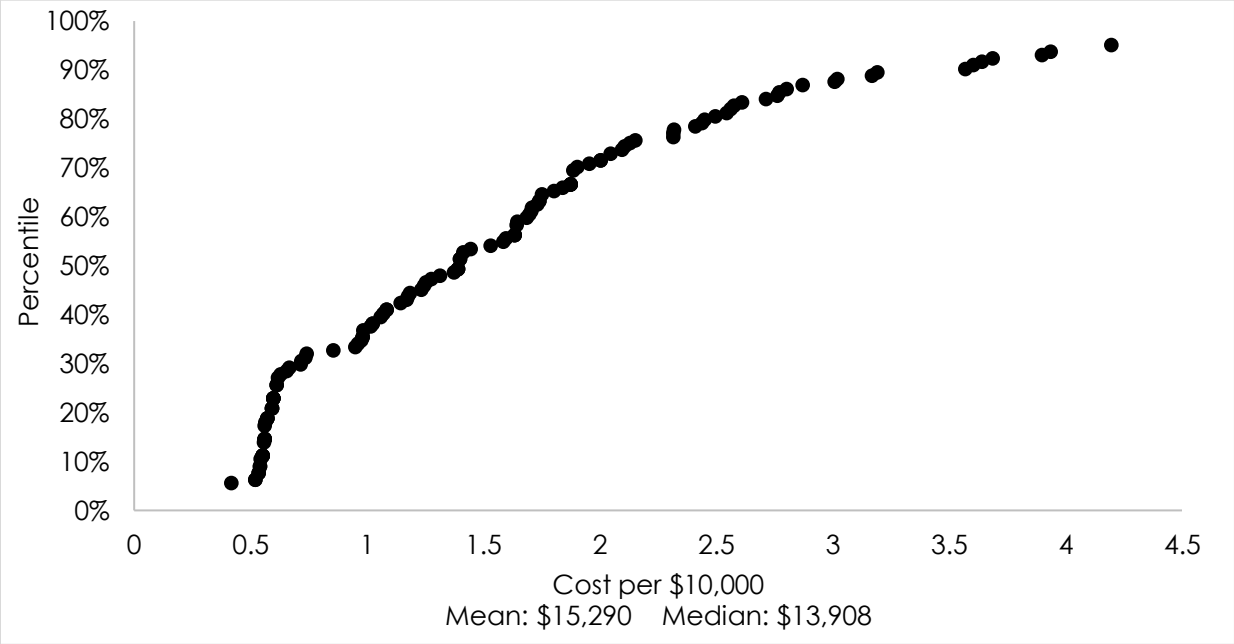


Figure 38: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with non-Hodgkin's lymphoma (2013 dollars)

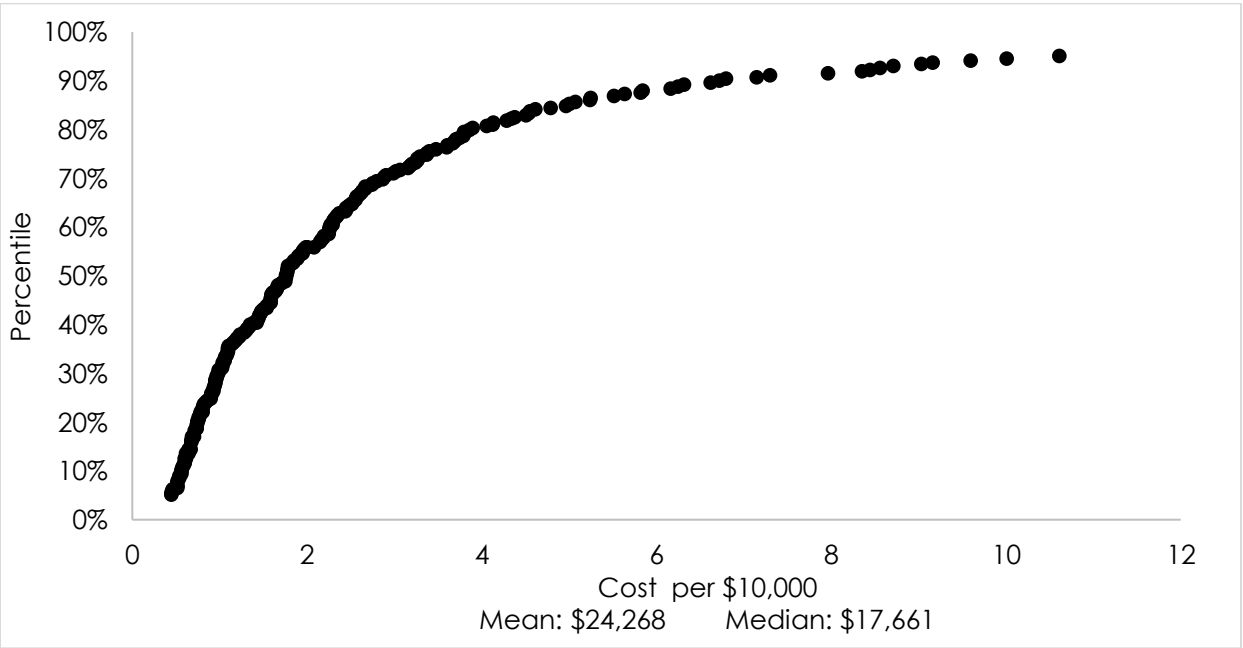


Figure 39: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with non-Hodgkin's lymphoma (2013 dollars)

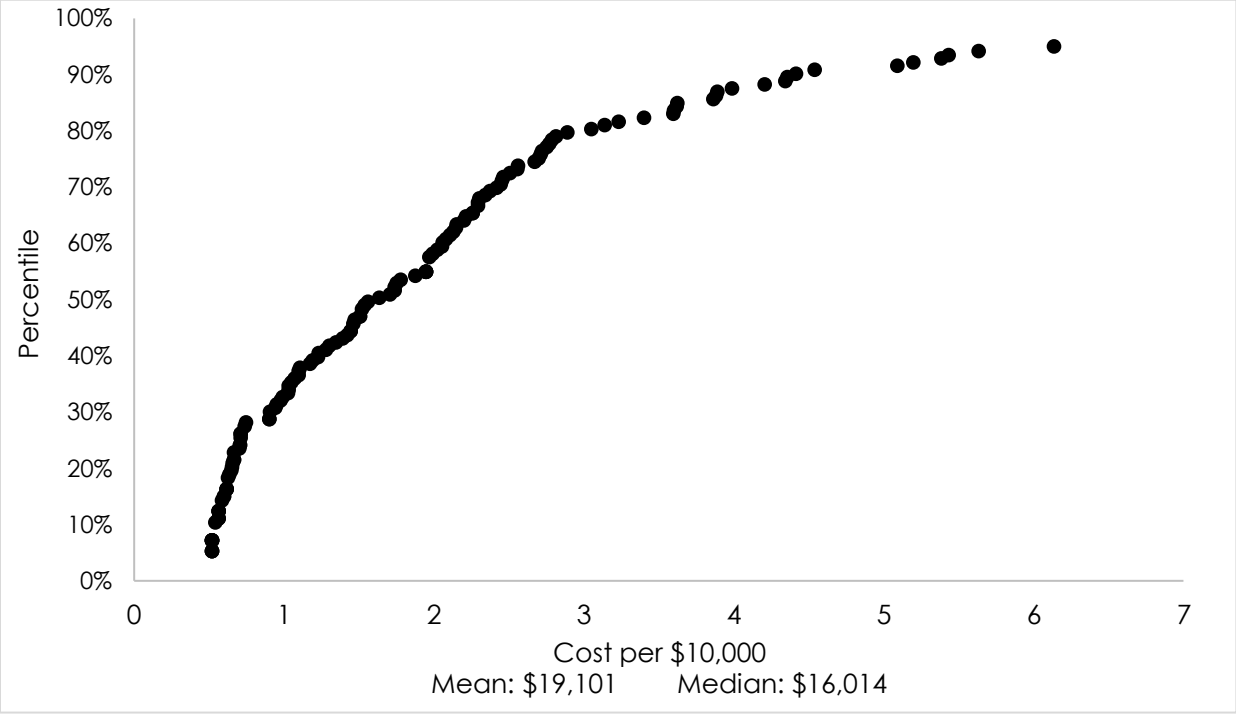
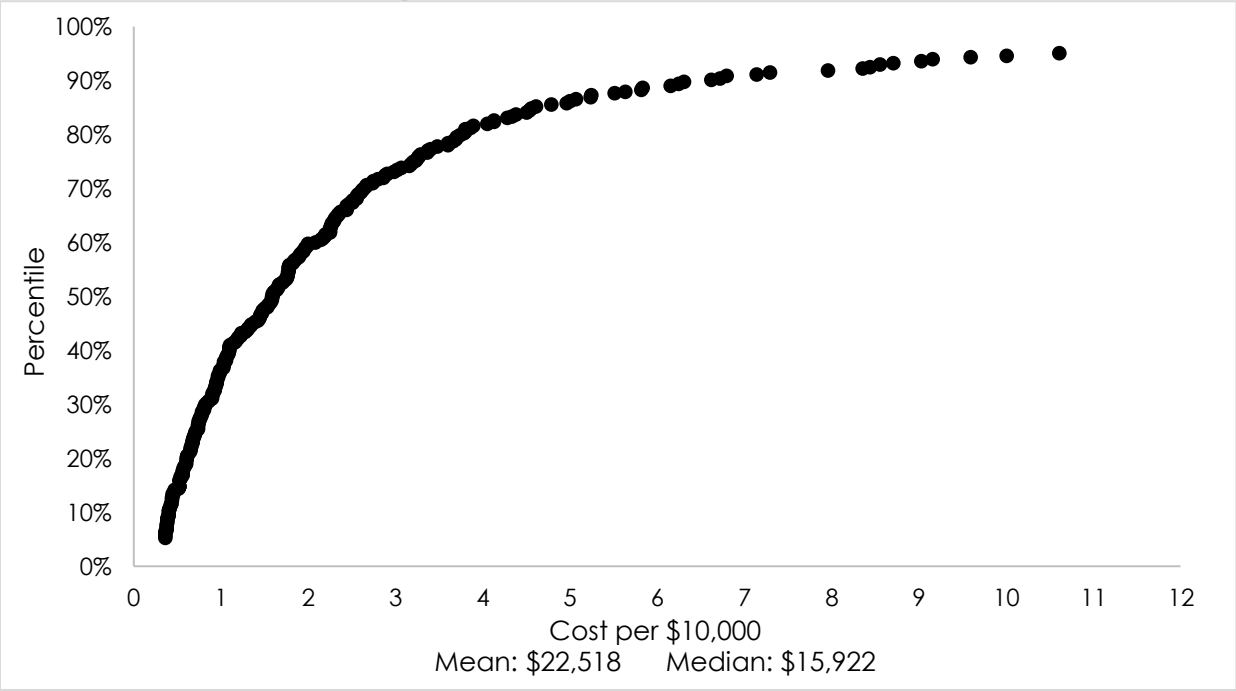


Figure 40: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with non-Hodgkin's lymphoma (2013 dollars)



Oesophageal cancer

Figure 41: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

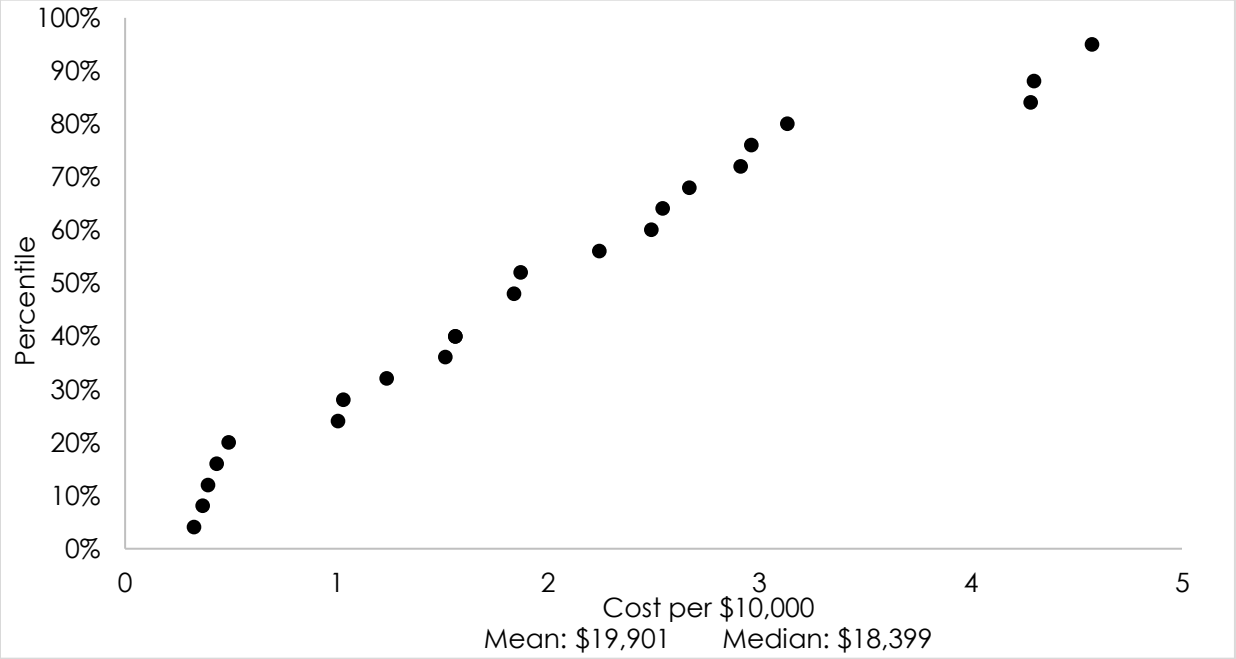


Figure 42: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

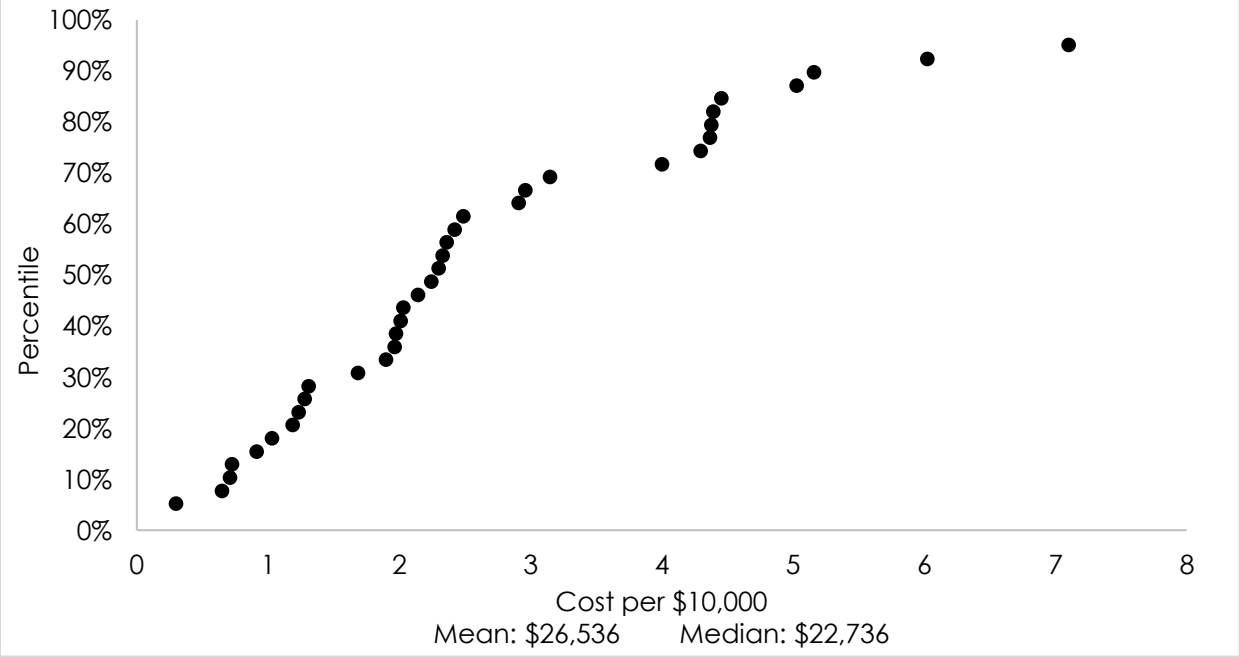


Figure 43: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with oesophageal cancer (2013 dollars)

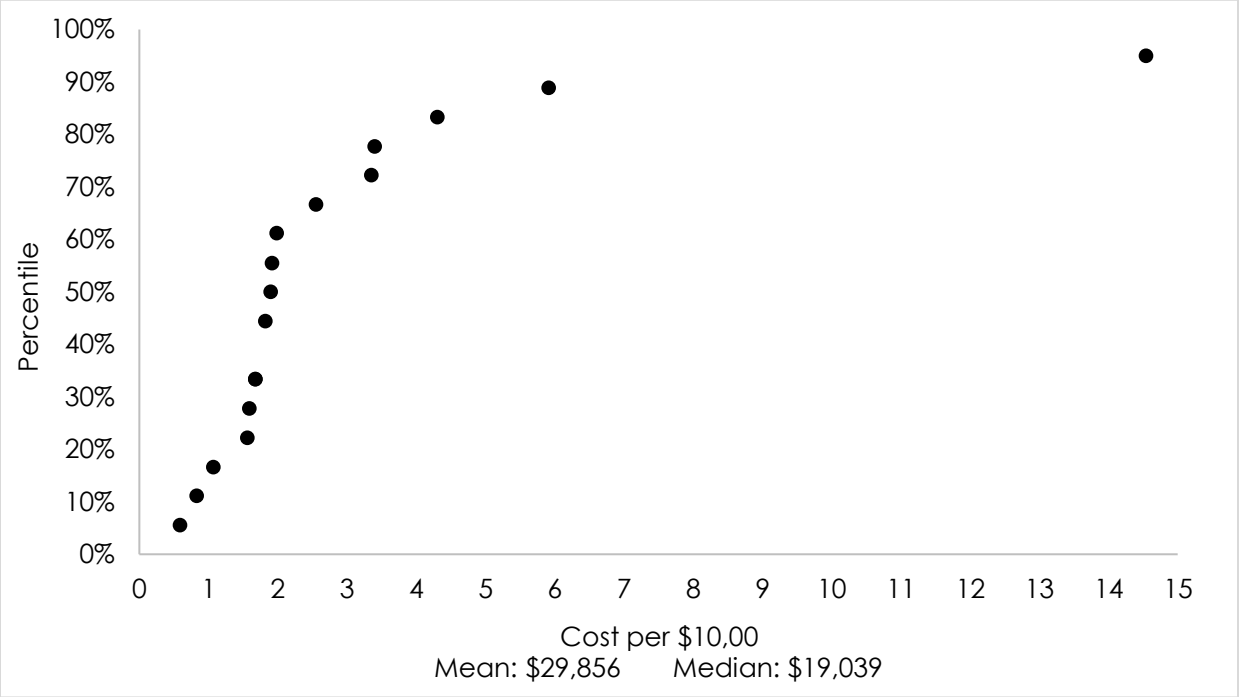


Figure 44: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with oesophageal cancer (2013 dollars)

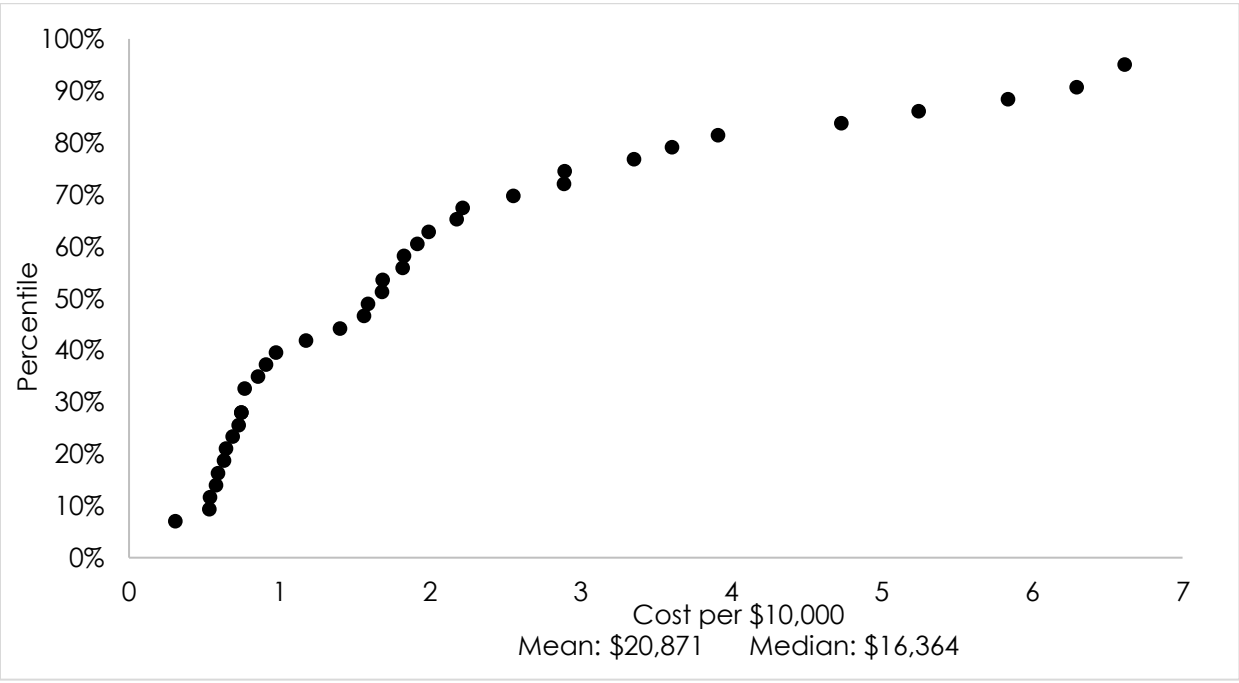


Figure 45: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with prostate cancer (2013 dollars)

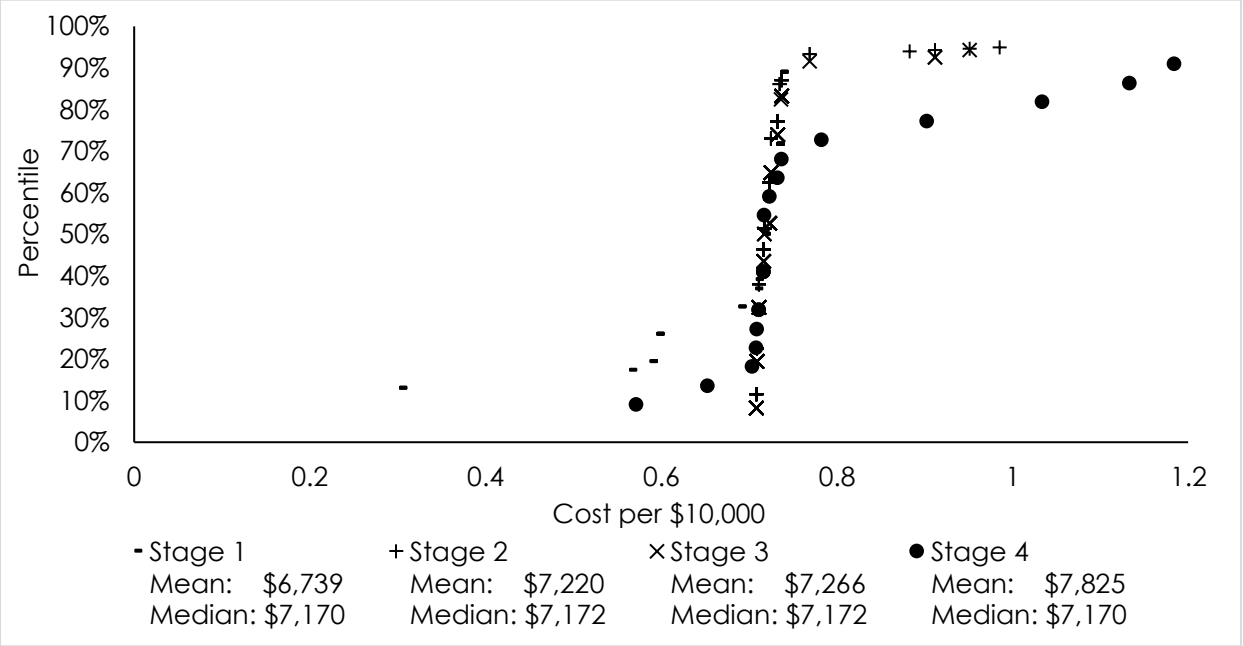


Figure 46: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with prostate cancer (2013 dollars)

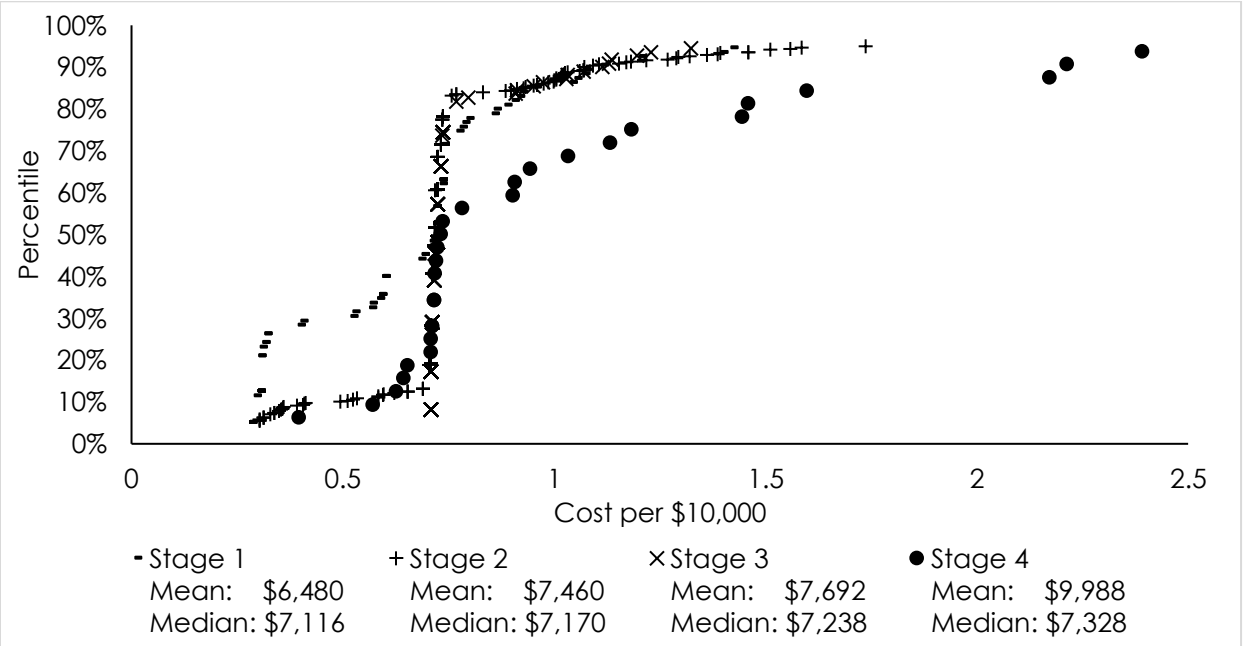


Figure 47: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with prostate cancer (2013 dollars)

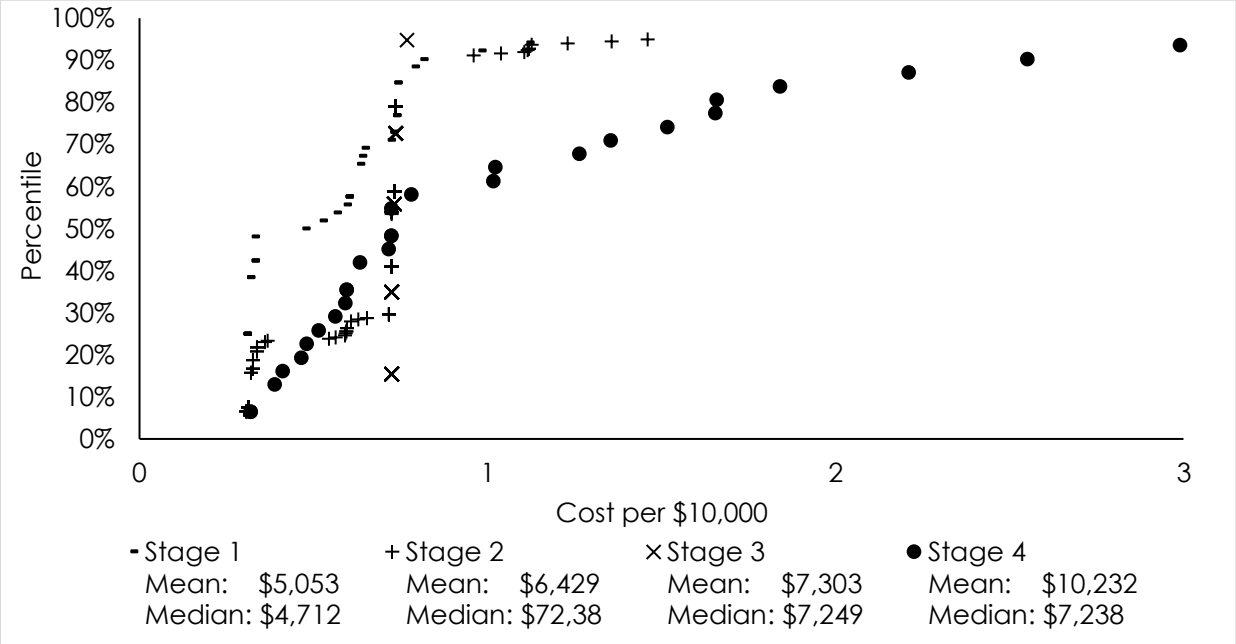


Figure 48: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with prostate cancer (2013 dollars)

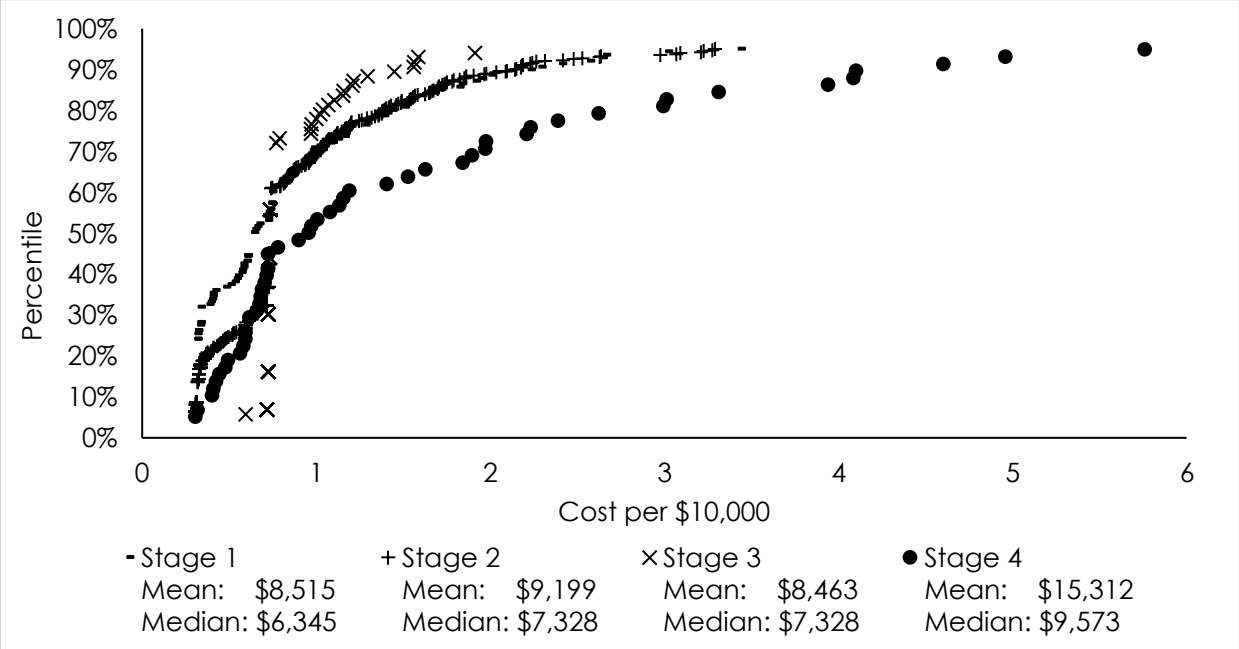


Figure 49: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with rectal cancer (2013 dollars)

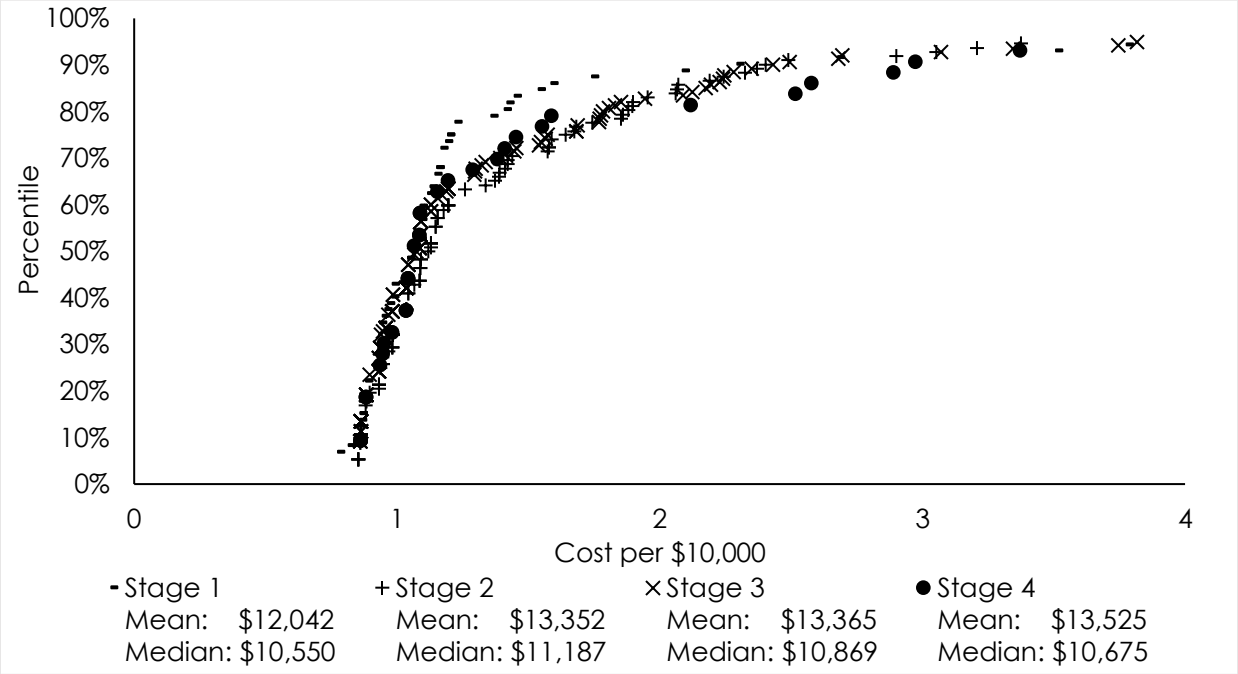


Figure 50: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with rectal cancer (2013 dollars)

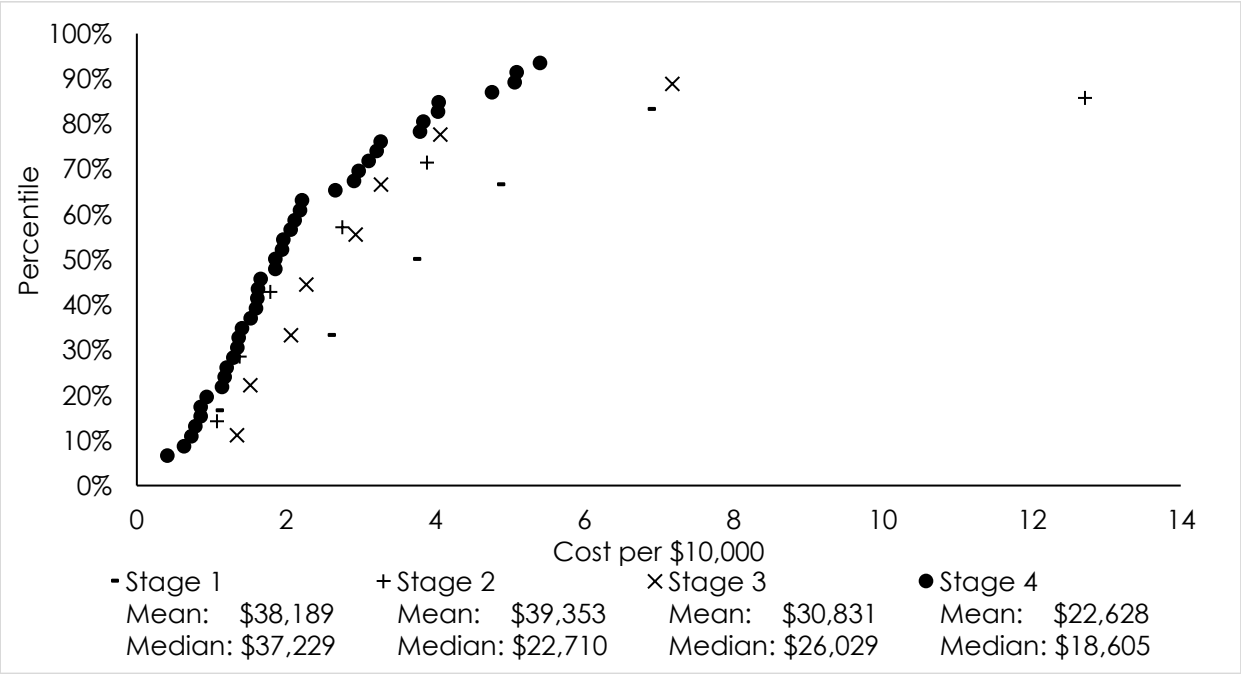


Figure 51: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with rectal cancer (2013 dollars)

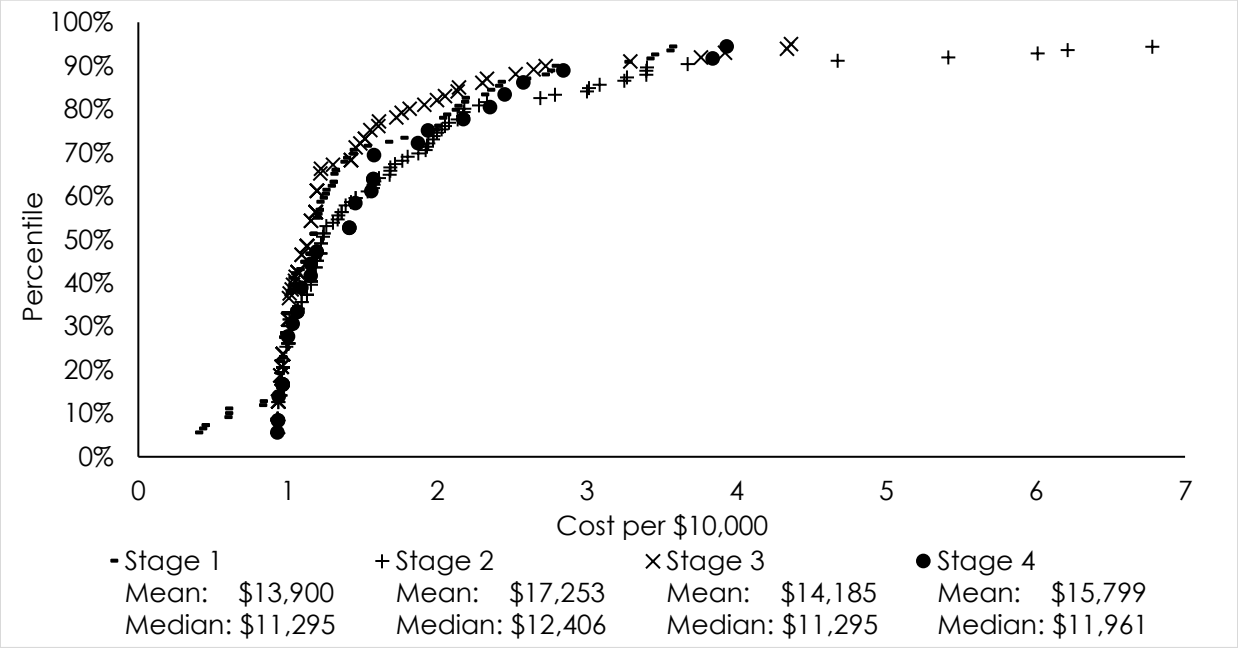


Figure 52: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with rectal cancer (2013 dollars)

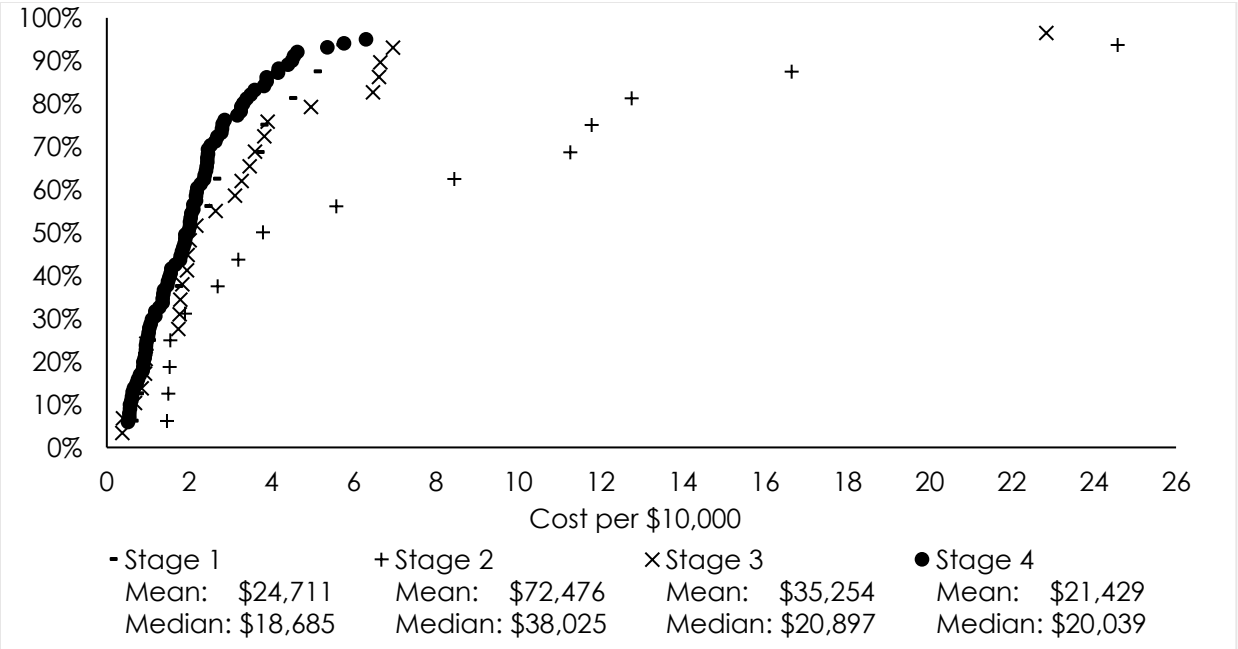


Figure 53: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with skin cancer (2013 dollars)

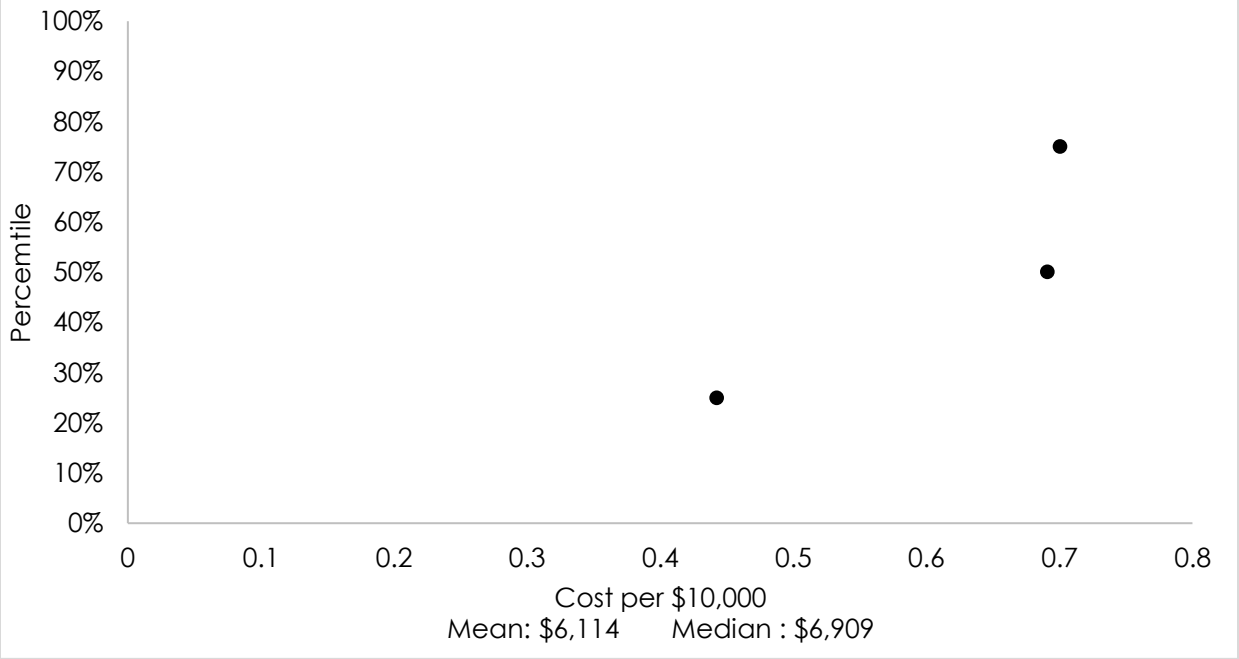


Figure 54: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with skin cancer (2013 dollars)

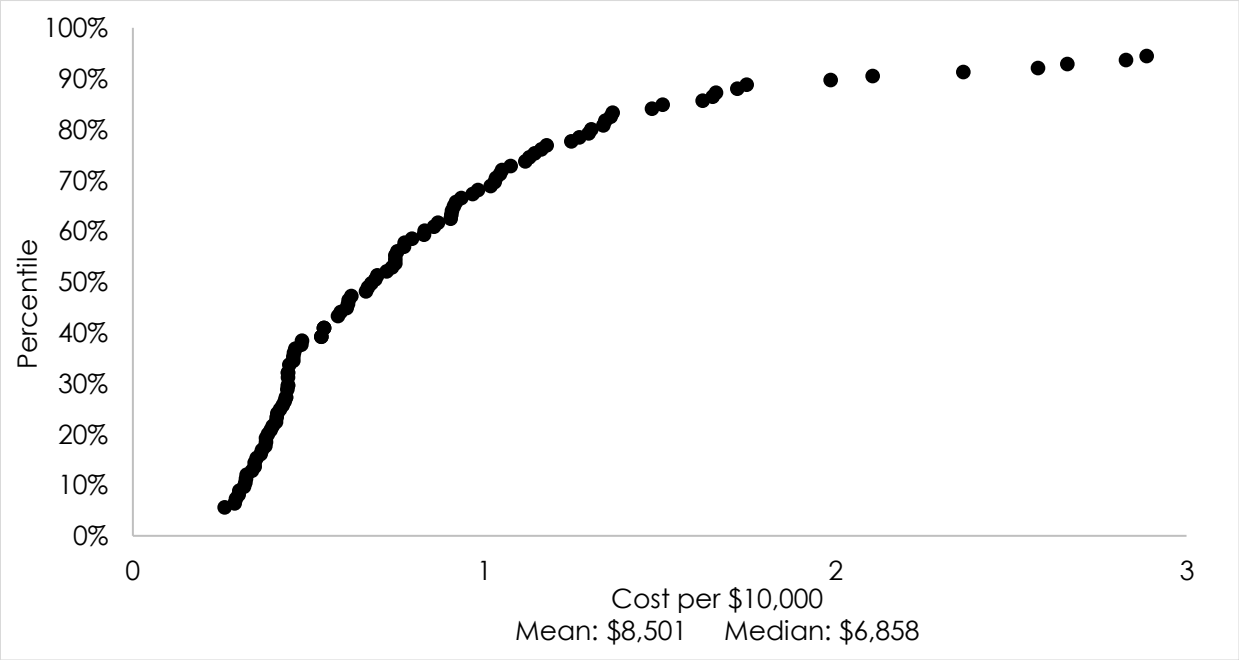


Figure 55: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with skin cancer (2013 dollars)

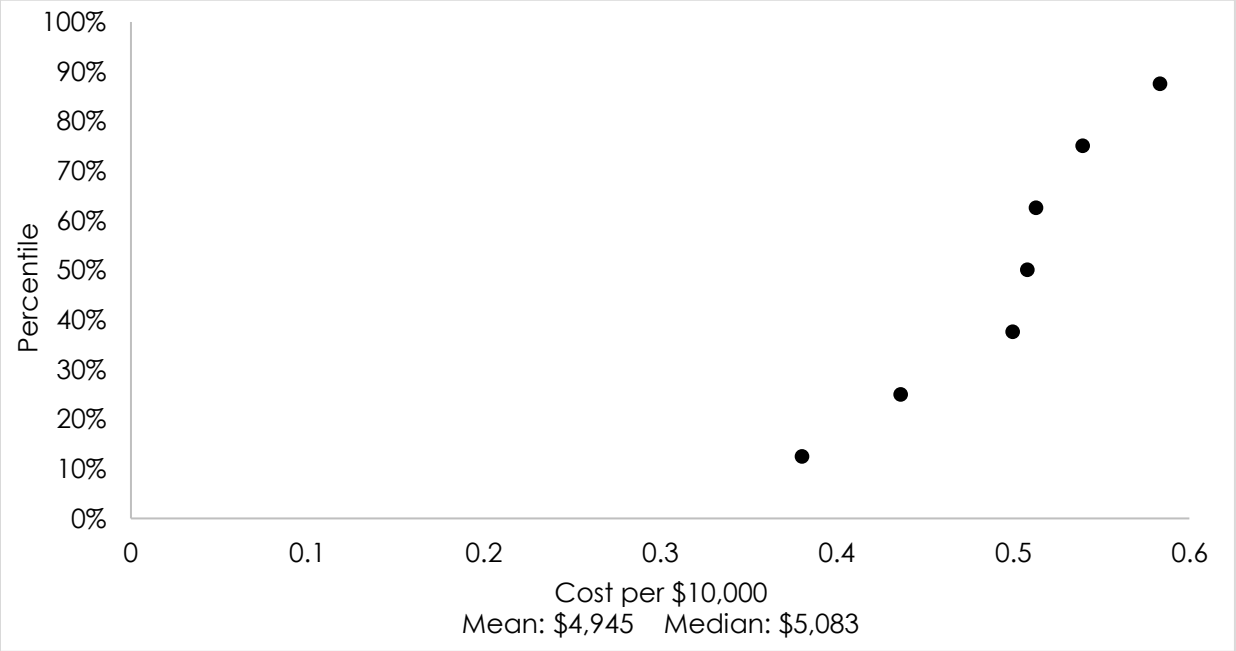


Figure 56: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with skin cancer (2013 dollars)

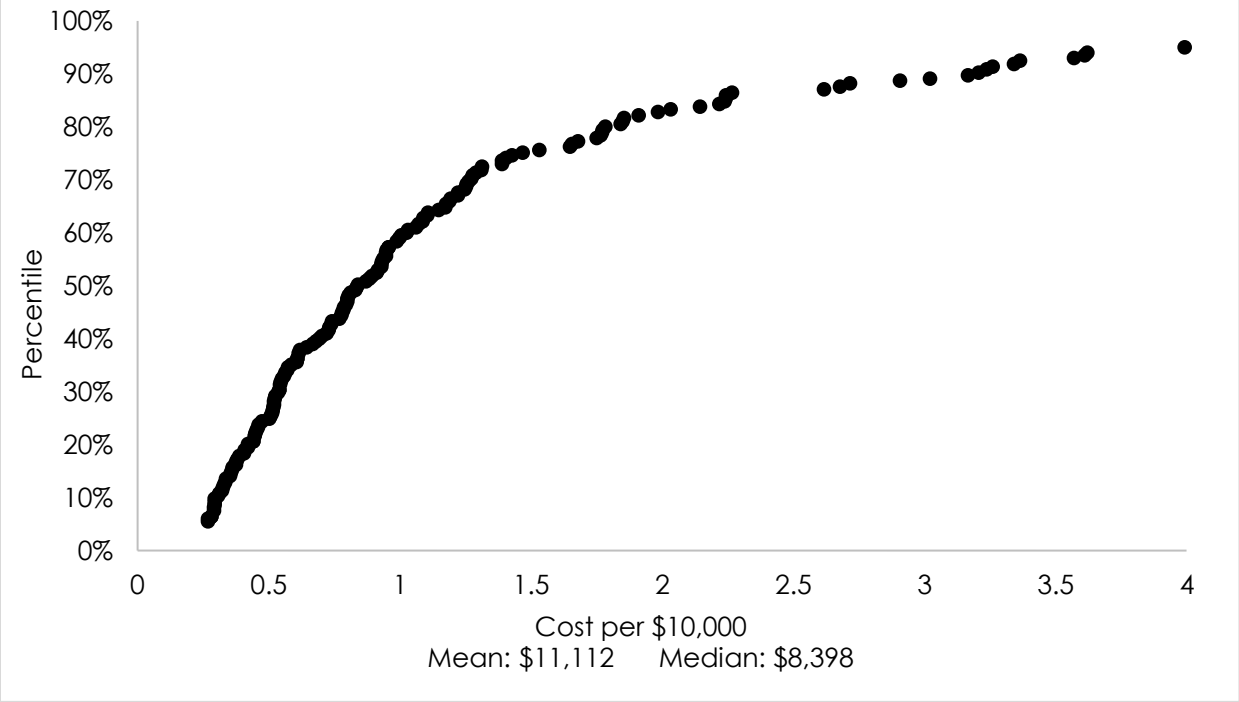


Figure 57: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with testicular cancer (2013 dollars)

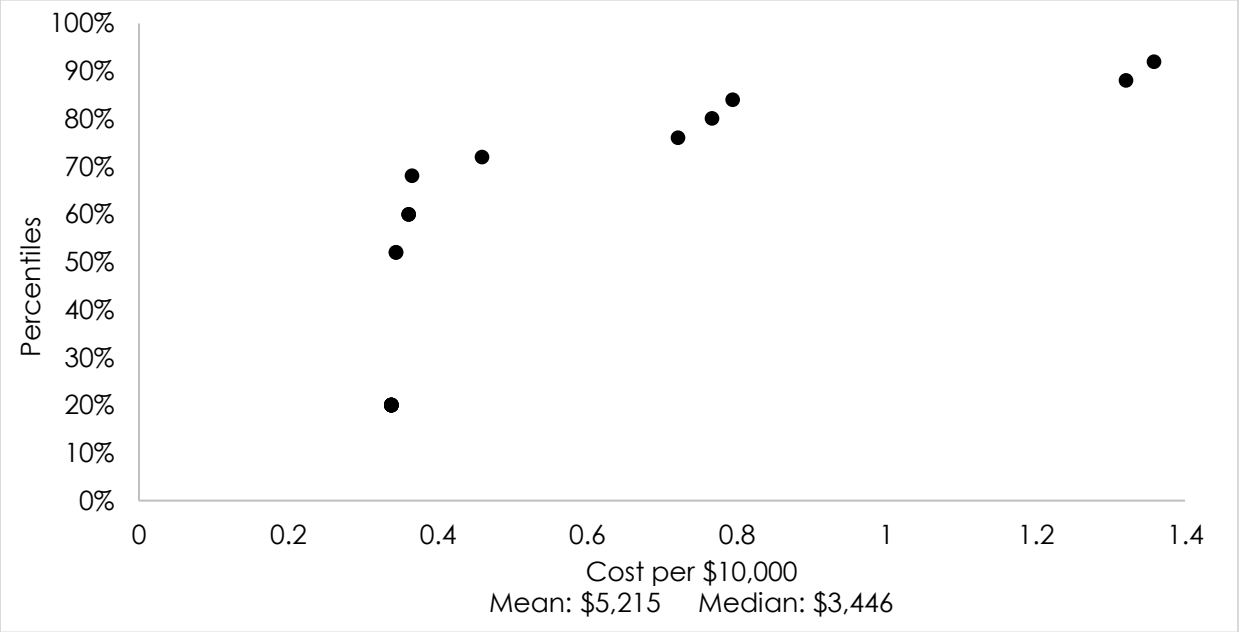
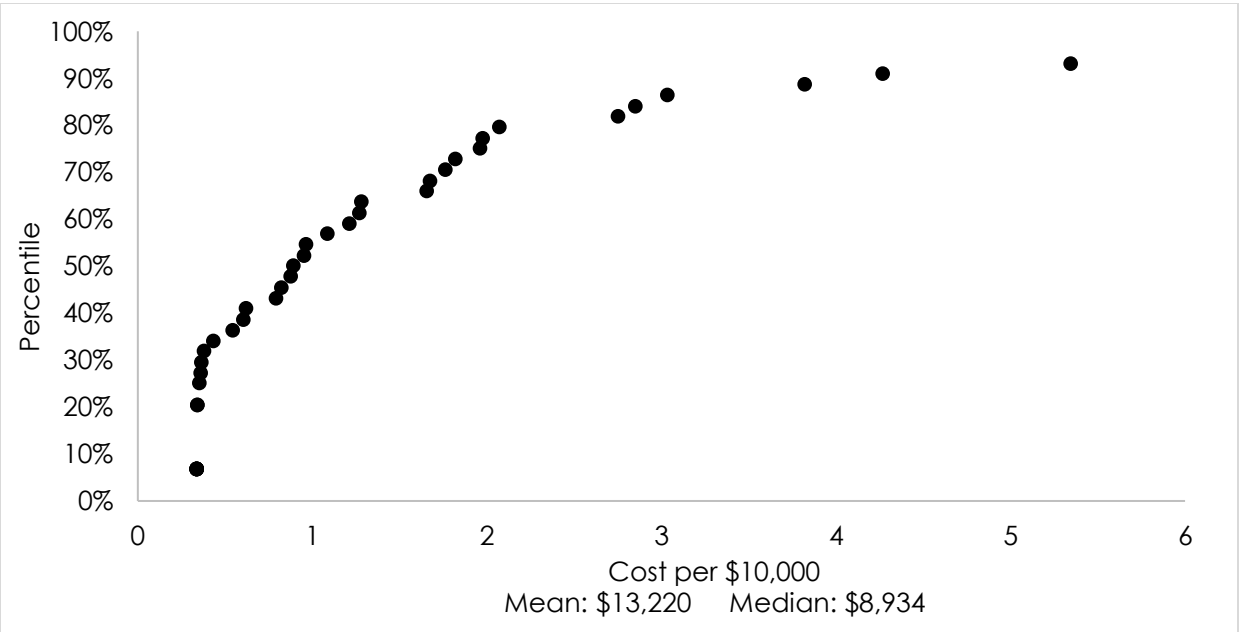
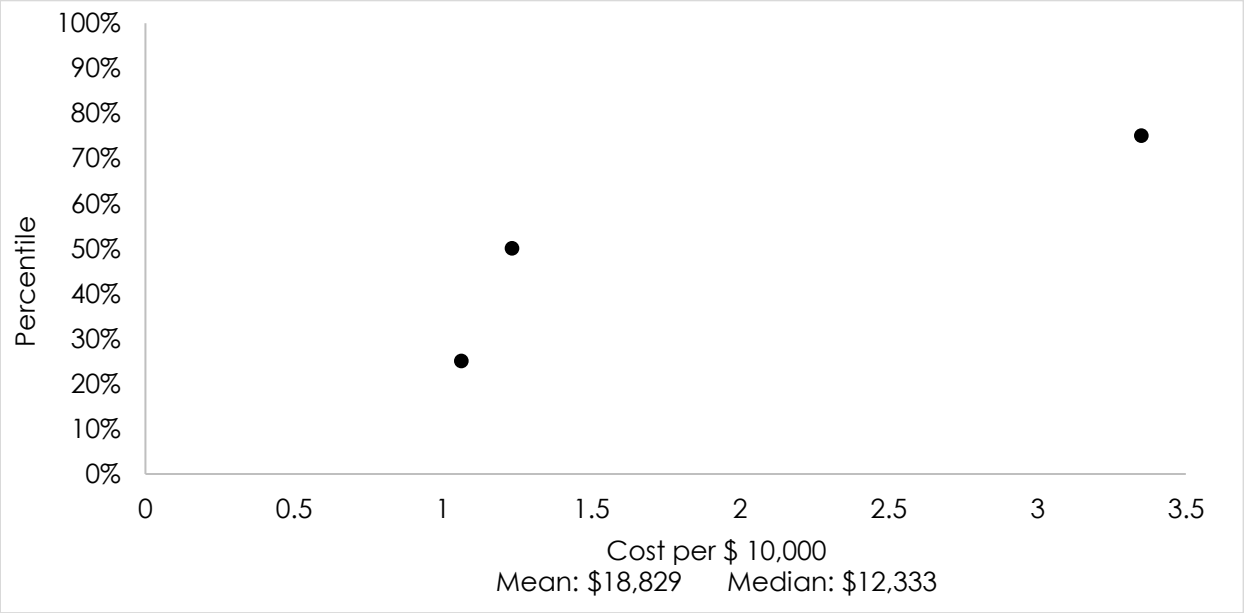


Figure 58: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with testicular cancer (2013 dollars)



* Testicular 18 months 65+ conservative estimates suppressed. No mean available

Figure 59: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with testicular cancer (2013 dollars)



Ureter cancer

Figure 60: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with ureter cancer (2013 dollars)

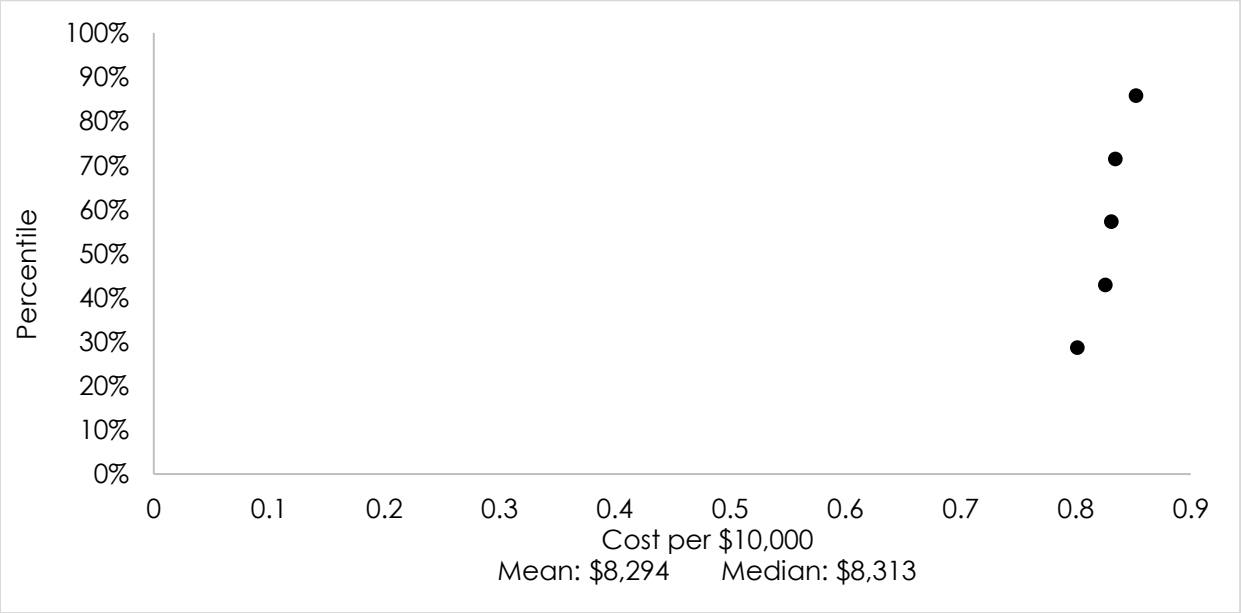


Figure 61: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with ureter cancer (2013 dollars)

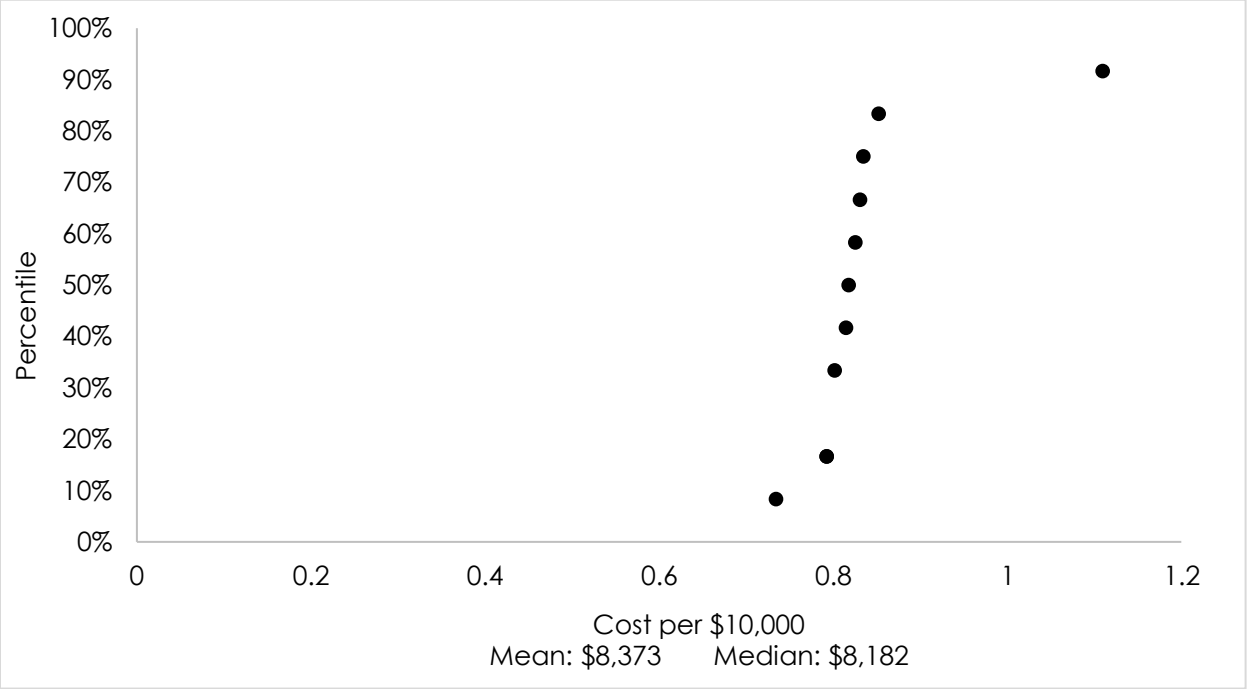


Figure 62: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with ureter cancer (2013 dollars)

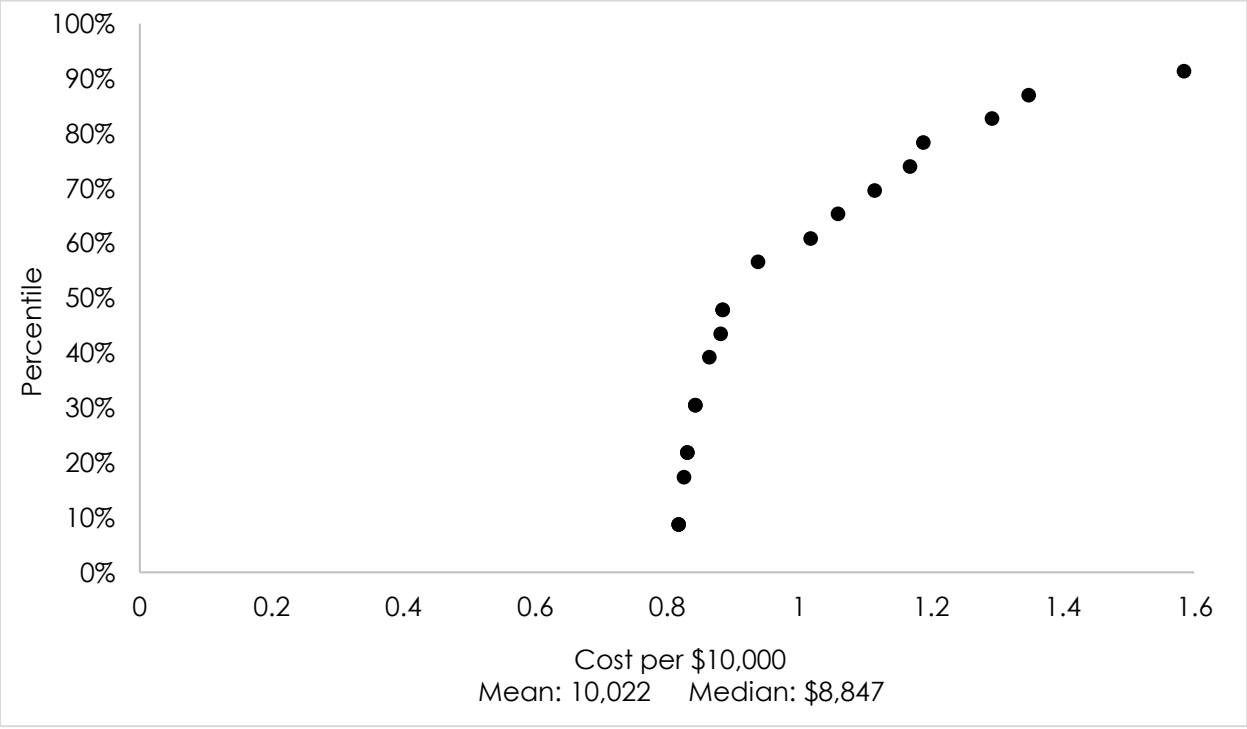
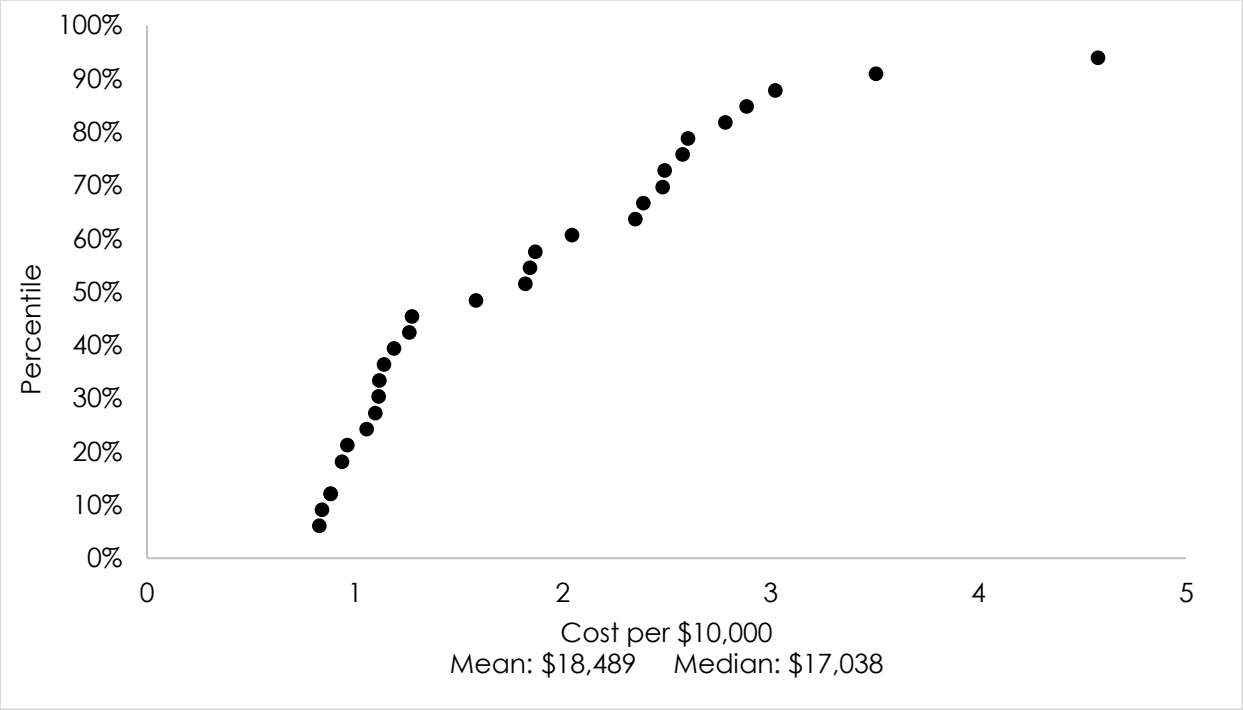


Figure 63: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years or more with ureter cancer (2013 dollars)



APPENDIX 3. 12-month trimmed graphs

Bladder cancer

Figure 64: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with bladder cancer (2013 dollars)

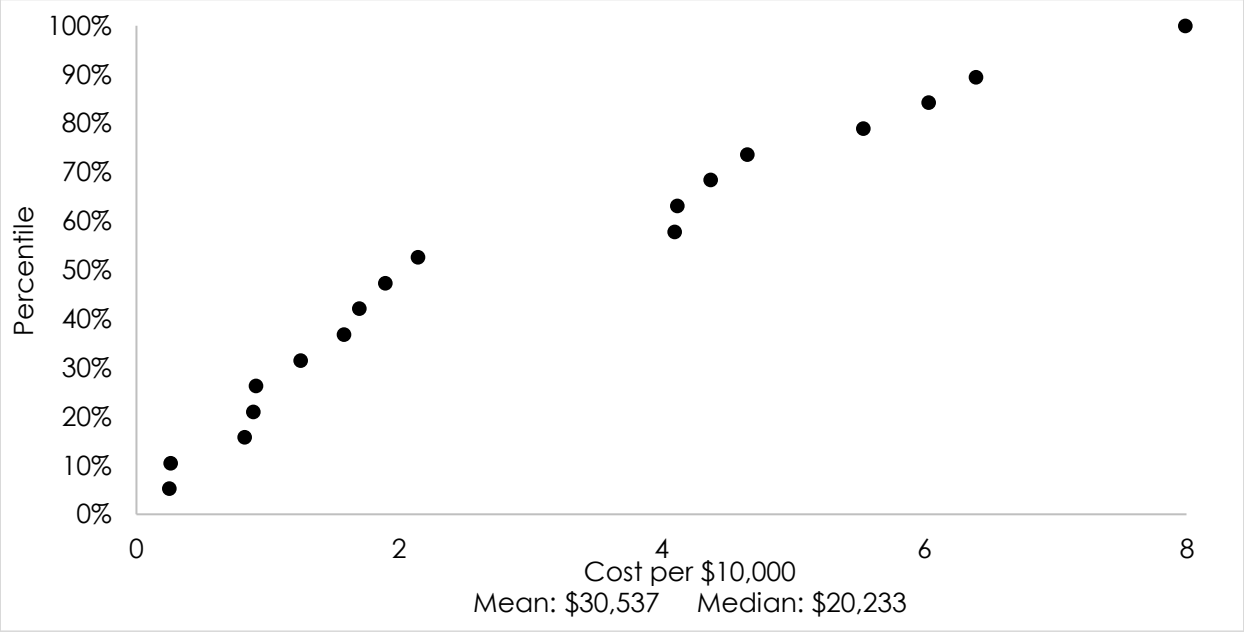


Figure 65: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18-64 years with bladder cancer (2013 dollars)

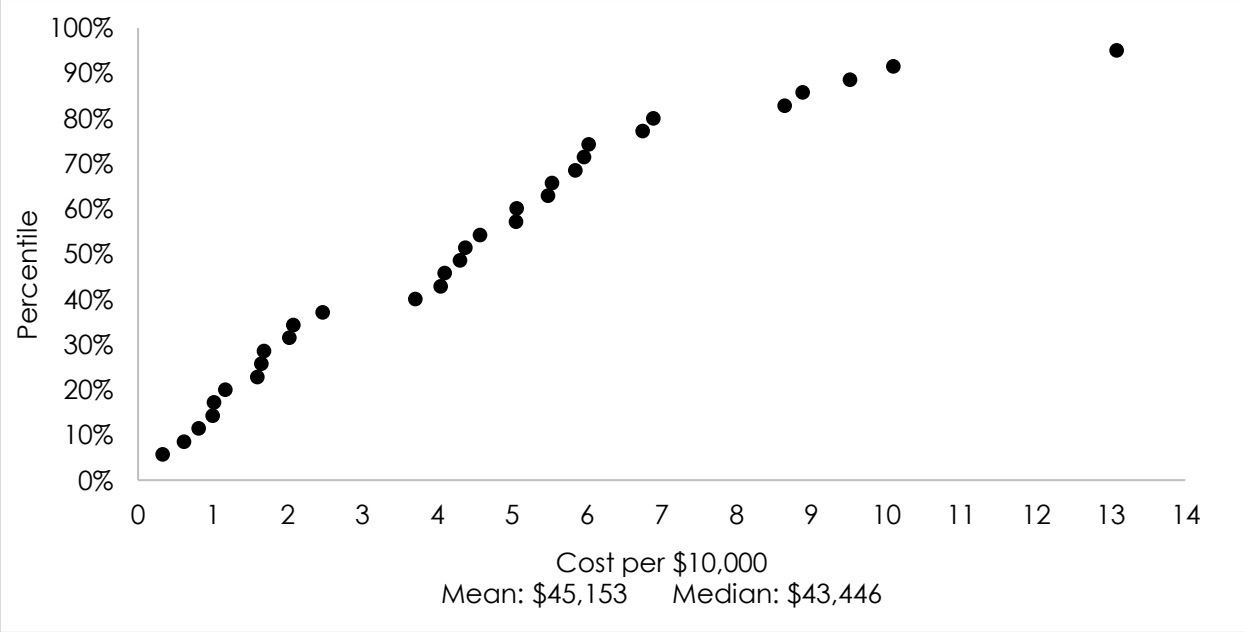


Figure 66: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with bladder cancer (2013 dollars)

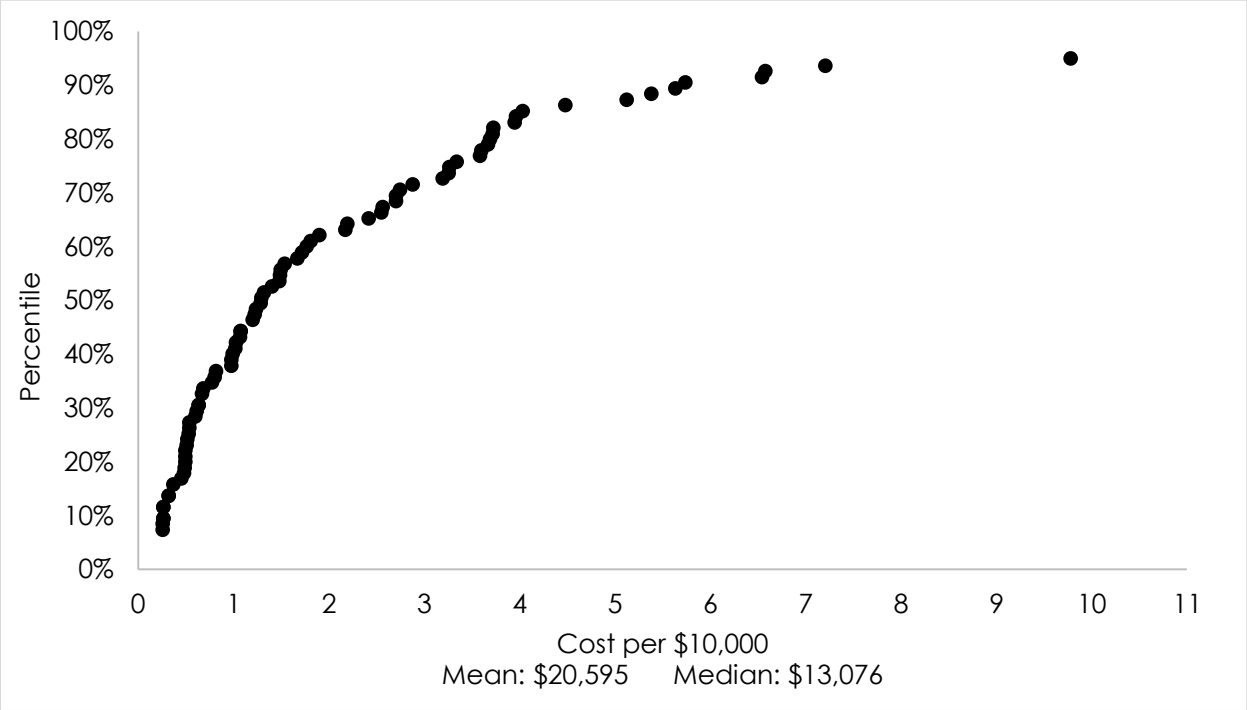


Figure 67: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with bladder cancer (2013 dollars)

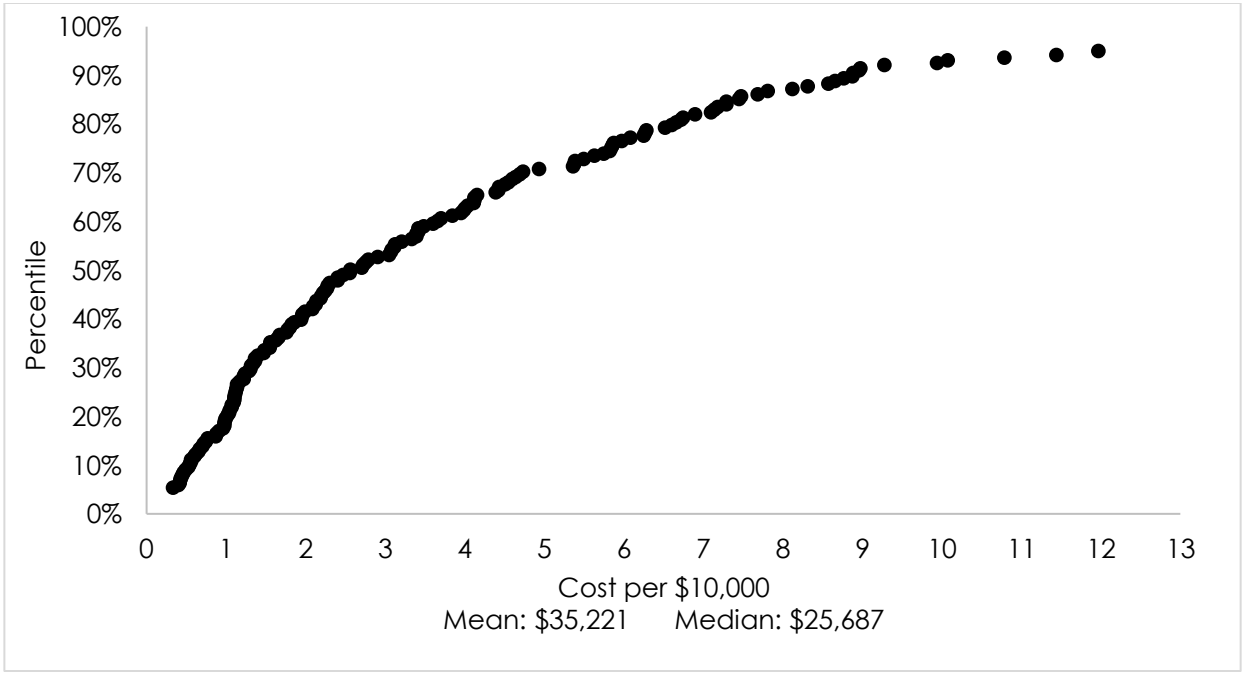


Figure 68: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with brain cancer (2013 dollars)

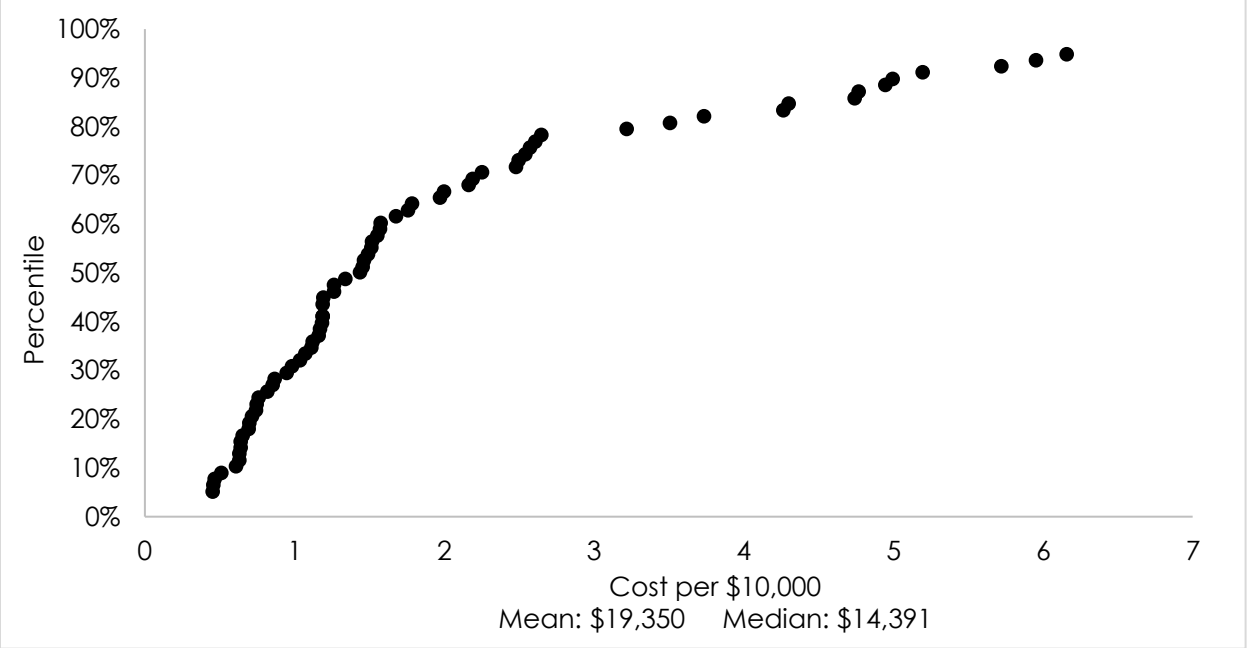


Figure 69: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with brain cancer (2013 dollars)

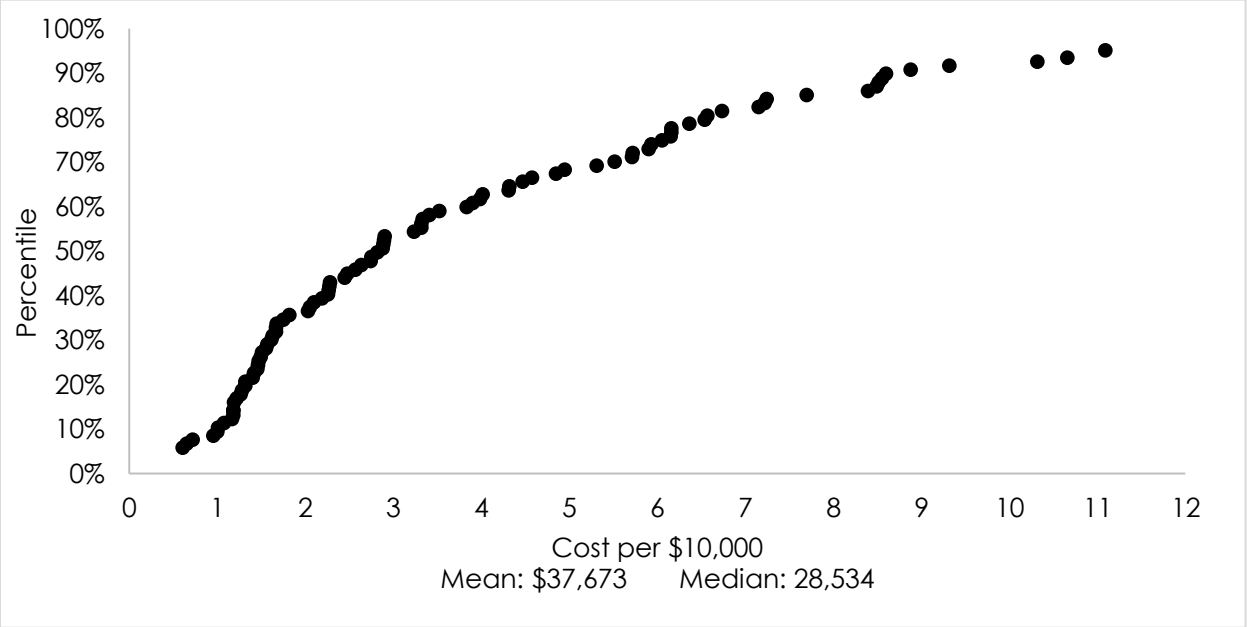


Figure 70: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with brain cancer (2013 dollars)

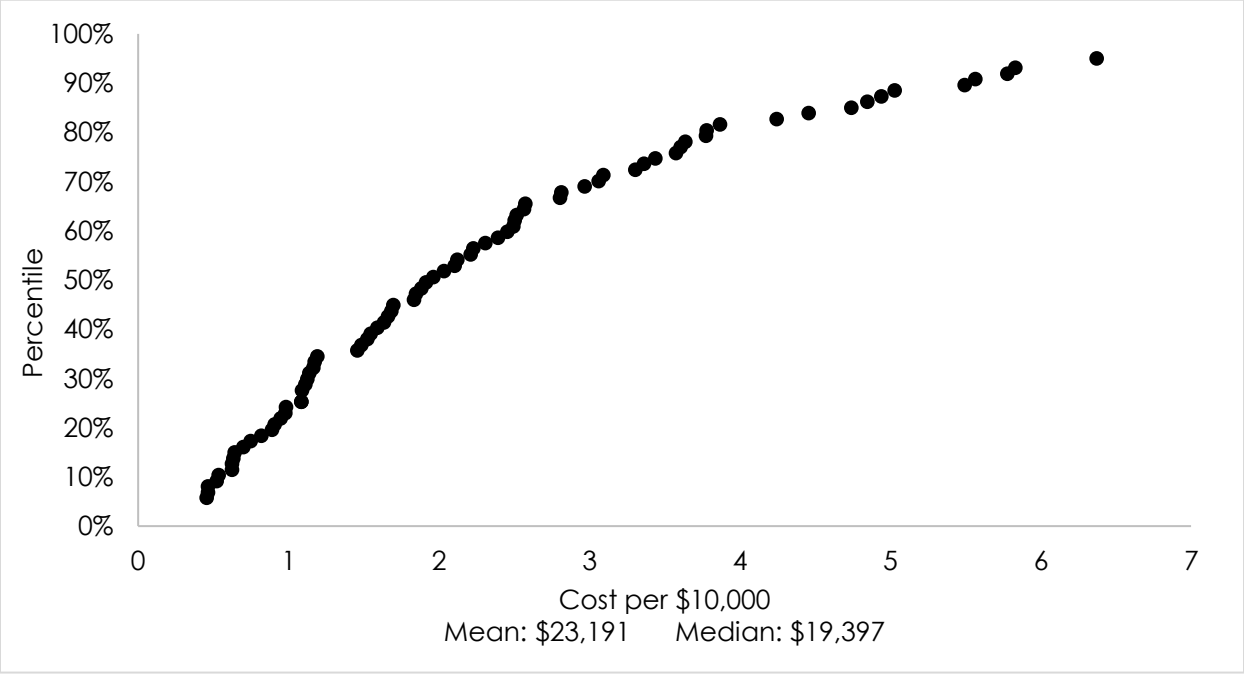


Figure 71: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with brain cancer (2013 dollars)

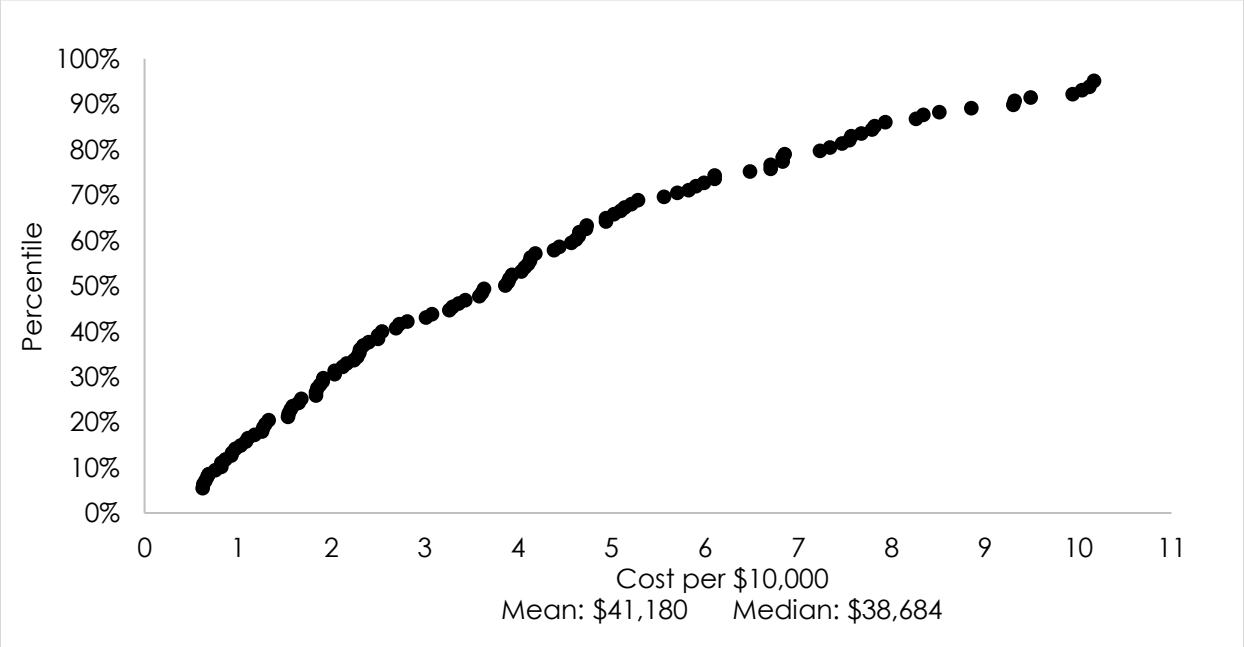


Figure 72: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with breast cancer (2013 dollars)

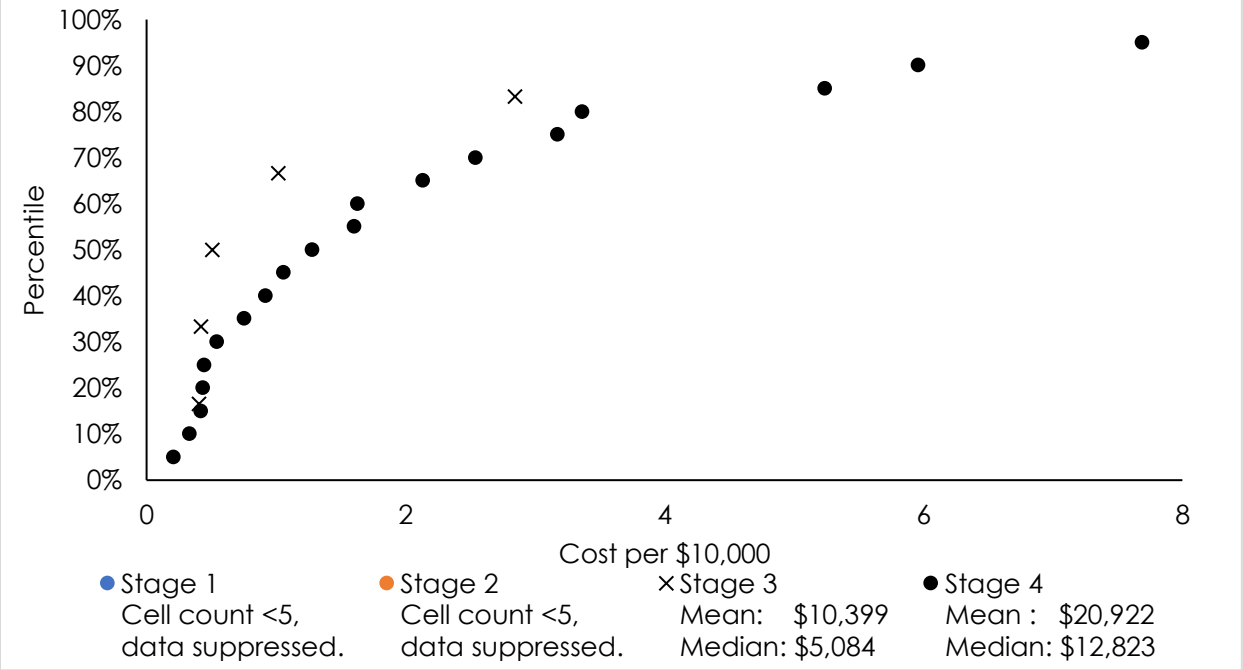


Figure 73: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with breast cancer (2013 dollars)

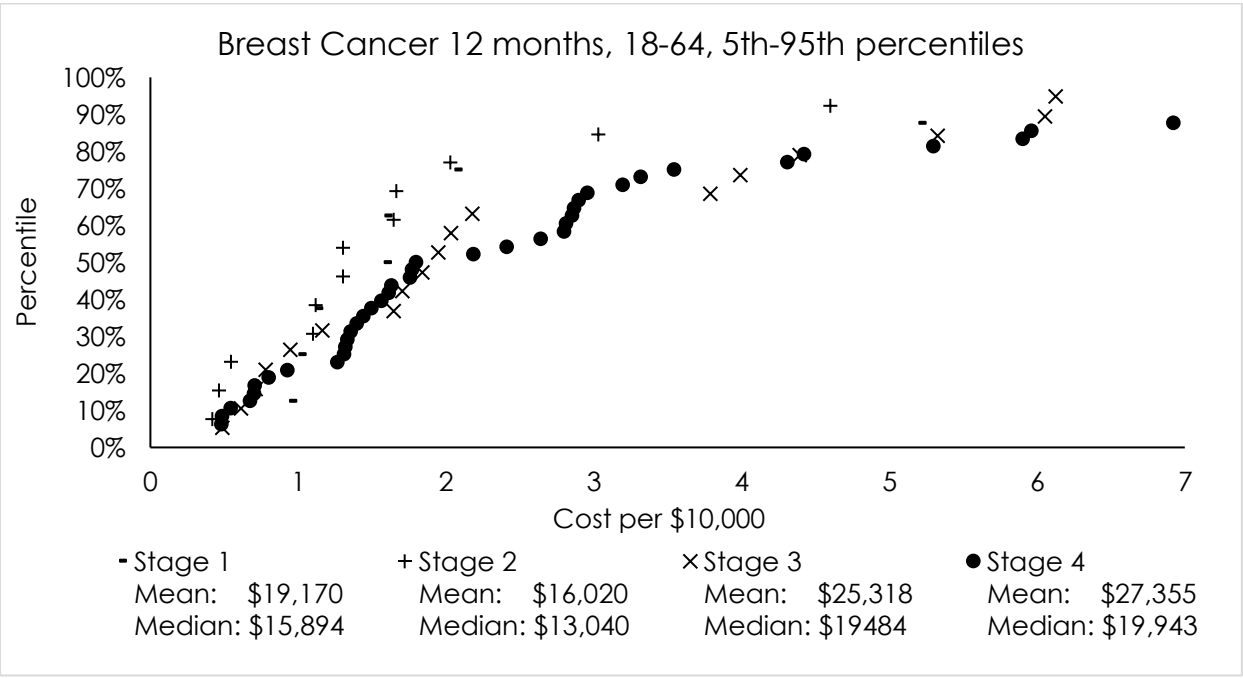


Figure 74: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with breast cancer (2013 dollars)

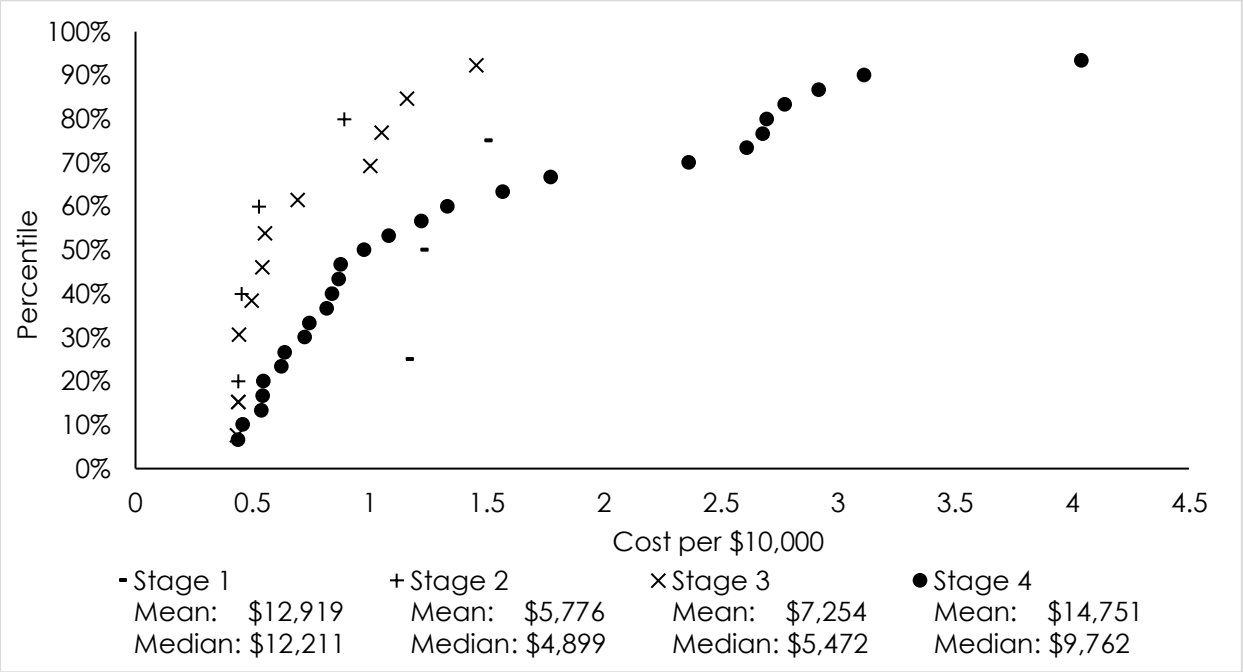


Figure 75: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with breast cancer (2013) dollars

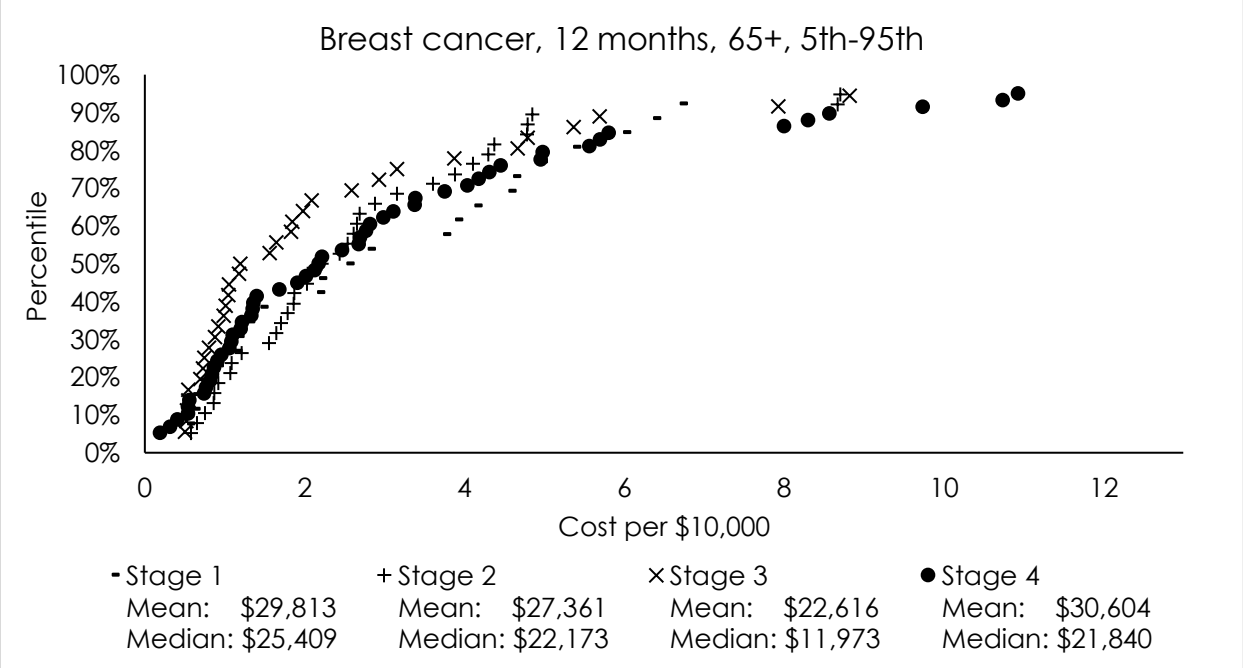


Figure 76: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with colon cancer (2013 dollars)

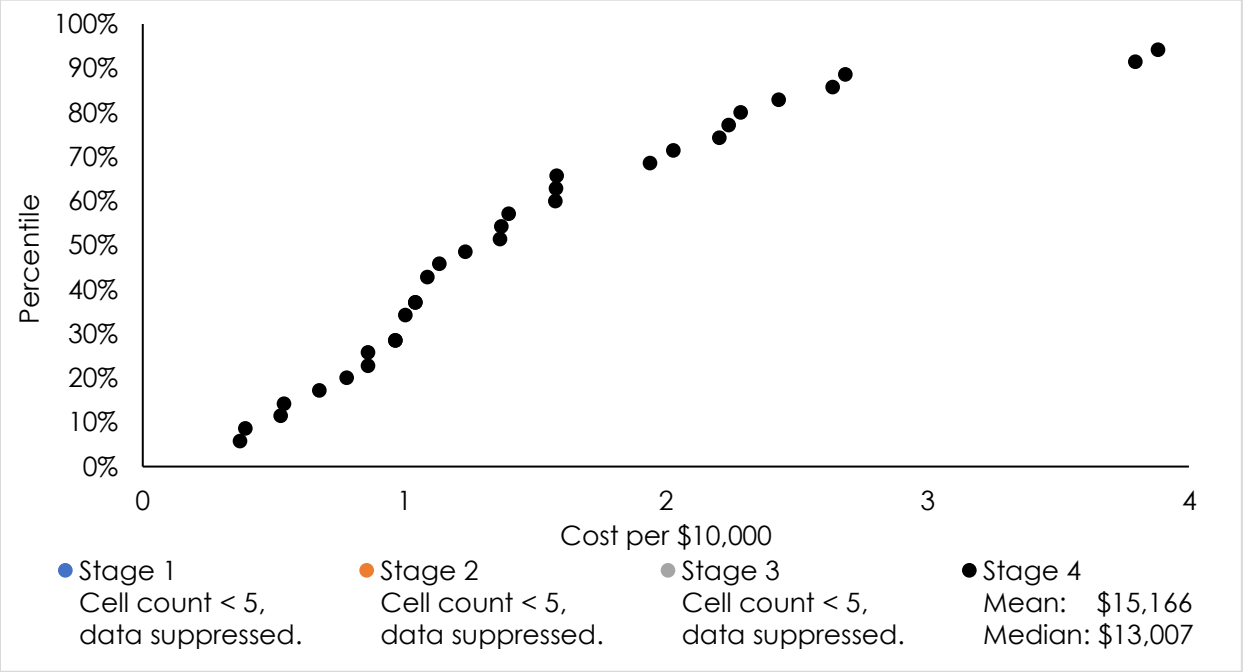


Figure 77: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with colon cancer (2013 dollars)

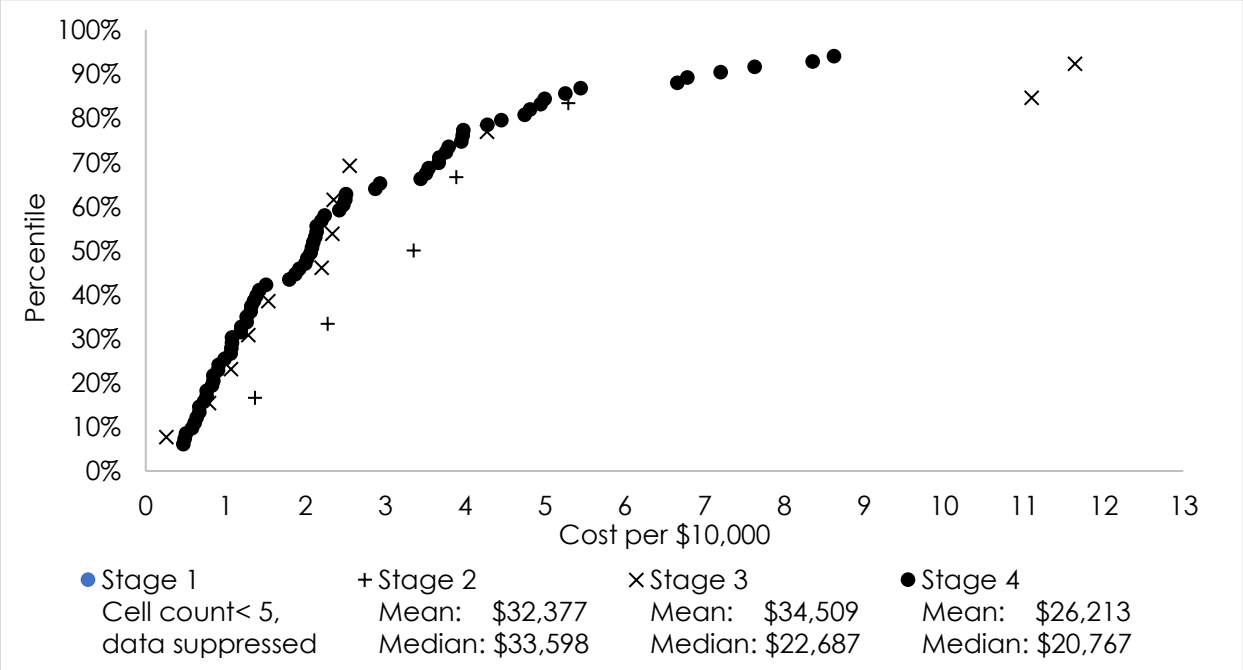


Figure 78: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with colon cancer (2013 dollars)

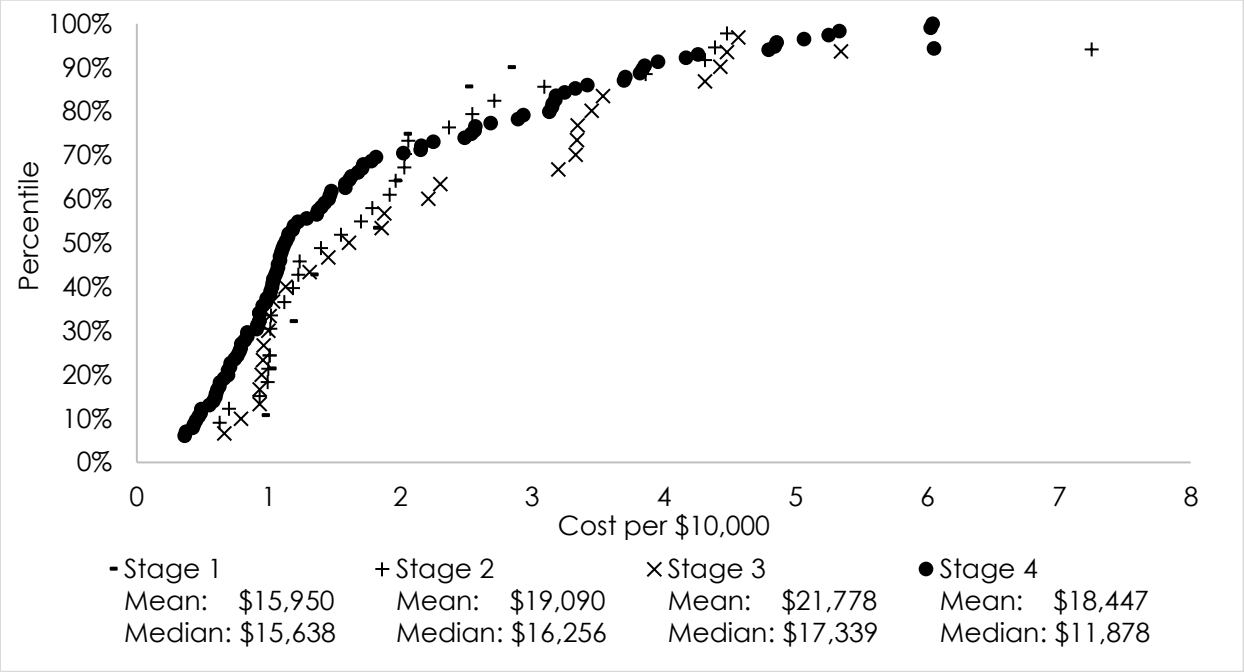


Figure 79: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with colon cancer (2013 dollars)

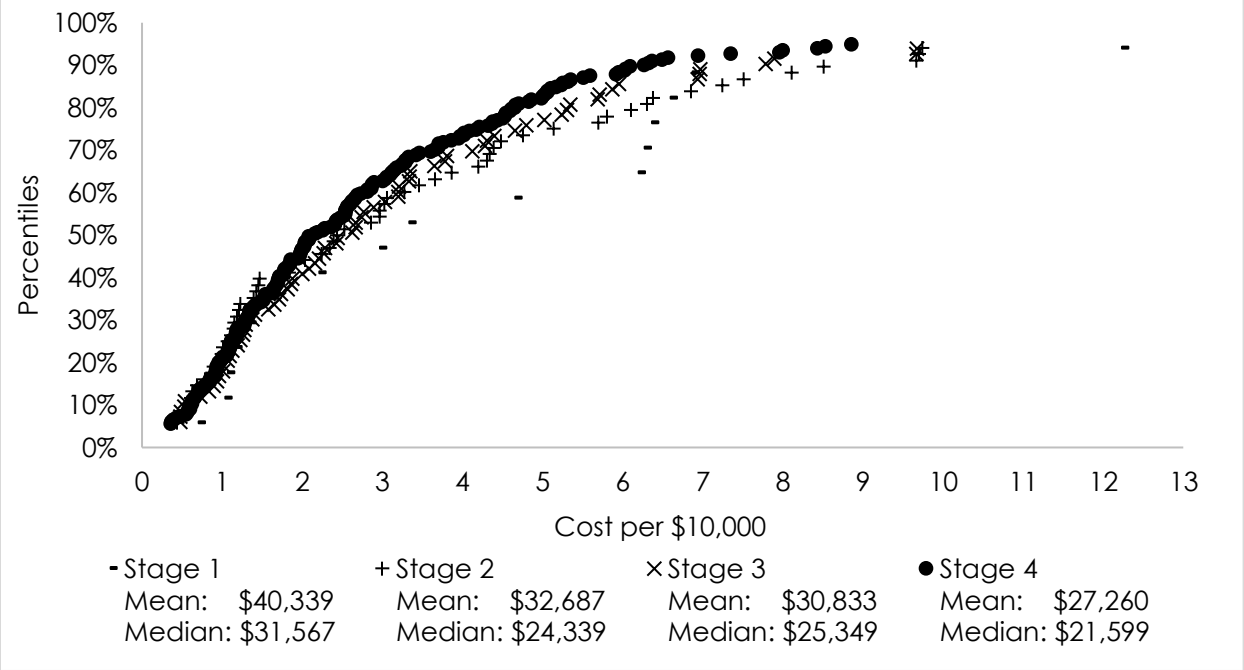


Figure 80: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with kidney cancer (2013 dollars)

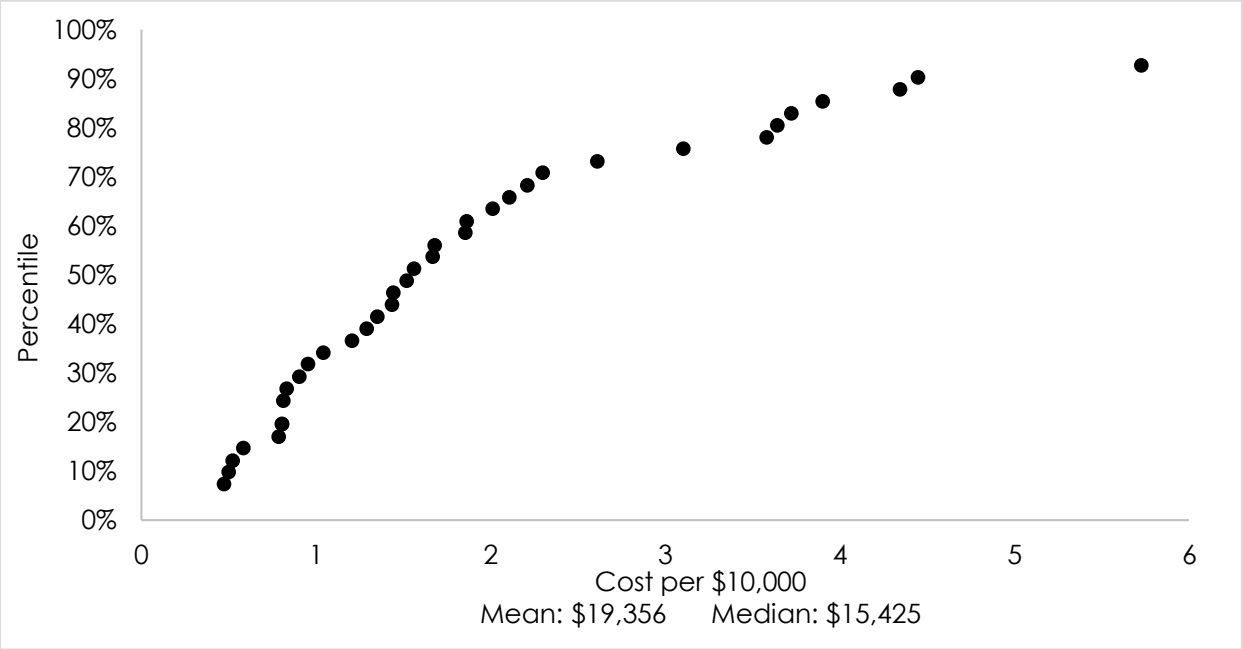


Figure 81: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with kidney cancer (2013 dollars)

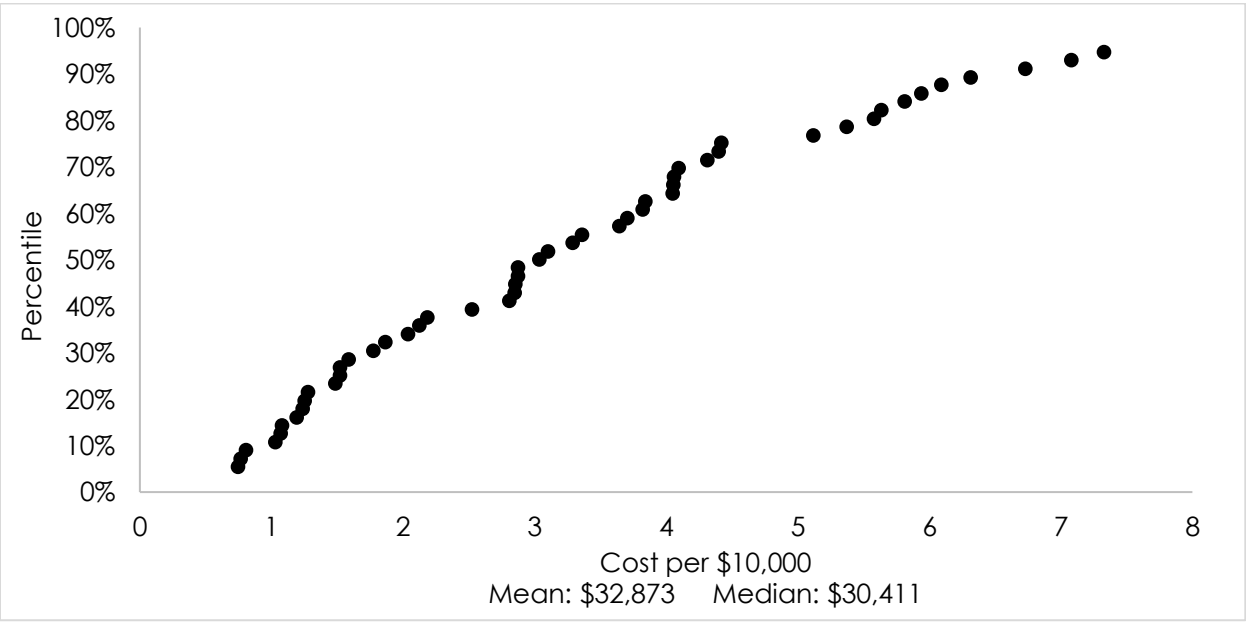


Figure 82: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with kidney cancer (2013 dollars)

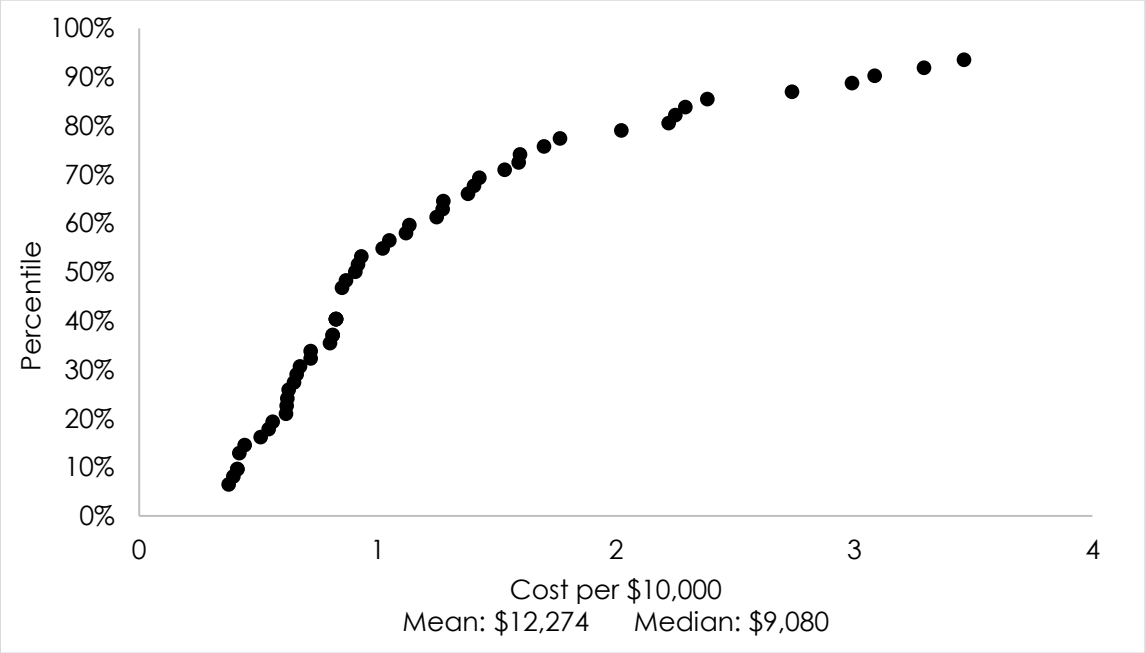


Figure 83: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with kidney cancer (2013 dollars)

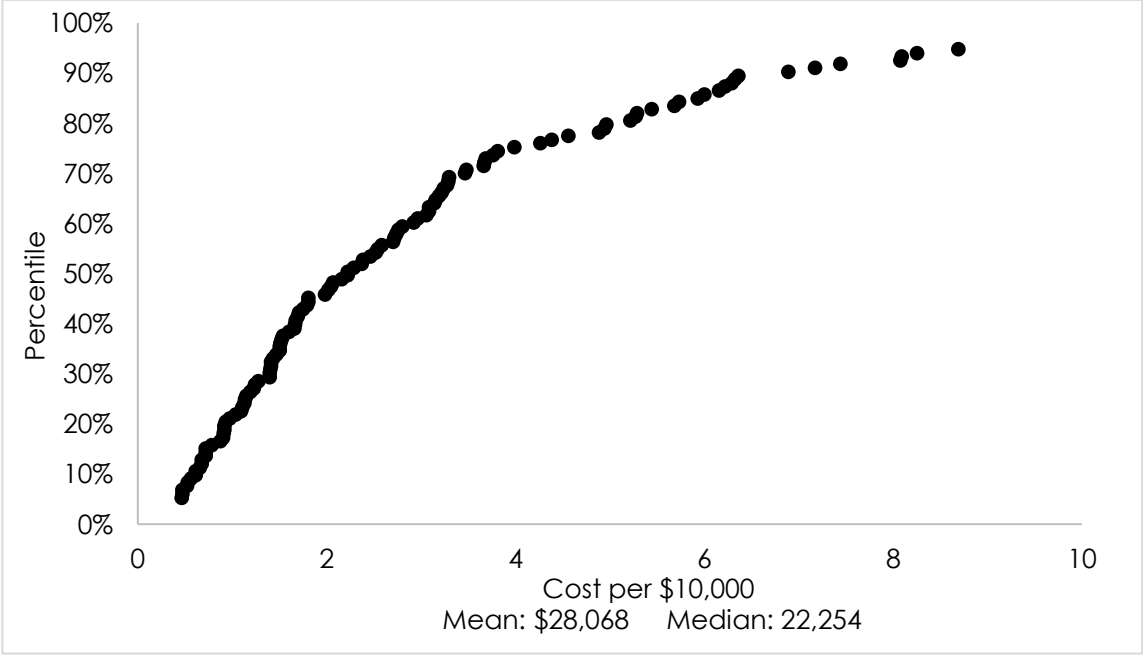


Figure 84: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with leukemia (2013 dollars)

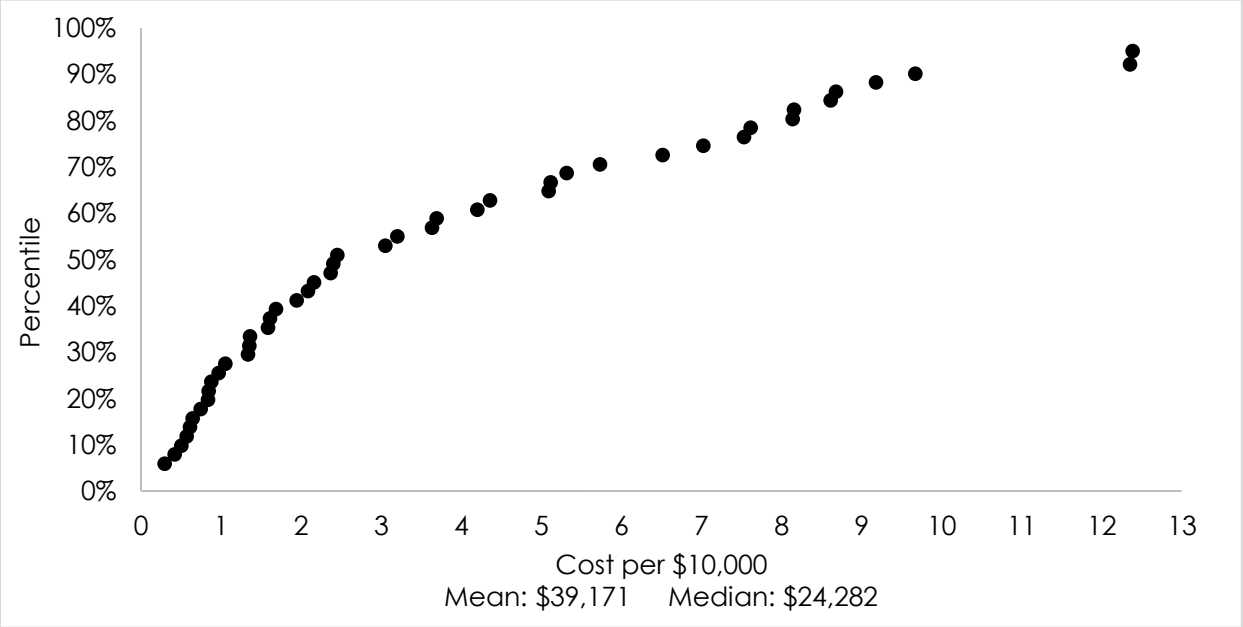


Figure 85: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with leukemia (2013 dollars)

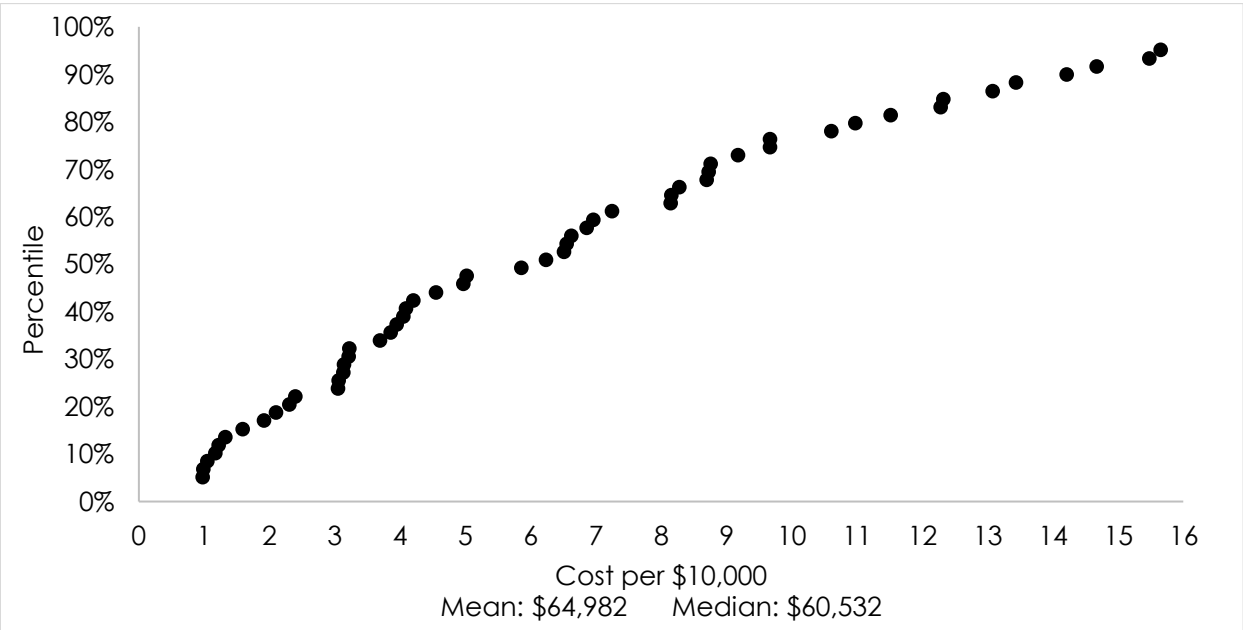


Figure 86: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with leukemia (2013 dollars)

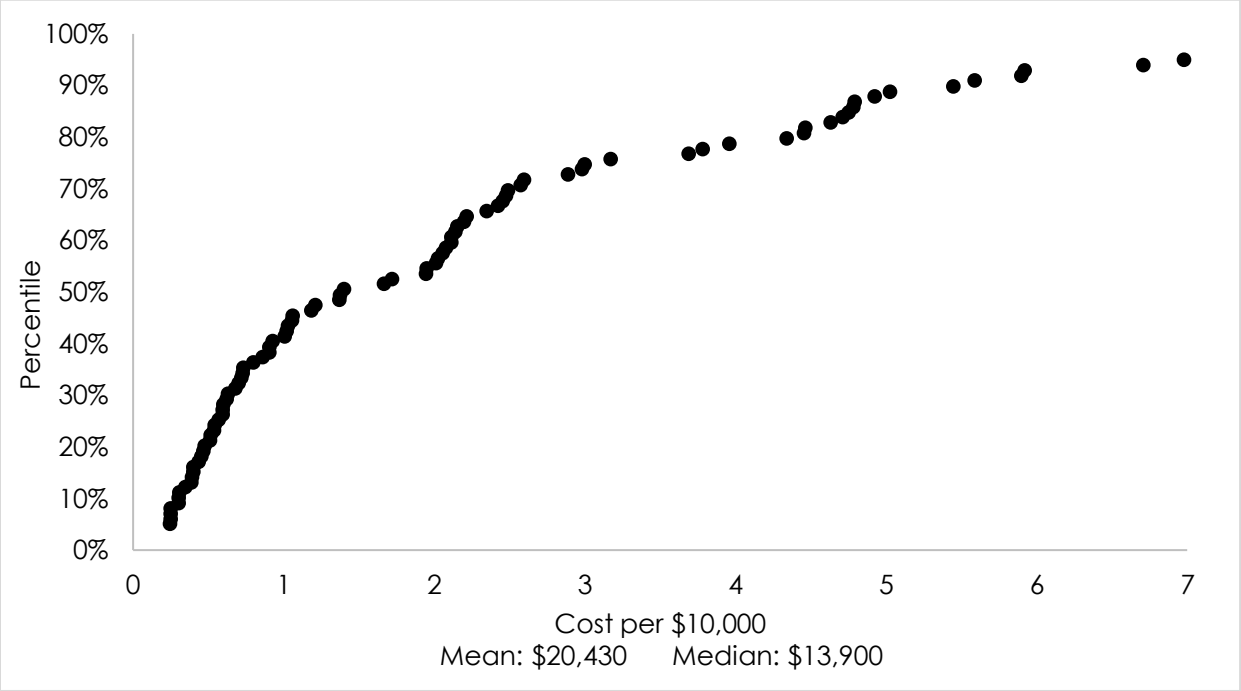


Figure 87: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with leukemia (2013 dollars)

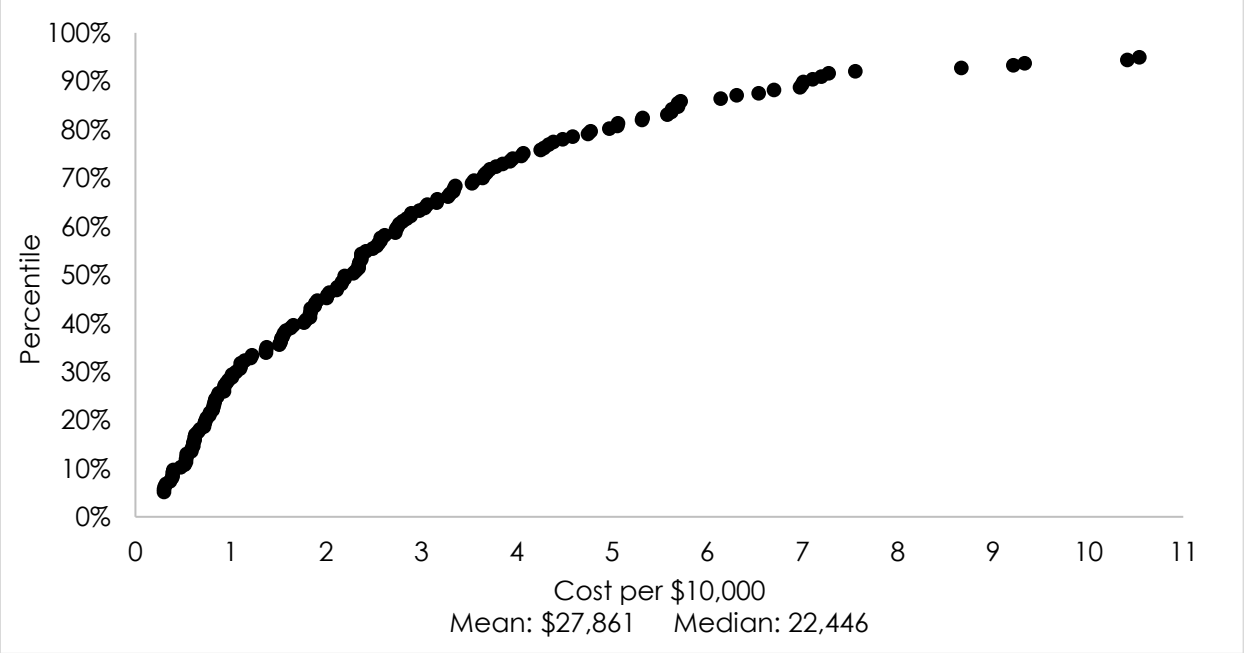


Figure 88: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with lung cancer (2013 dollars)

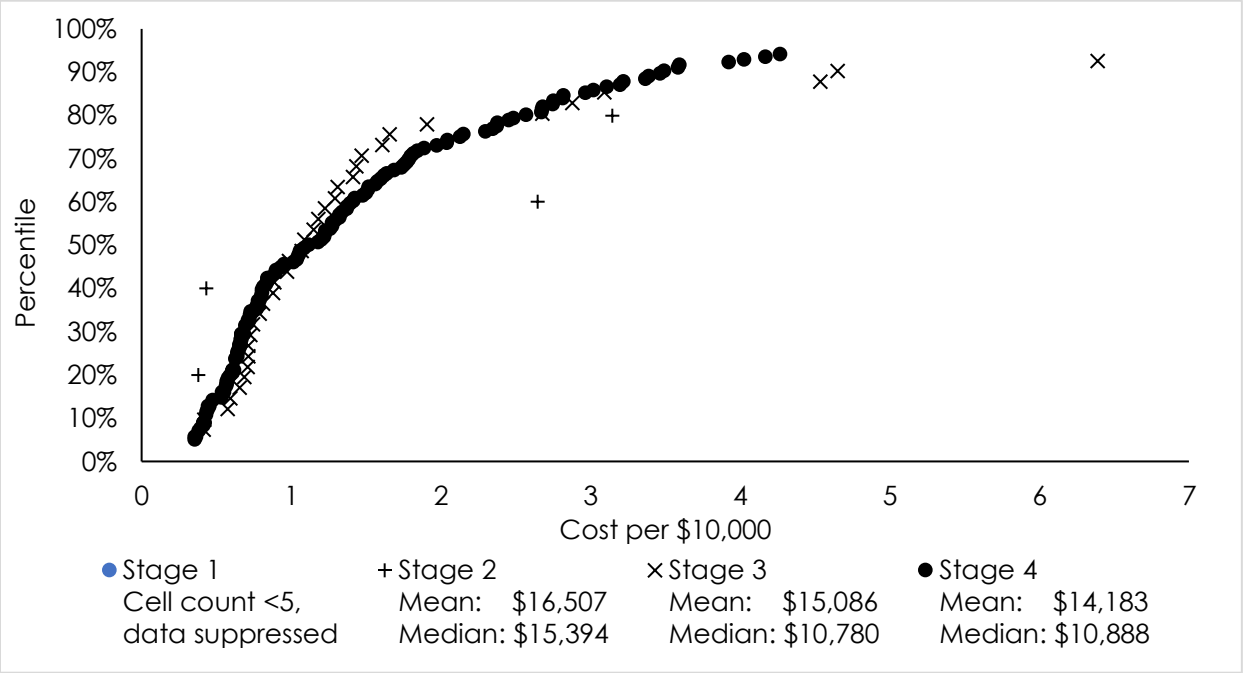


Figure 89: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with lung cancer (2013 dollars)

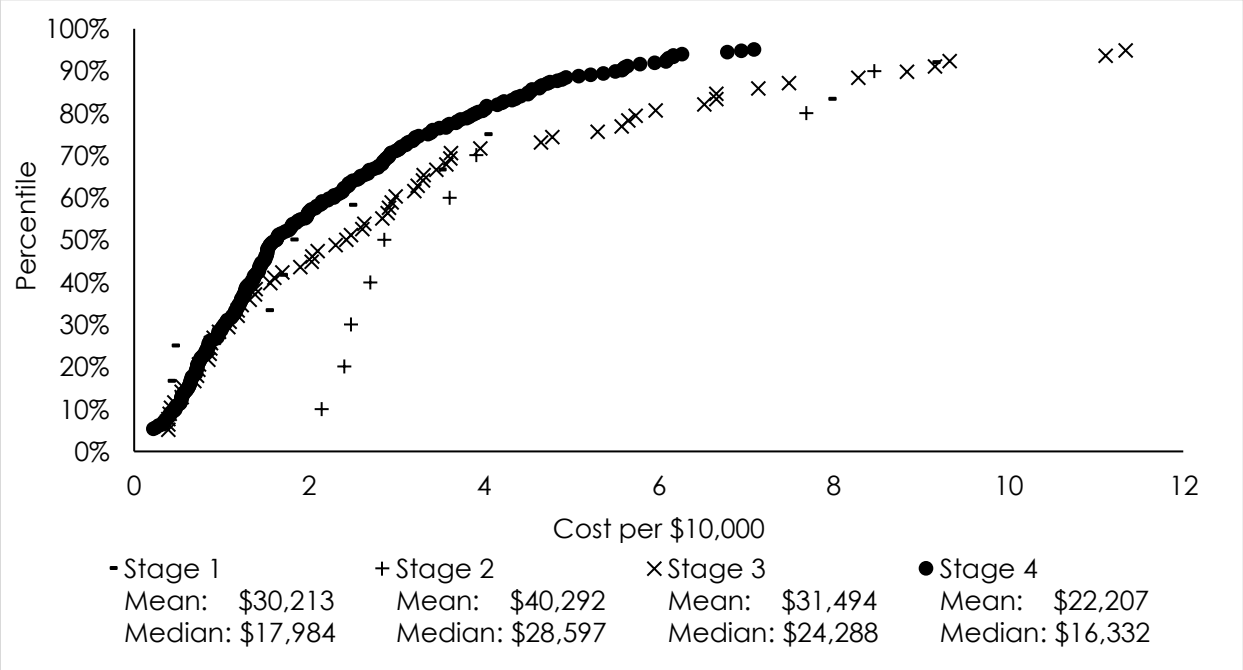


Figure 90: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with lung cancer (2013 dollars)

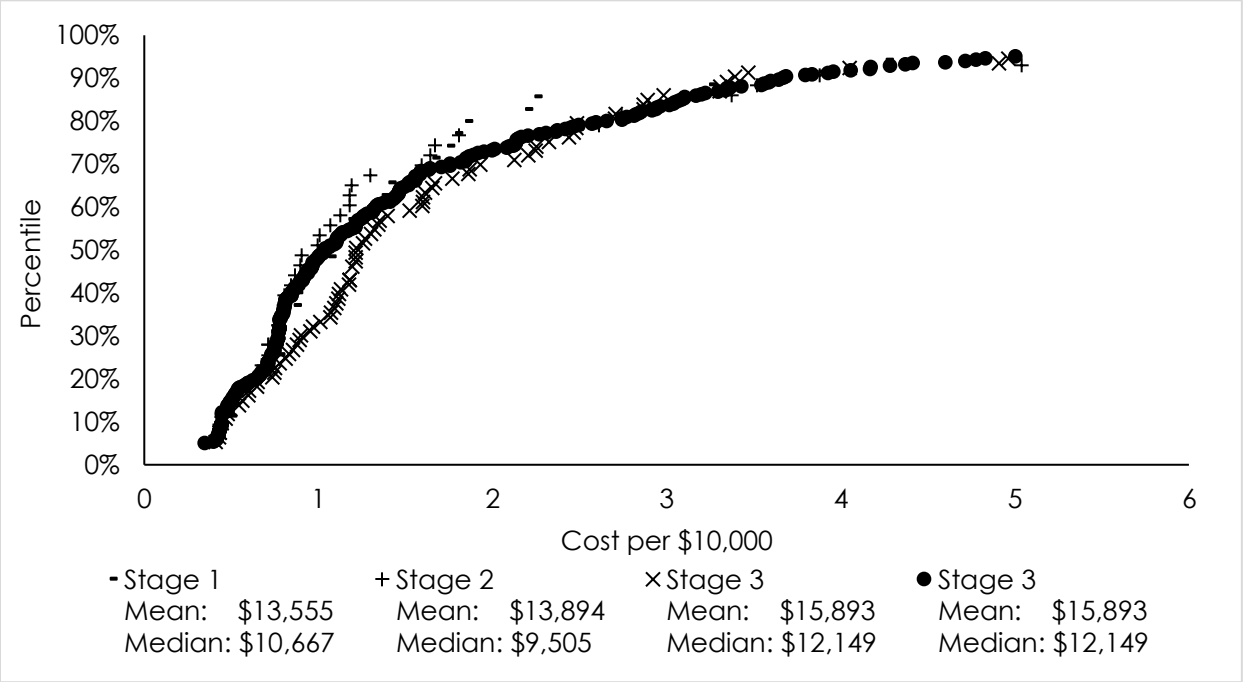
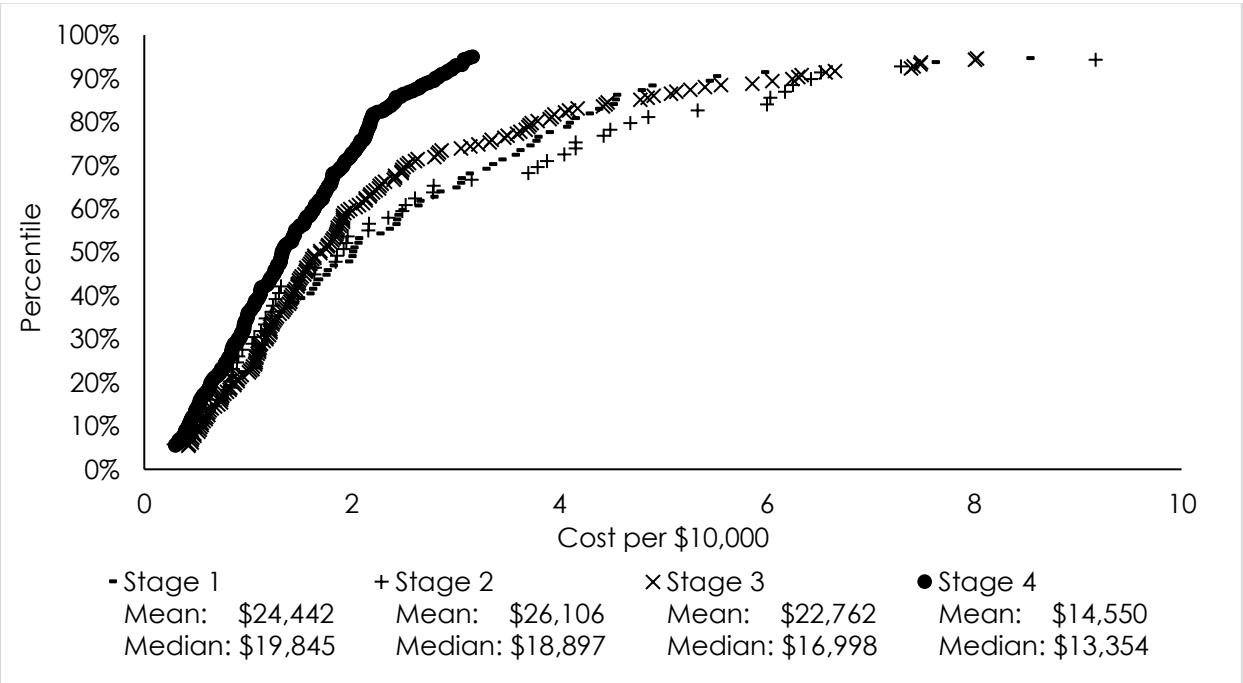


Figure 91: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with lung cancer (2013 dollars)



Myeloma

Figure 92: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with myeloma (2013 dollars)

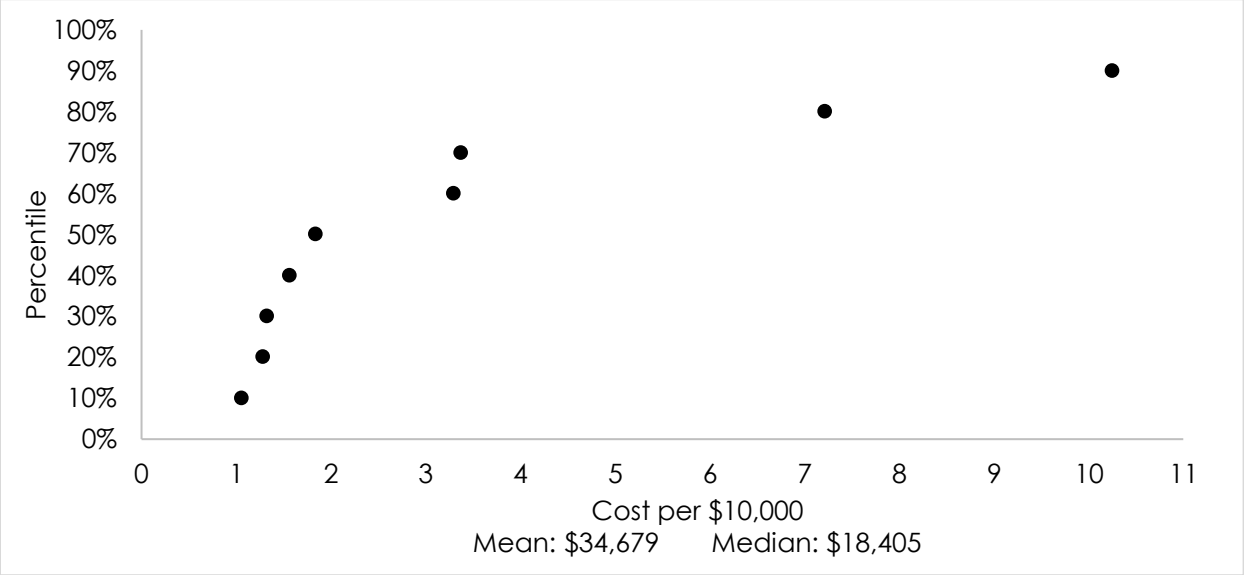


Figure 93: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with colon cancer (2013 dollars)

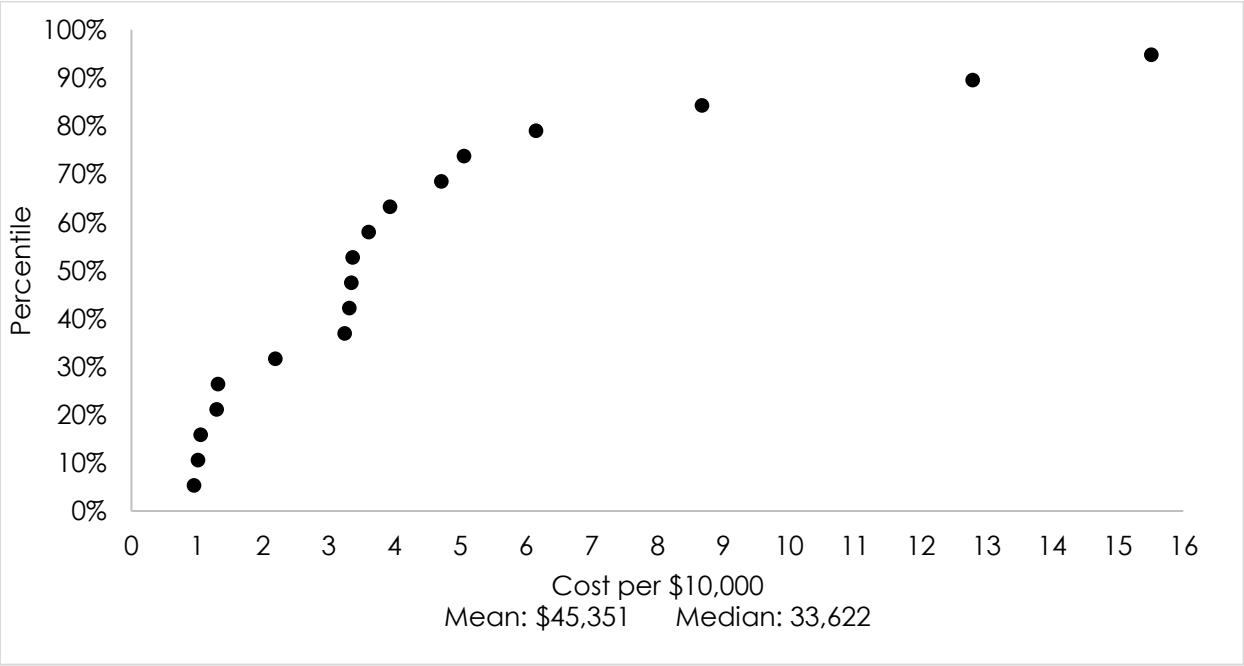


Figure 94: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with myeloma (2013 dollars)

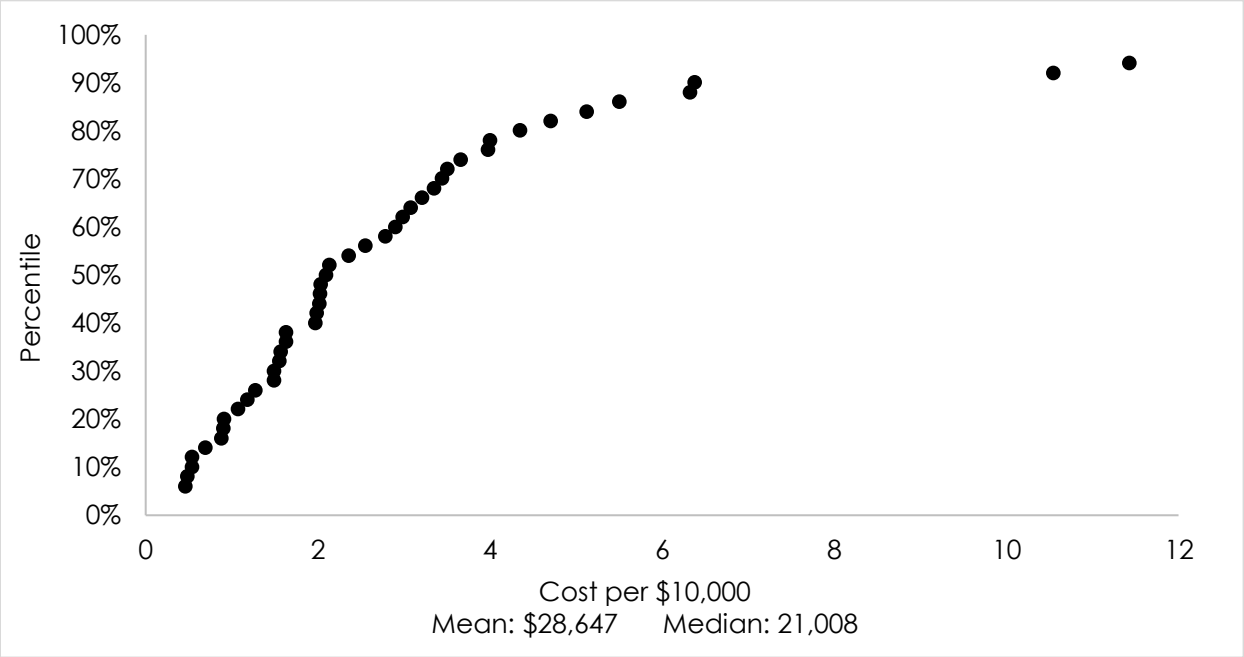


Figure 95: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with colon cancer (2013 dollars)

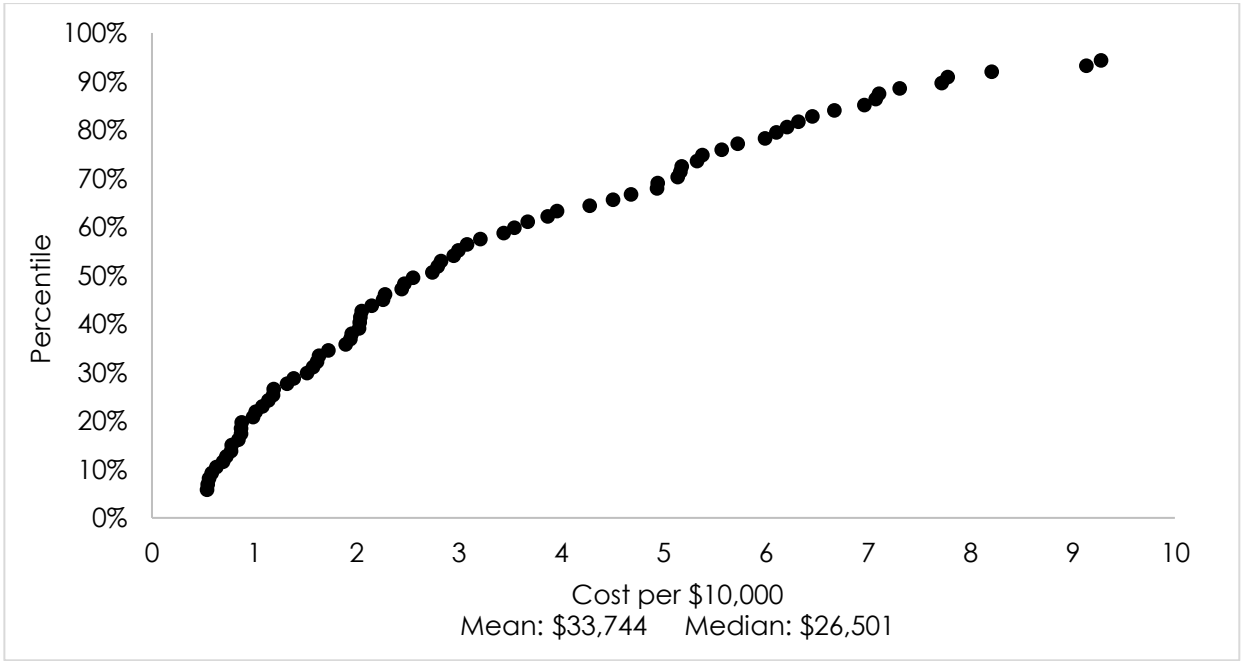


Figure 96: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with non-Hodgkin's lymphoma (2013 dollars)

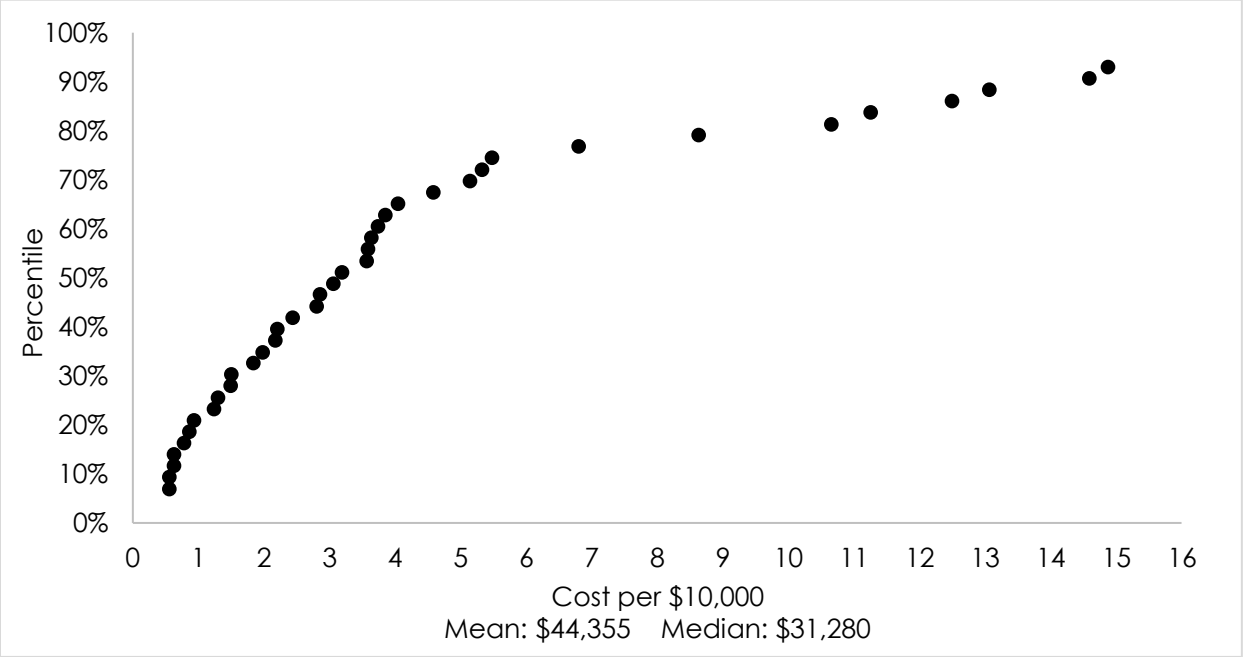


Figure 97: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years non-Hodgkin's lymphoma (2013 dollars)

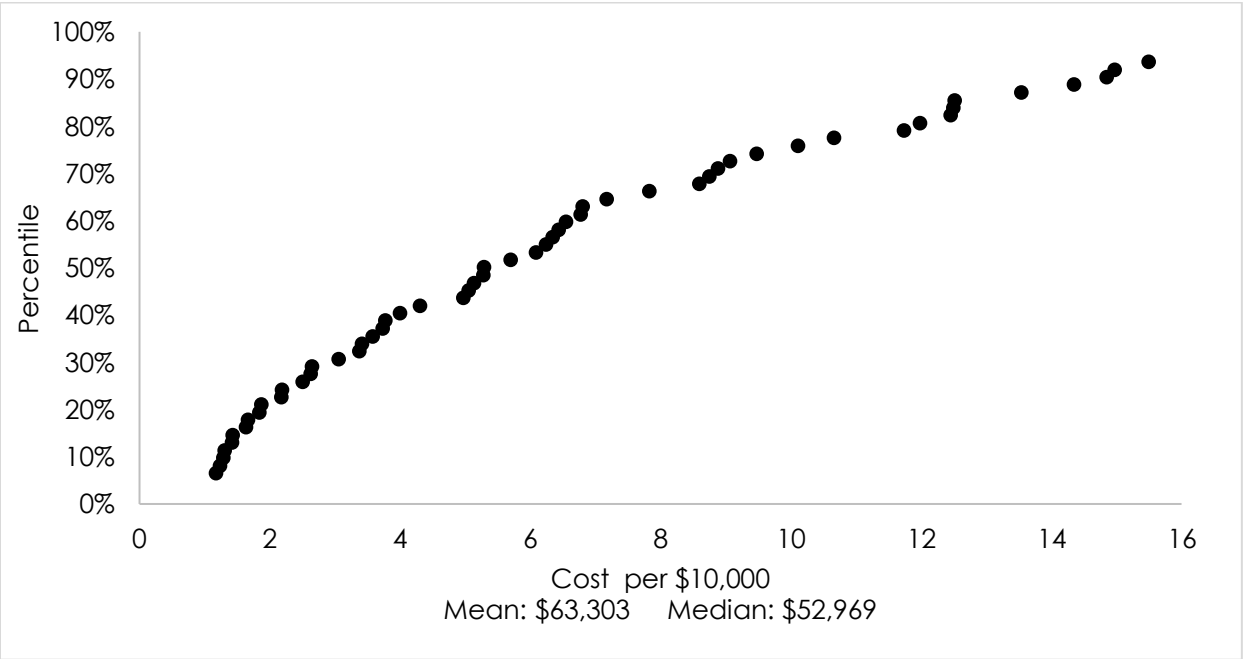


Figure 98: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with non-Hodgkin's lymphoma (2013 dollars)

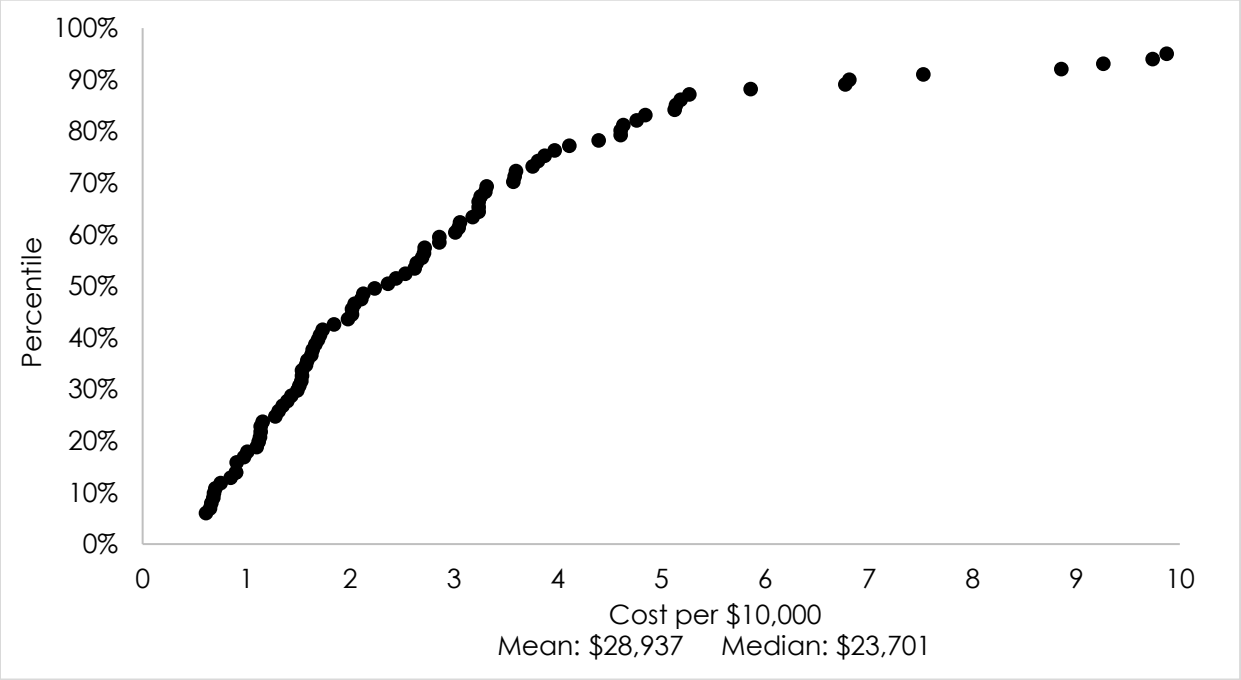
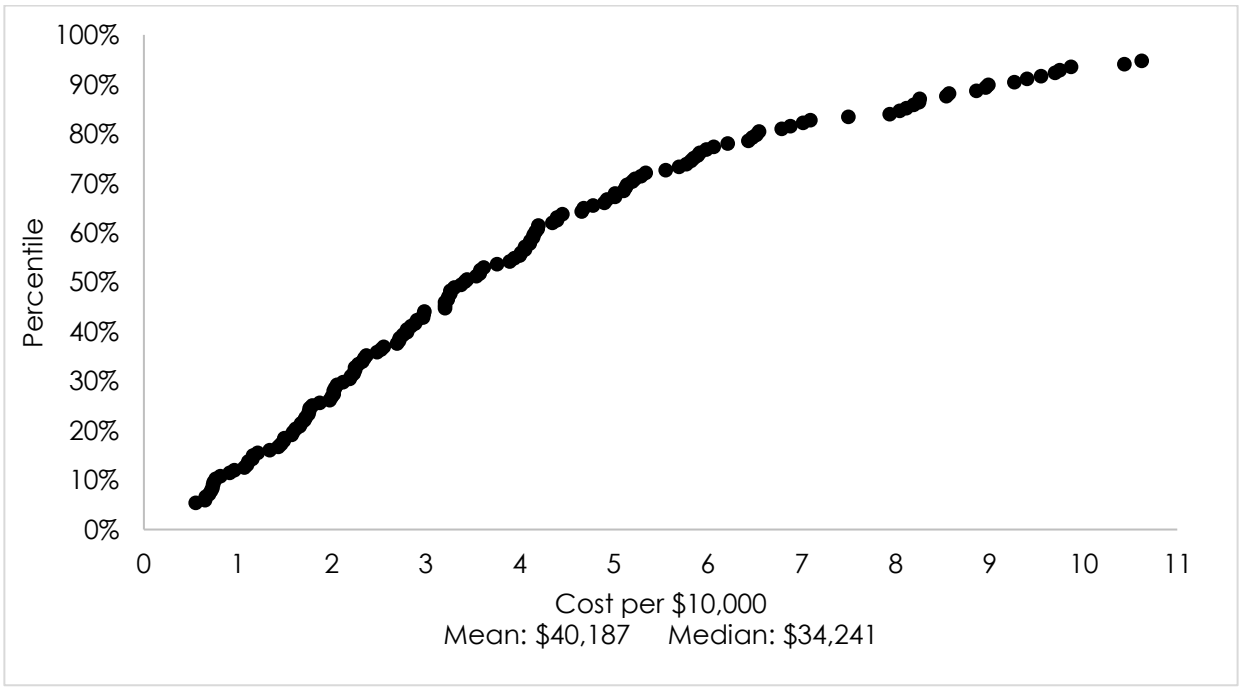


Figure 99: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with non-Hodgkin's lymphoma (2013 dollars)



Oesophageal cancer

Figure 100: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

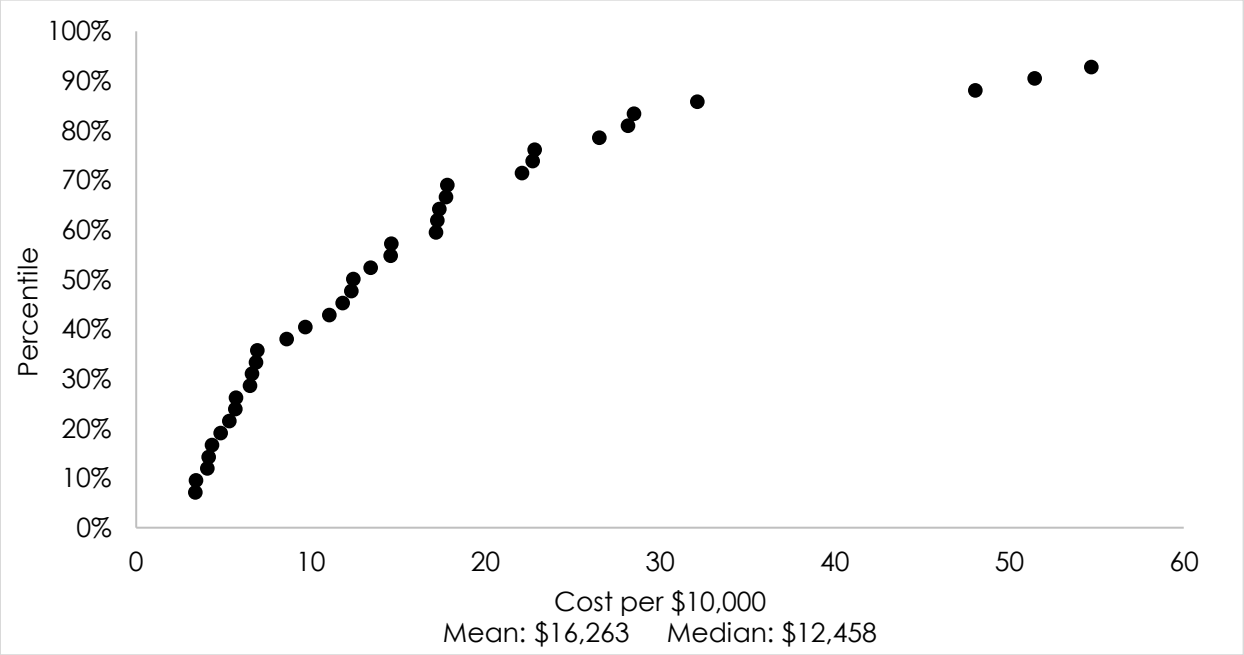


Figure 101: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

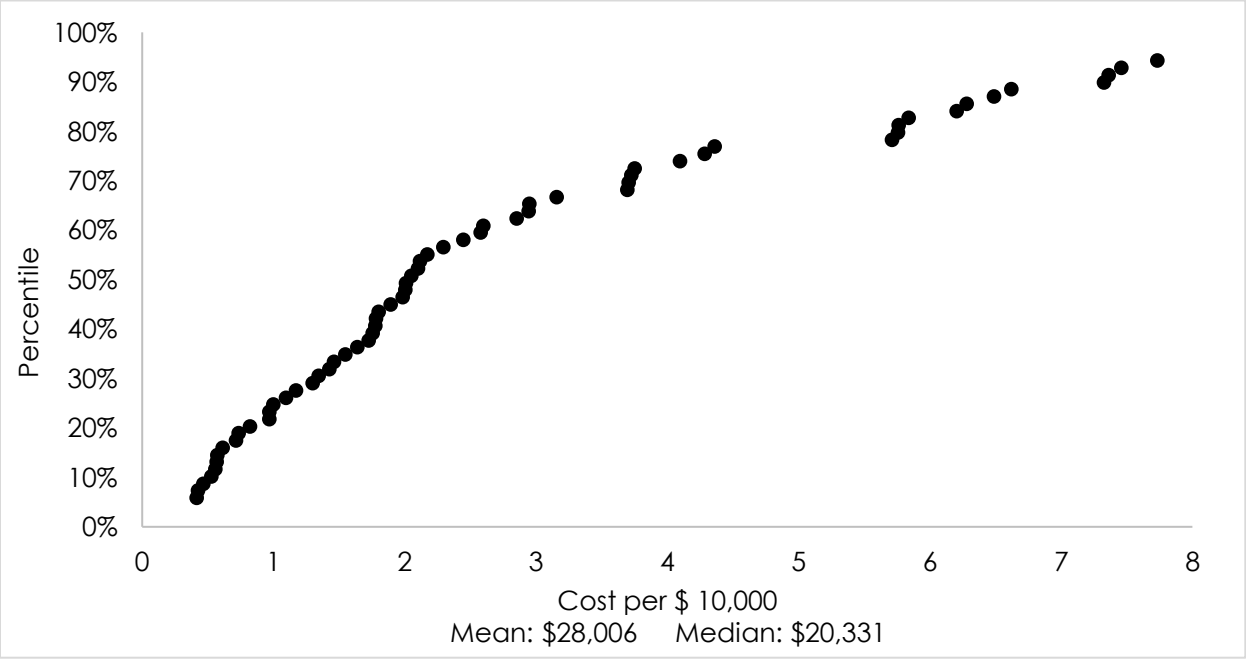


Figure 102: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with oesophageal cancer (2013 dollars)

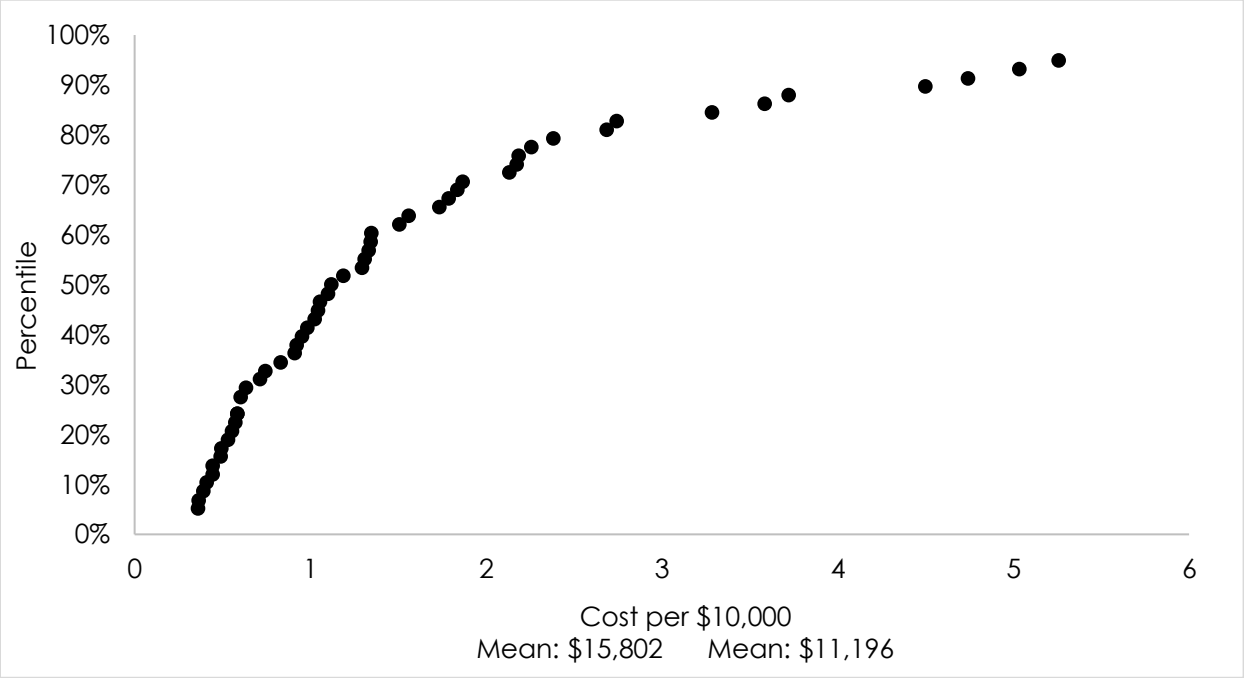
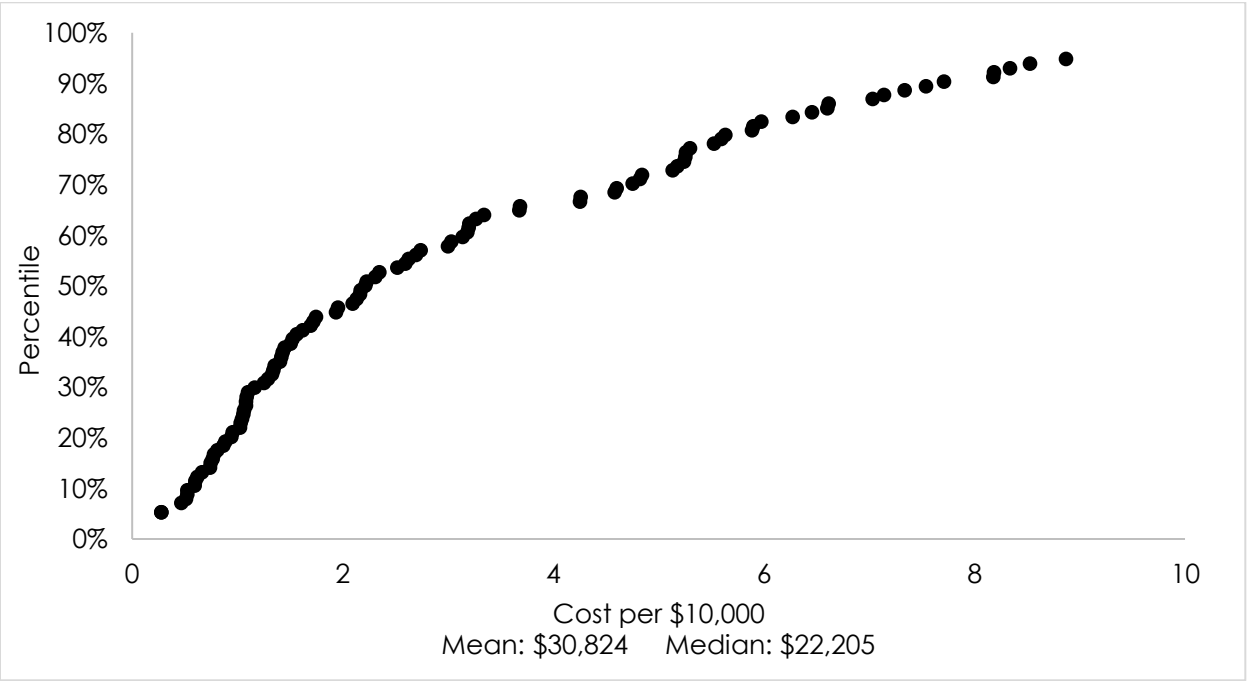


Figure 103: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with oesophageal cancer (2013 dollars)



Prostate cancer

*Data for aged 18-64 conservative estimates suppressed. No mean available.

Figure 104: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with prostate cancer (2013 dollars)

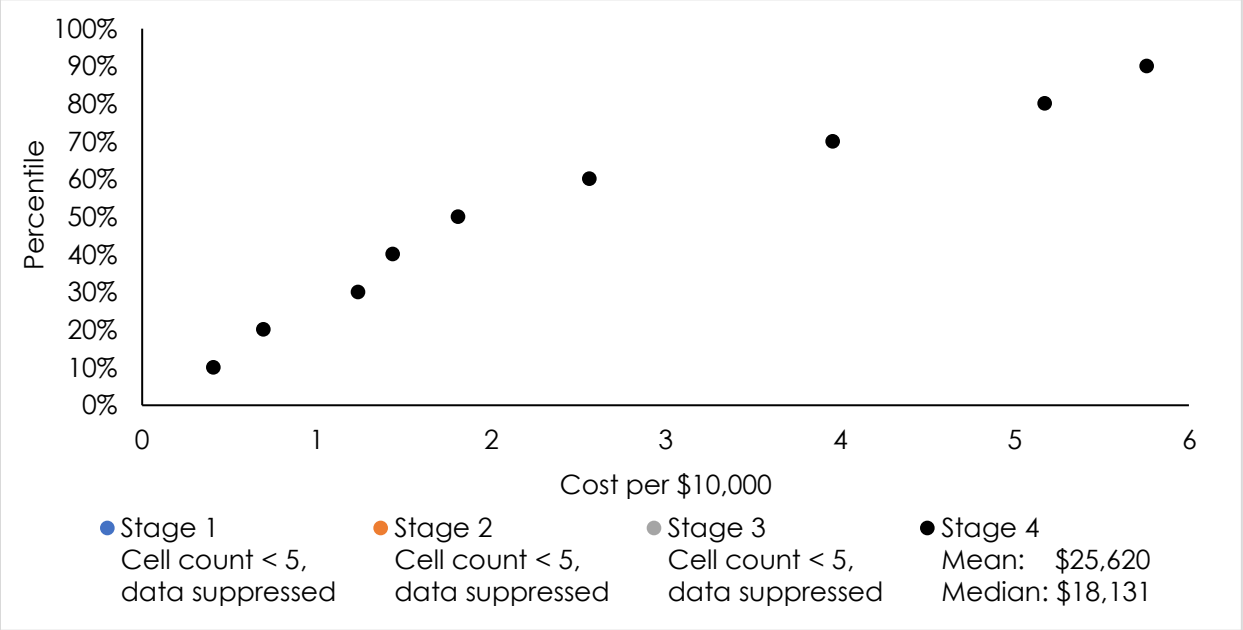


Figure 105: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with prostate cancer (2013 dollars)

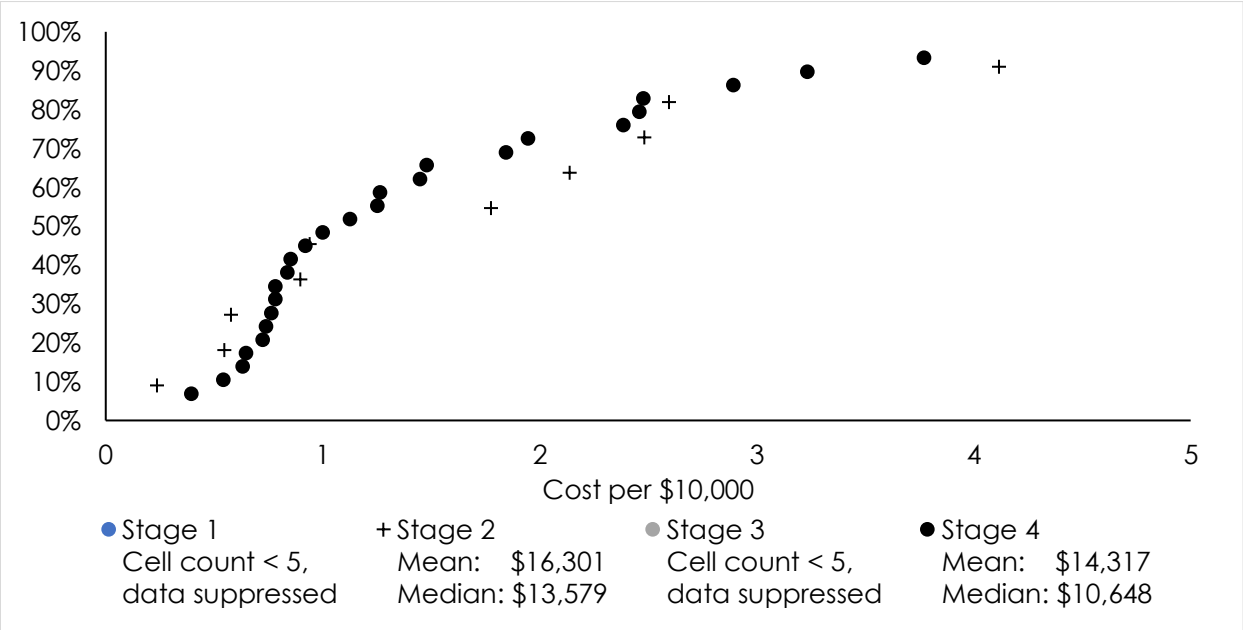
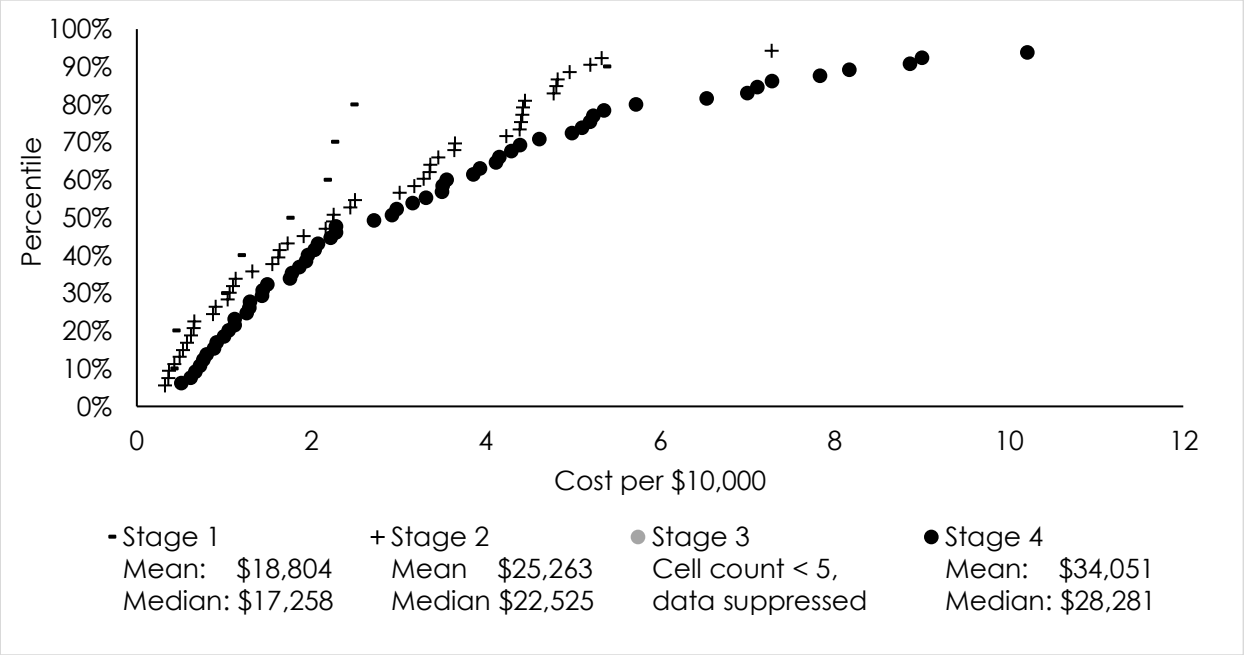


Figure 106: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with prostate cancer (2013 dollars)



Rectal cancer

Figure 107: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with rectal cancer (2013 dollars)

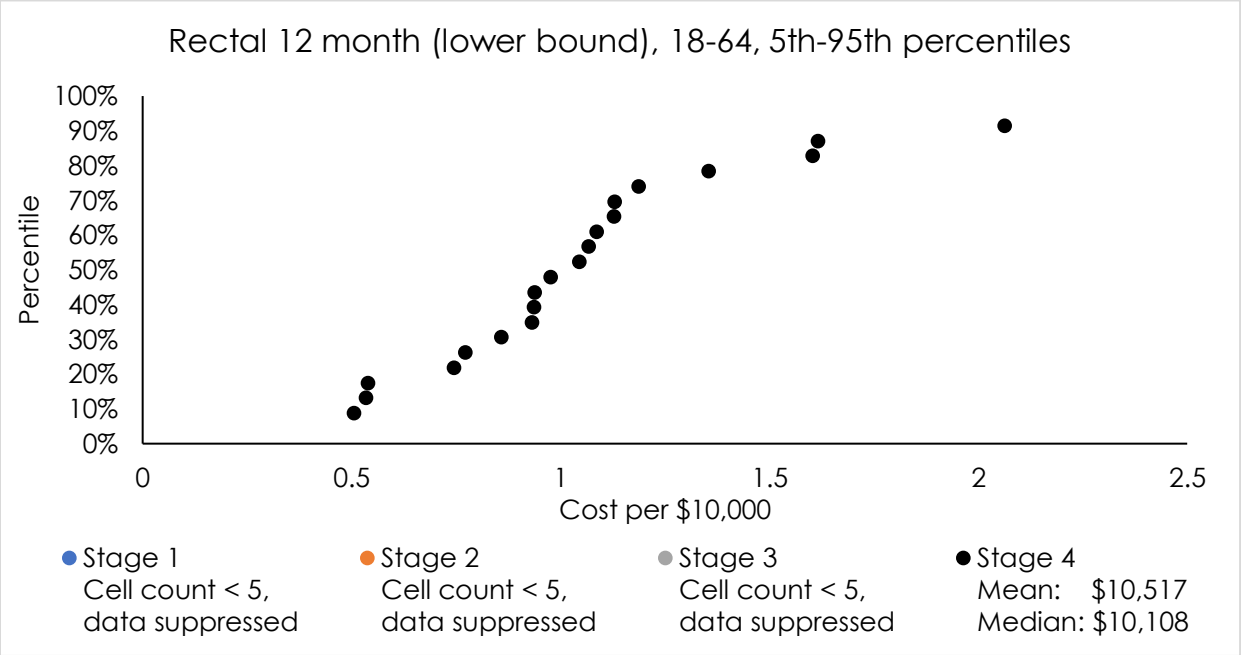


Figure 108: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with rectal cancer (2013 dollars)

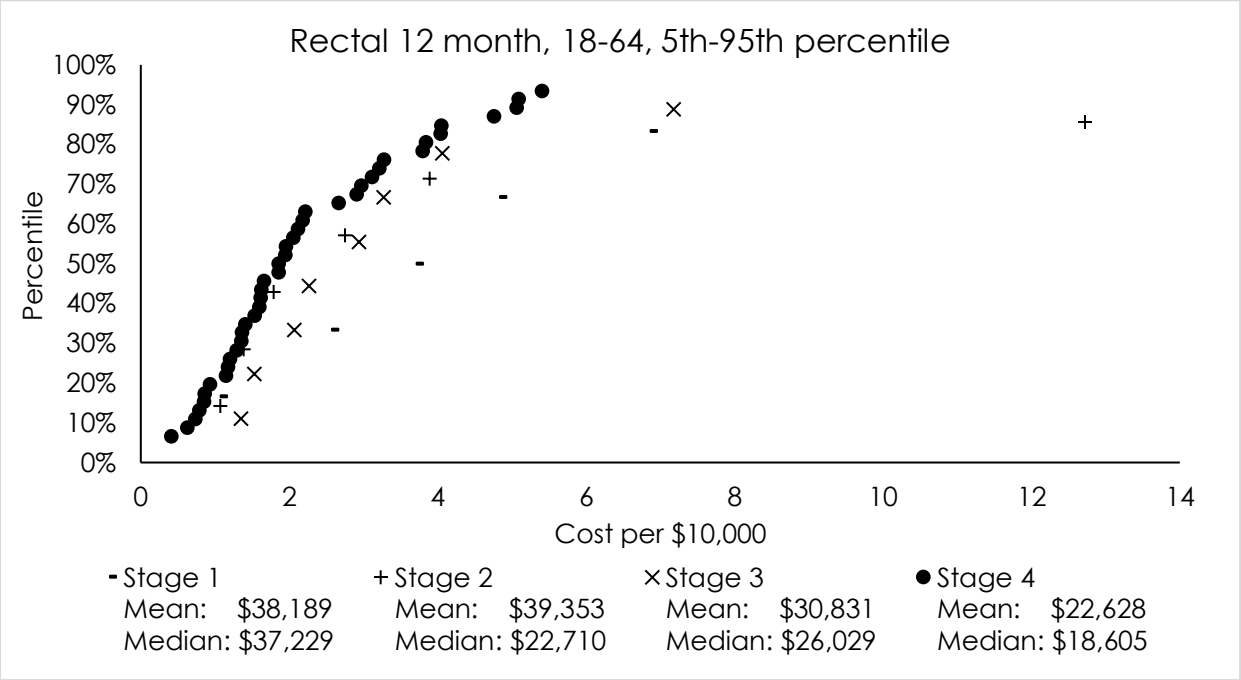


Figure 109: Estimated trimmed distribution (5 to 95 percentile) of the total cost (conservative estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with rectal cancer (2013 dollars)

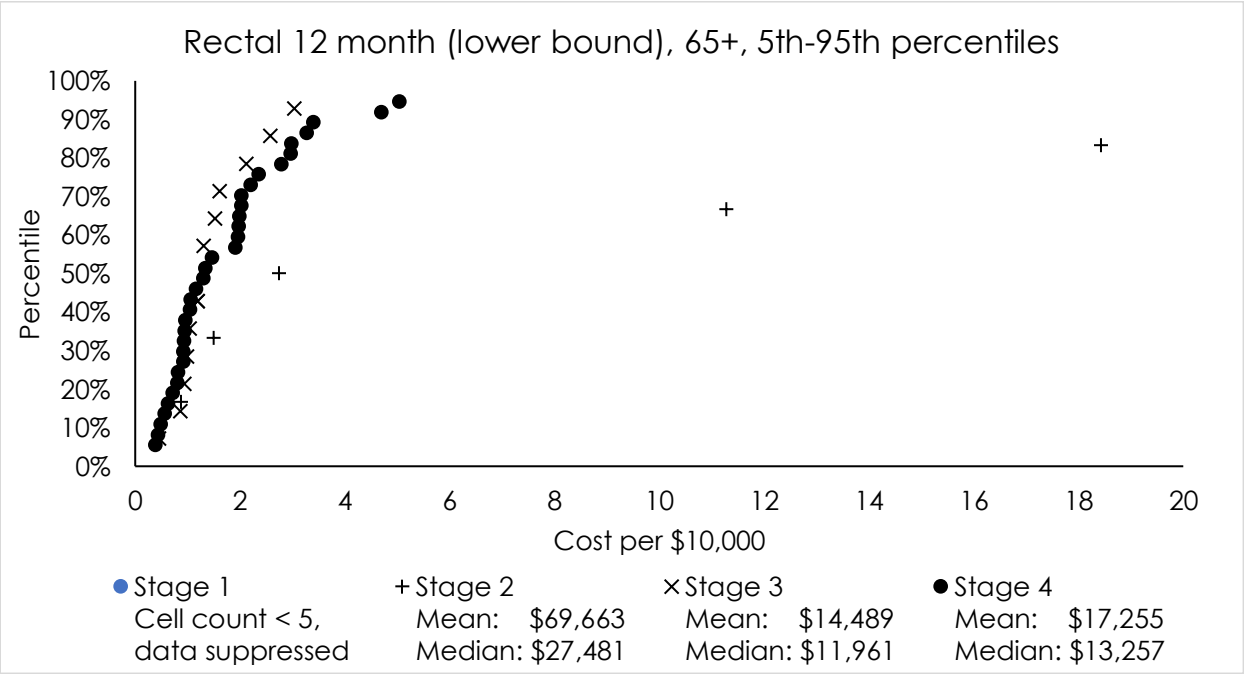
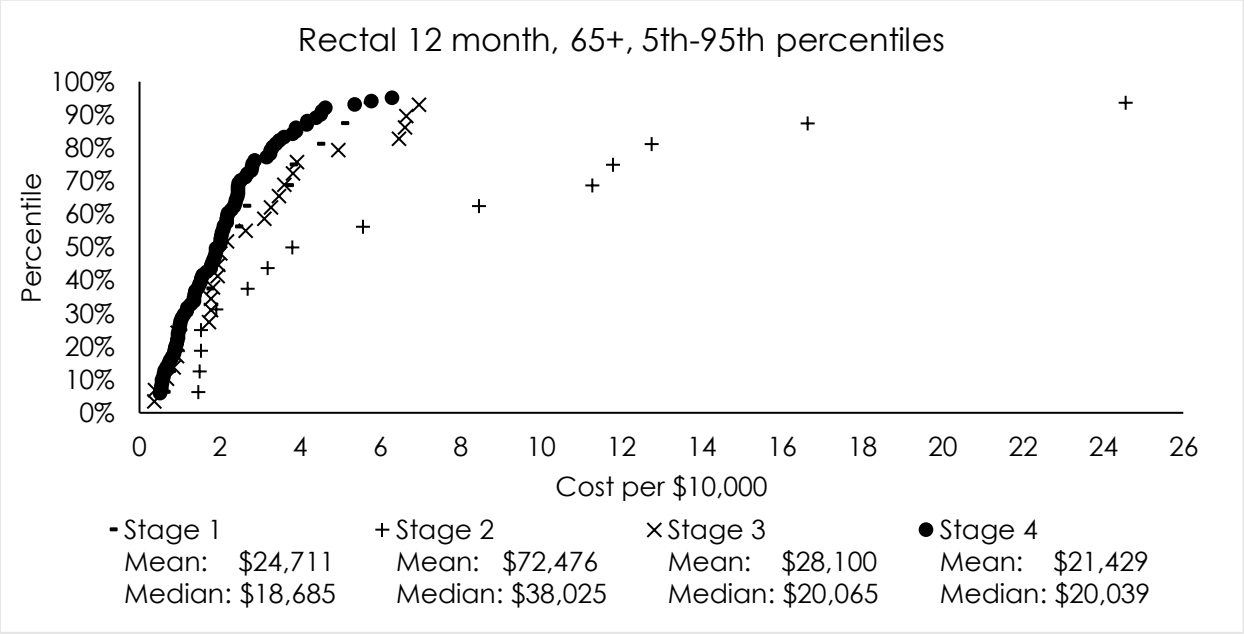


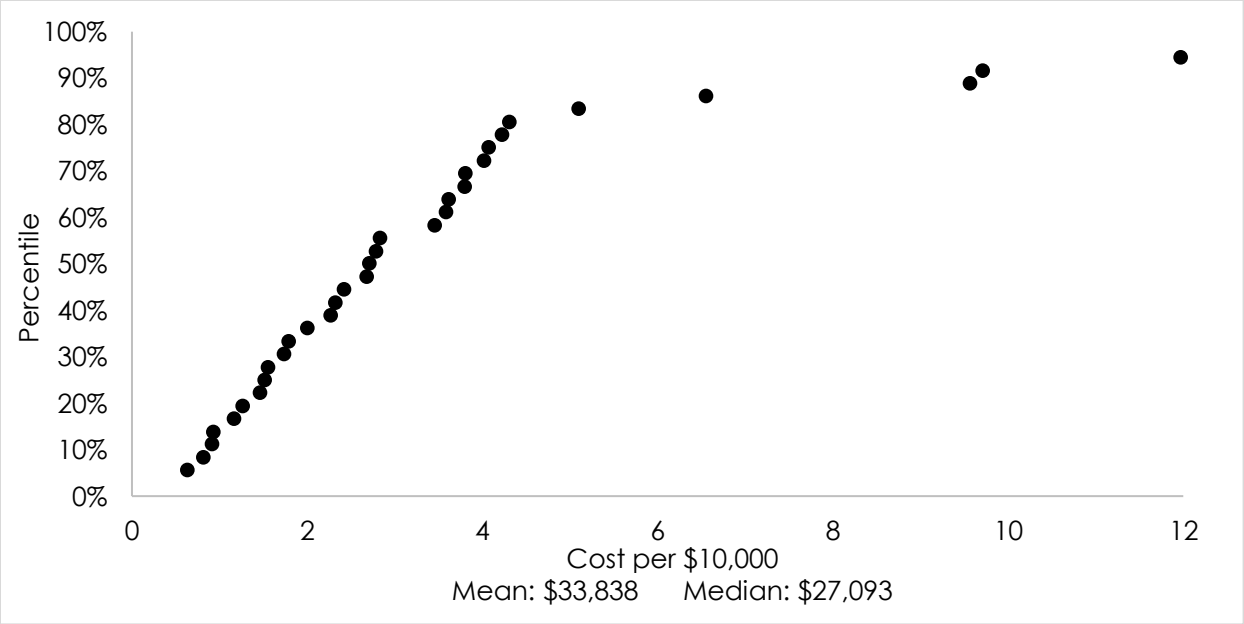
Figure 110: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with rectal cancer (2013 dollars)



Skin cancer

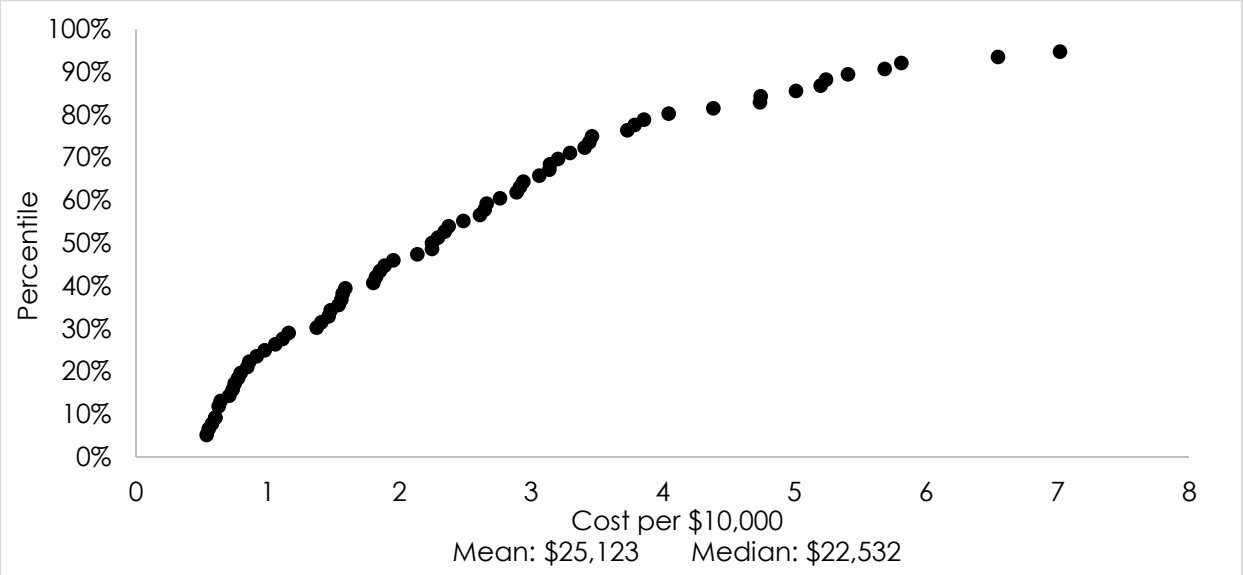
*Data for aged 18-64 conservative estimates suppressed. No mean available.

Figure 107: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 18 to 64 years with skin cancer (2013 dollars)



*Data for 65+ conservative estimates suppressed. Mean cost: $16,144

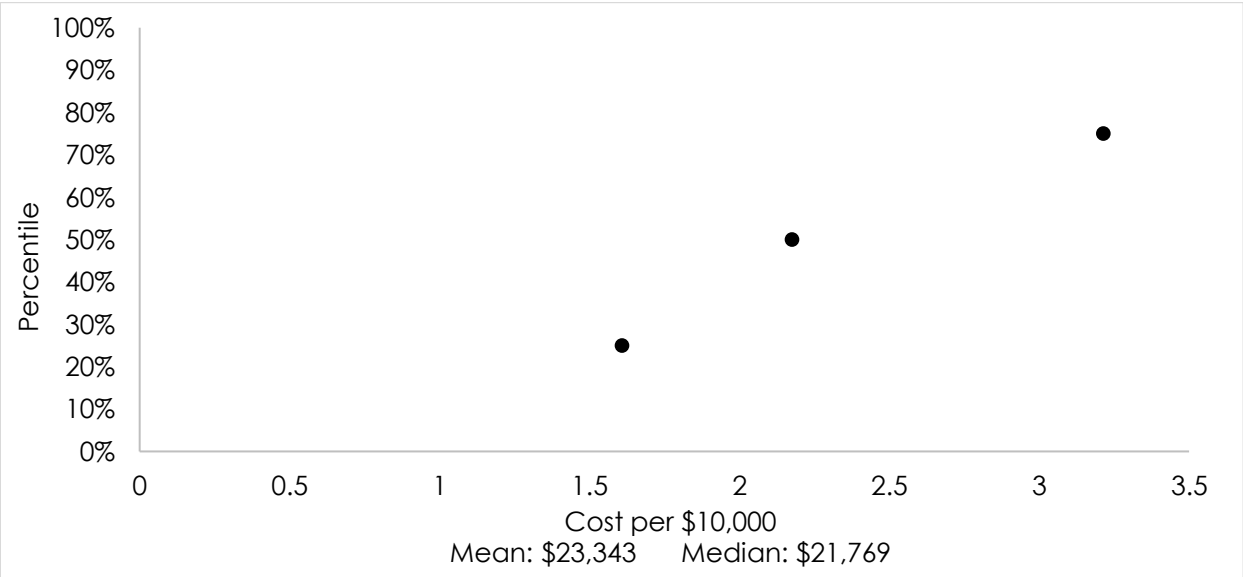
Figure 111: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with skin cancer (2013 dollars)



Testicular cancer

* Testicular 12 months 18-64 conservative estimates suppressed. **Mean**: **$138,254**
* Testicular 12 months 18-64 relaxed estimates suppressed. **Mean: $458,763**
* Testicular 12 months 65+ conservative estimates suppressed. No mean available.

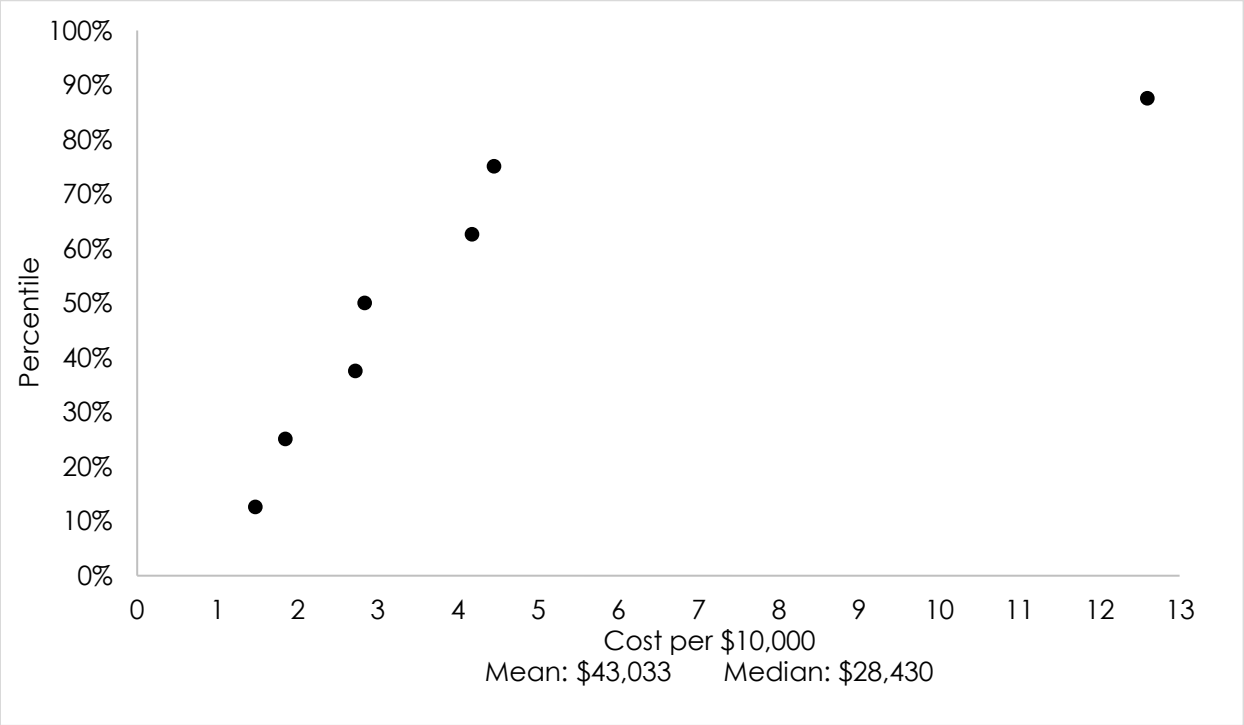
Figure 109: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with testicular cancer (2013 dollars)



Ureter cancer

*Ureter 12 months 18-64 conservative estimates suppressed. No mean available
* Ureter 12 month 18-64 suppressed. **Mean: $36,814**
* Ureter 12 months 65+ conservative estimates suppressed. No mean available

Figure 110: Estimated trimmed distribution (5 to 95 percentile) of the total cost (relaxed estimation) for inpatient hospitalizations during the 12-month period after date of diagnosis for patients aged 65 years or more with ureter cancer (2013 dollars)



APPENDIX 4. 18-month untrimmed graphs

Bladder

Figure 111: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with bladder cancer (2013 dollars)

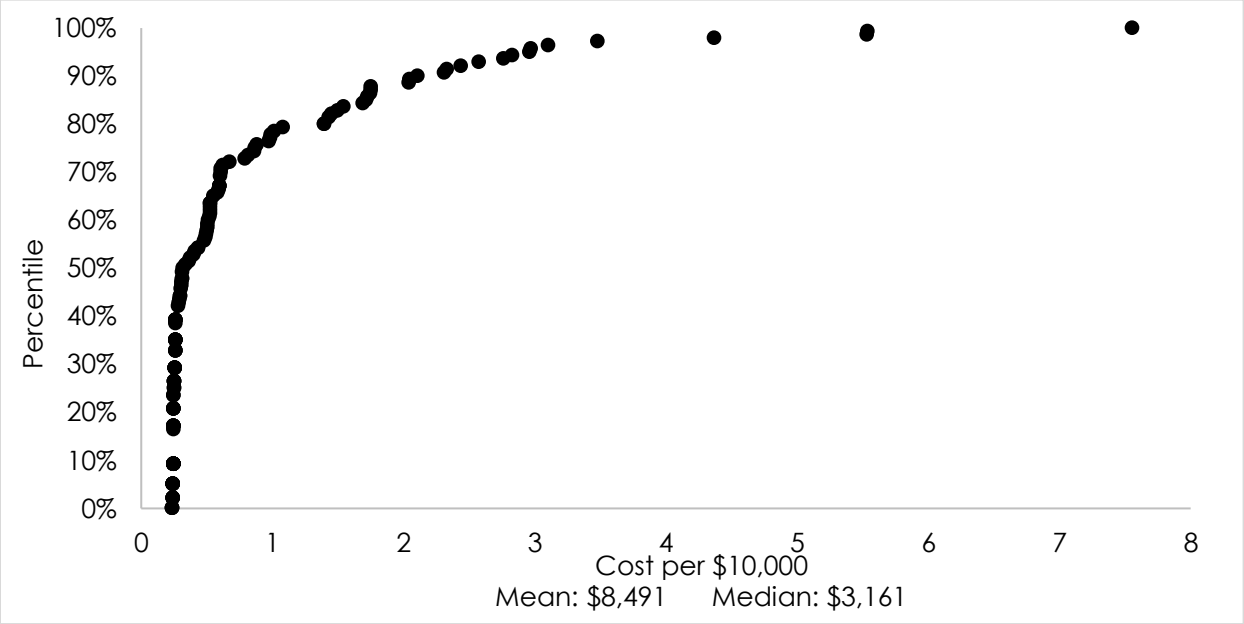


Figure 112: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with bladder cancer (2013 dollars)

Figure 113: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with bladder cancer (2013 dollars)

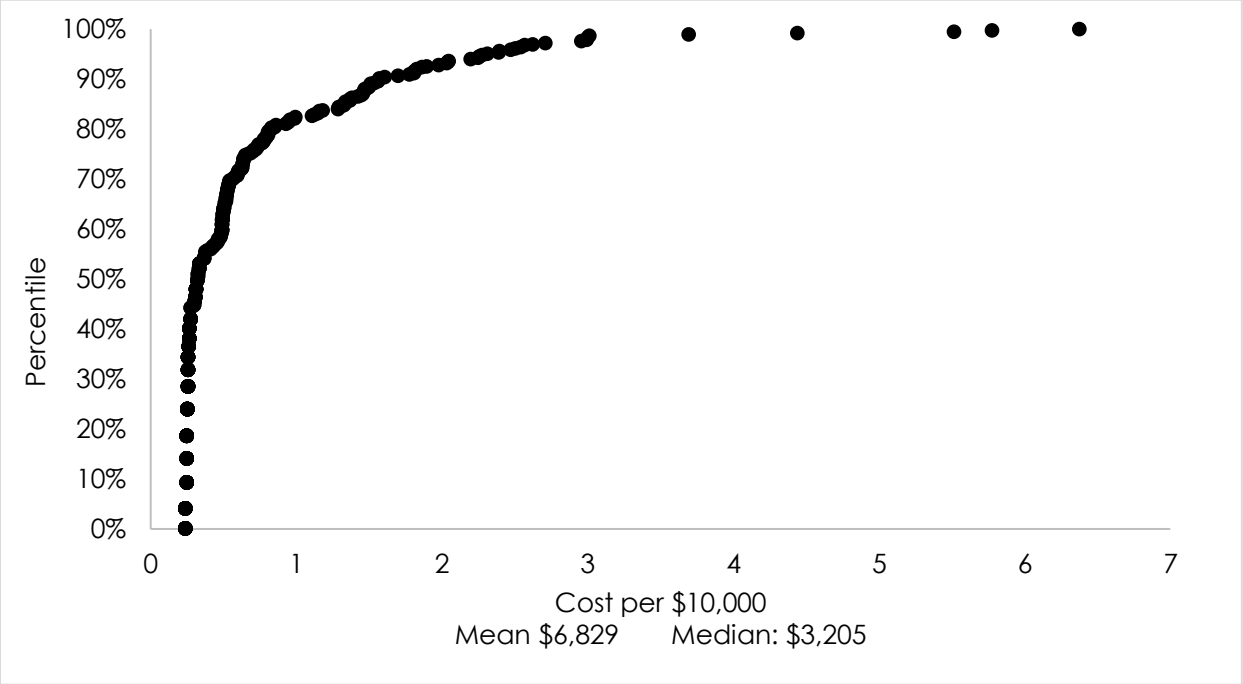


Figure 114: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with bladder cancer (2013 dollars)

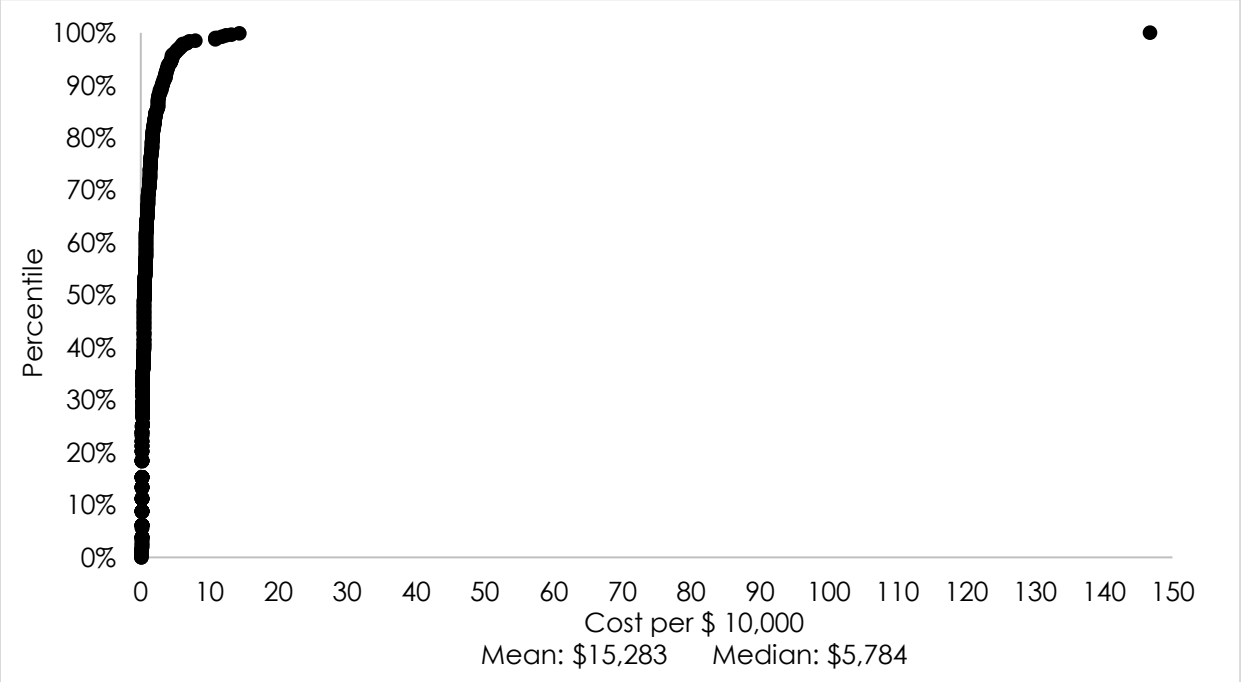


Figure 115: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with brain cancer (2013 dollars)

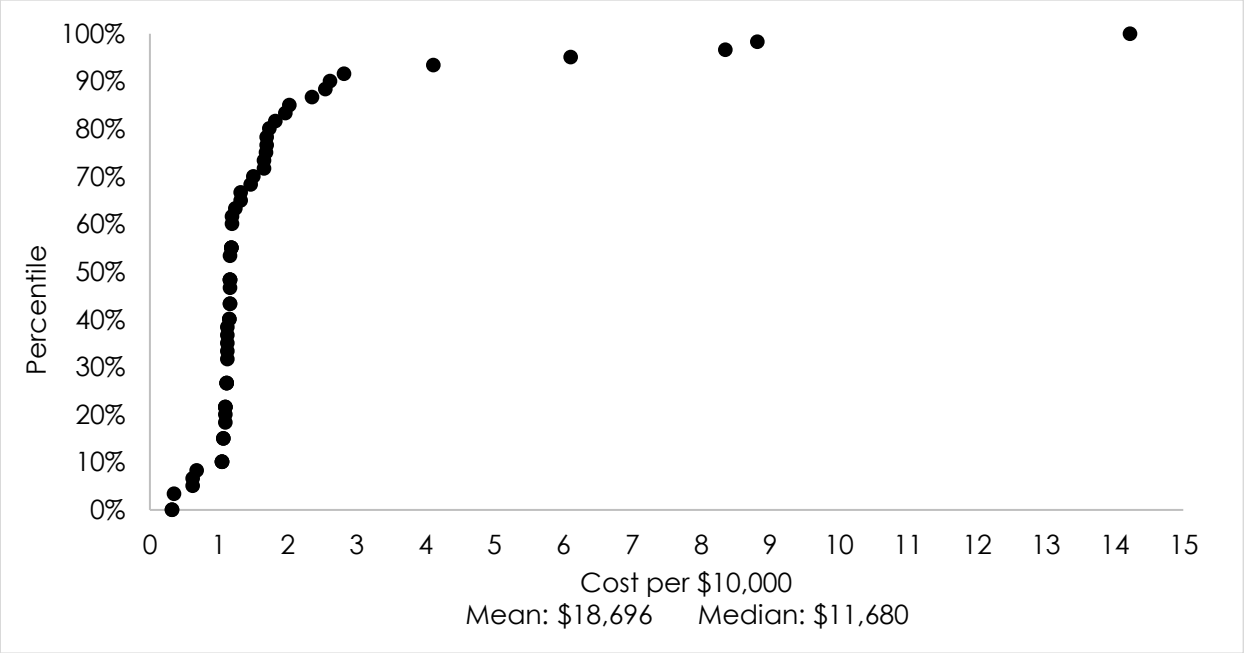


Figure 116: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with brain cancer (2013 dollars)

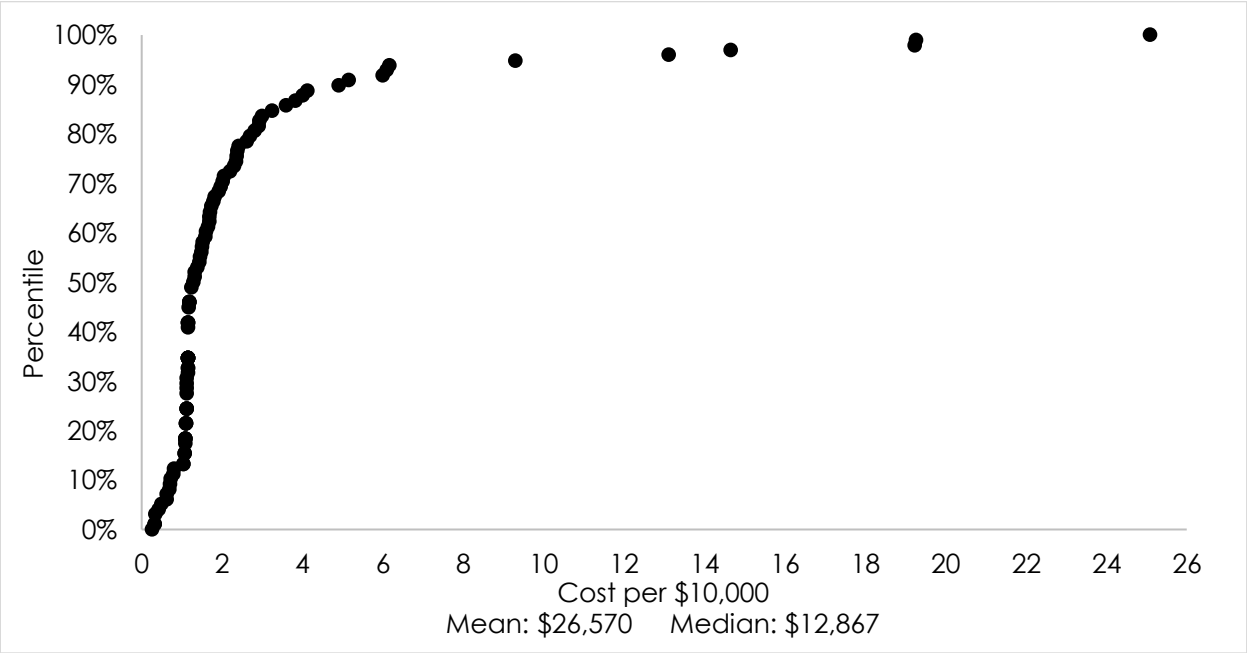


Figure 117: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with brain cancer (2013 dollars)

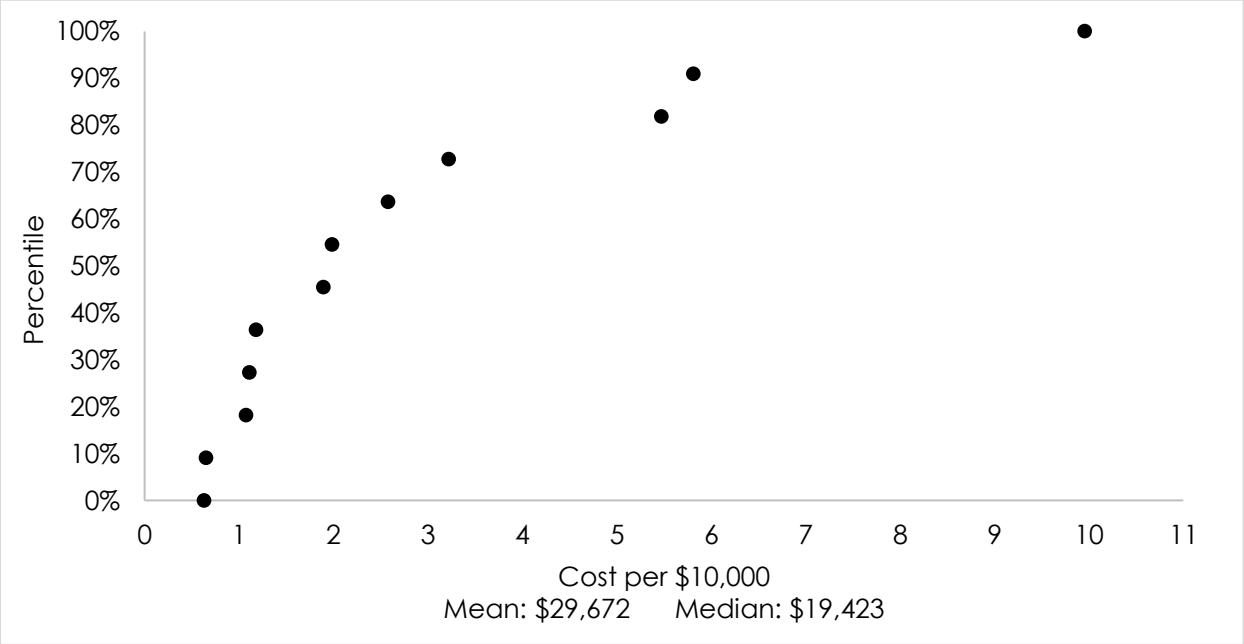


Figure 118: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with brain cancer (2013 dollars)

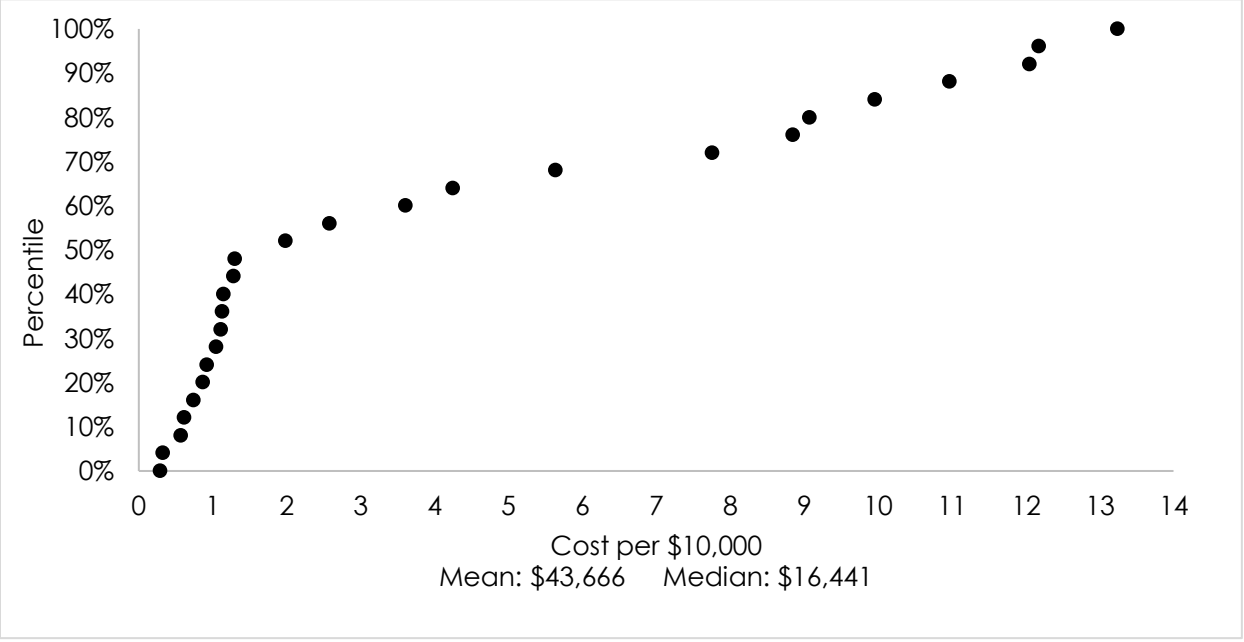


Figure 119: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with breast cancer (2013 dollars)

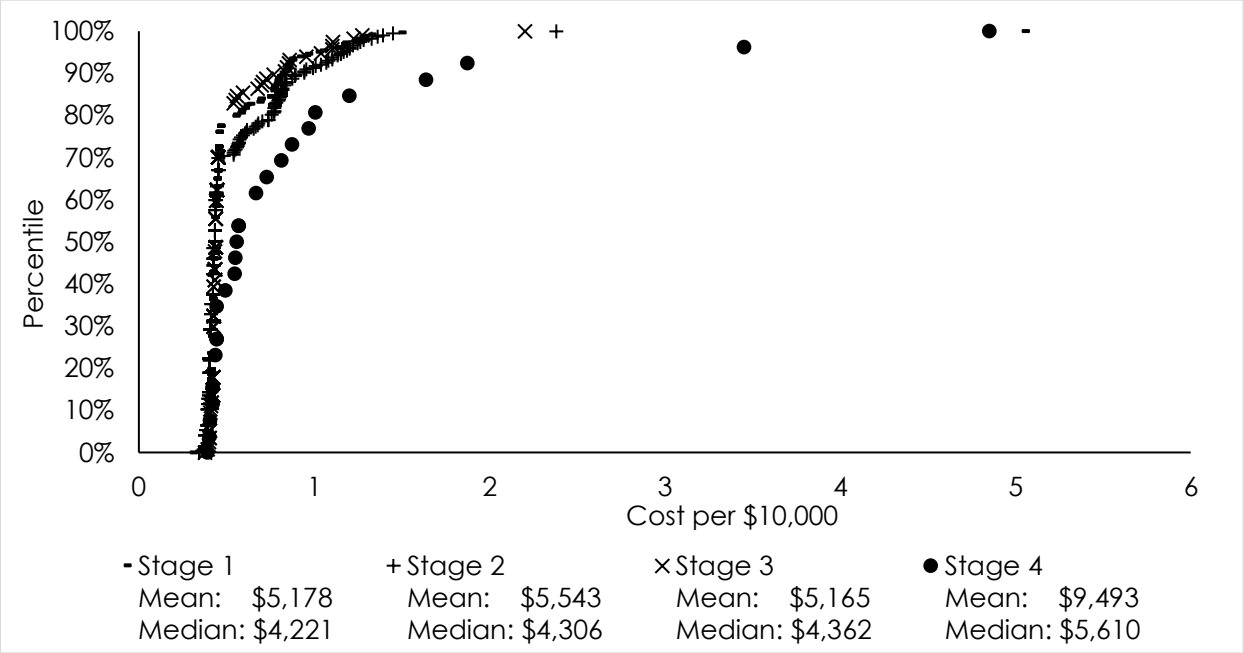


Figure 120: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with breast cancer (2013 dollars)

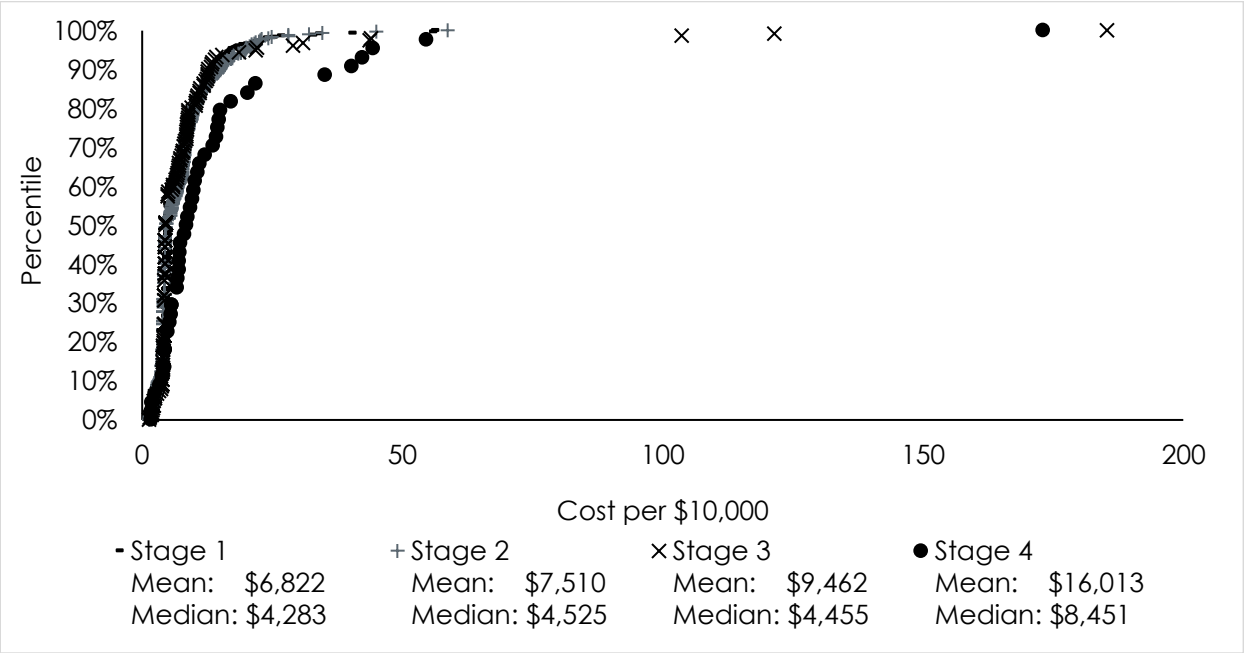


Figure 121: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with breast cancer (2013 dollars)

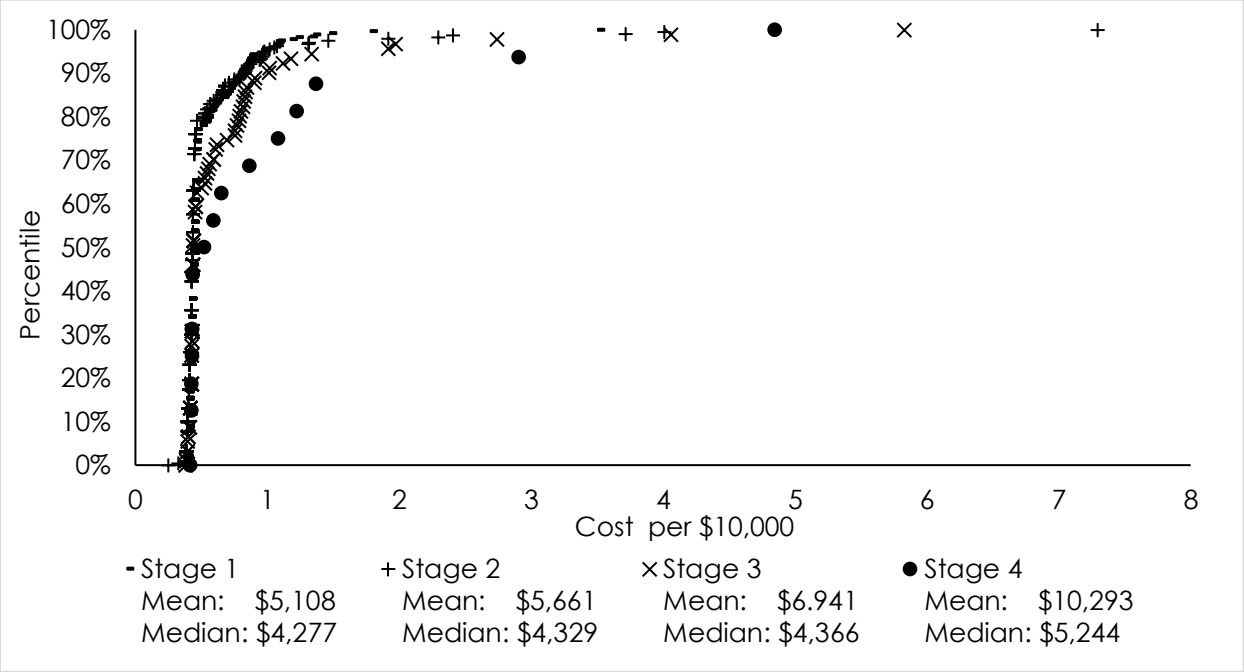


Figure 122: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with breast cancer (2013 dollars)

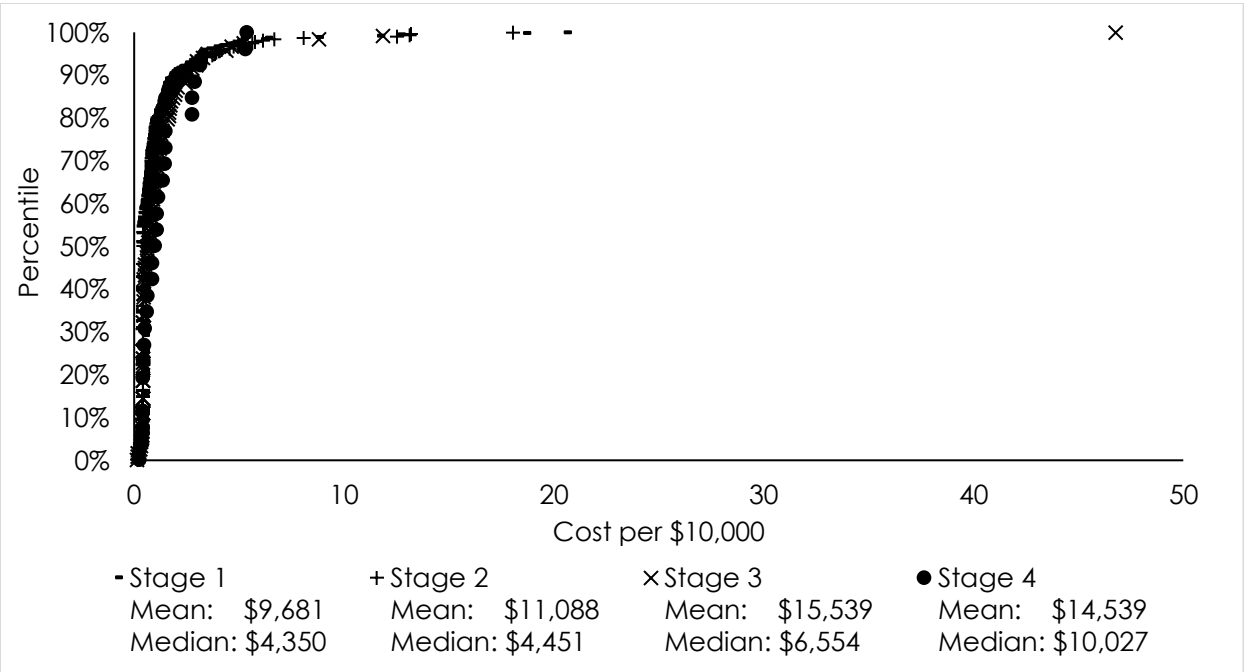


Figure 123: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with colon cancer (2013 dollars)

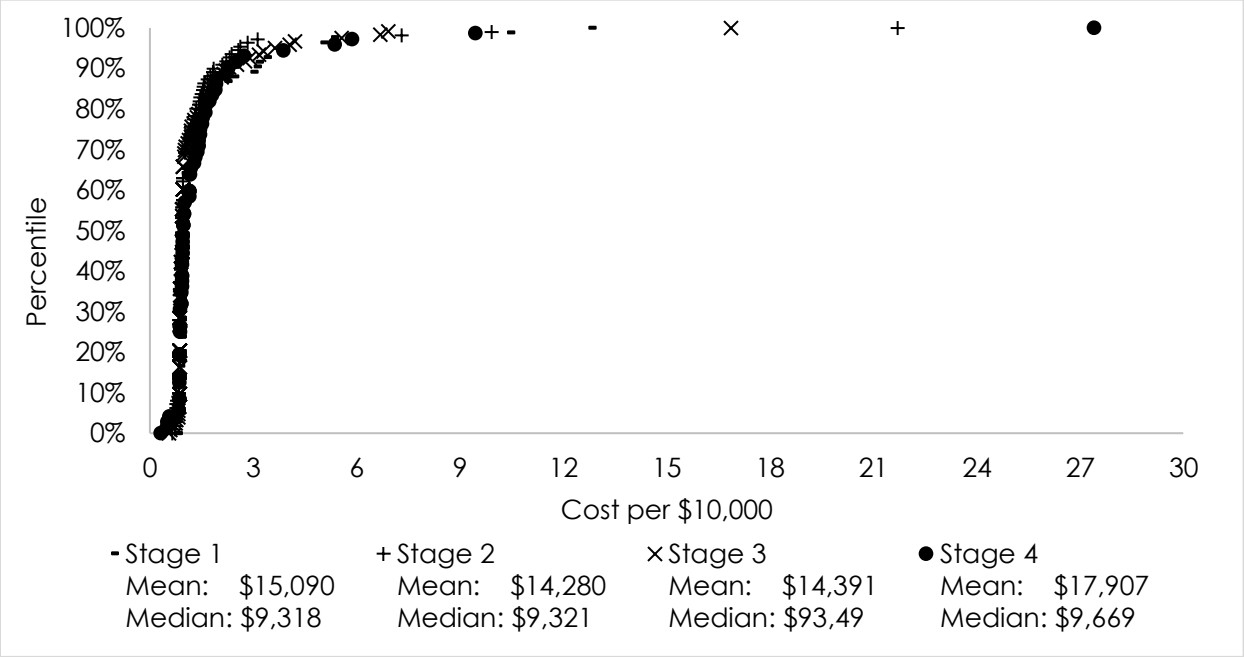


Figure 124: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients 18 to 64 years with colon cancer (2013 dollars)

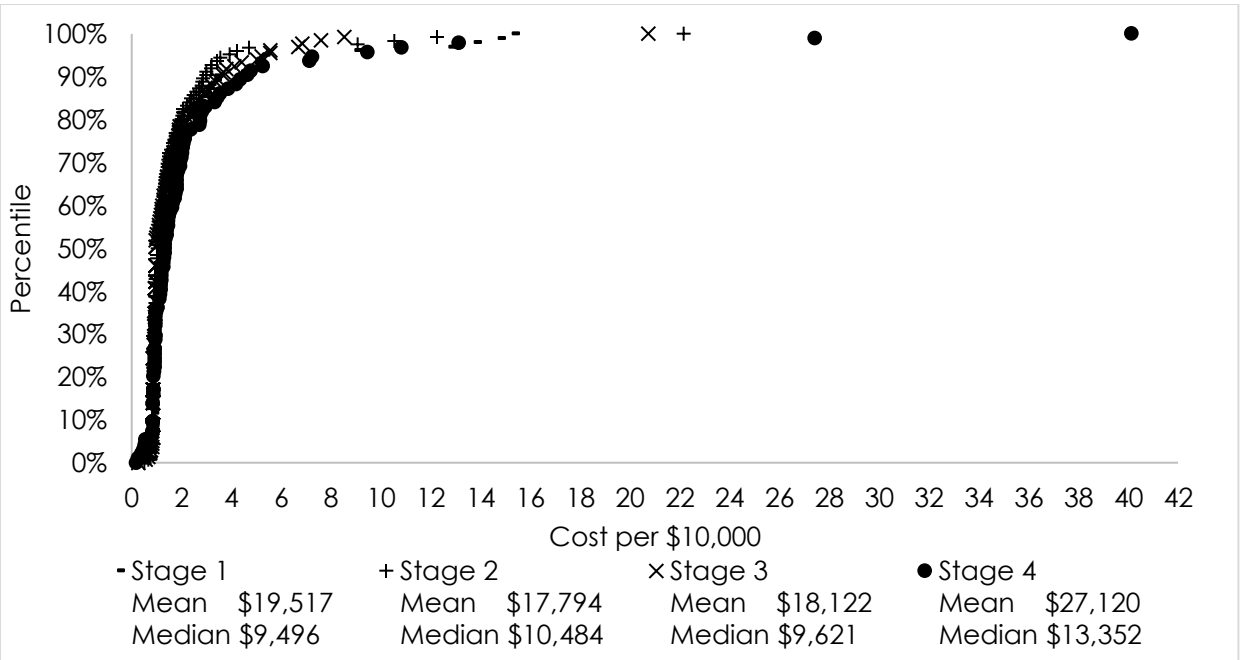


Figure 125: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with colon cancer (2013 dollars)

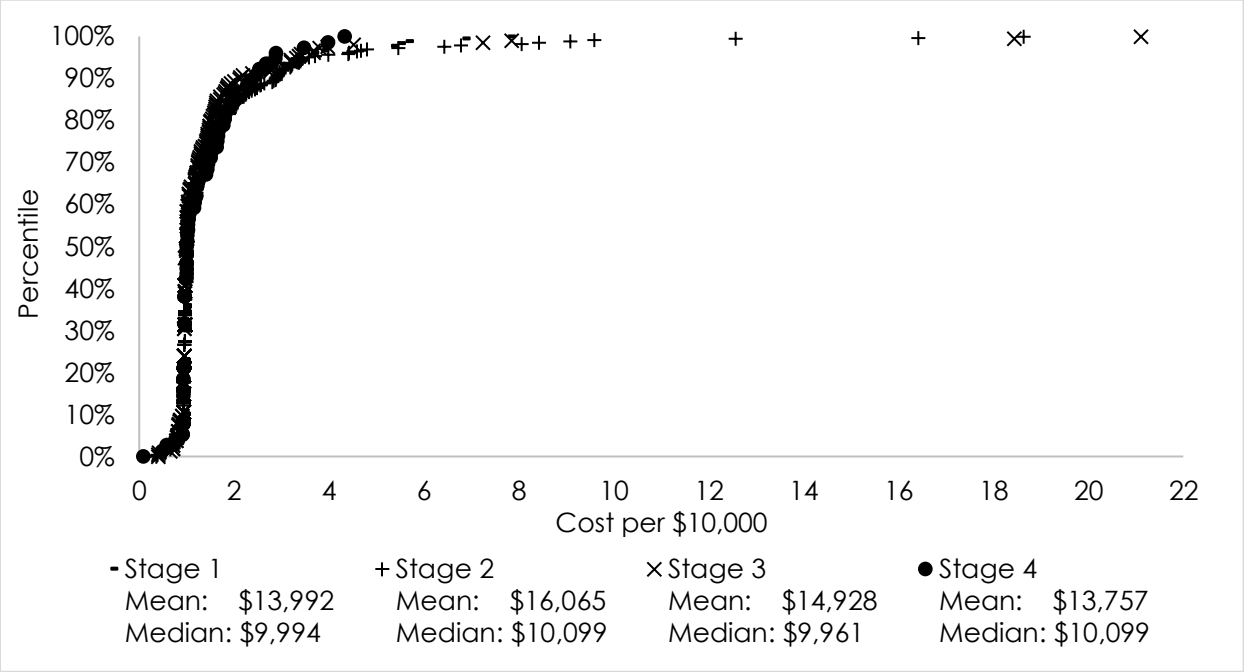


Figure 126: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with colon cancer (2013 dollars)

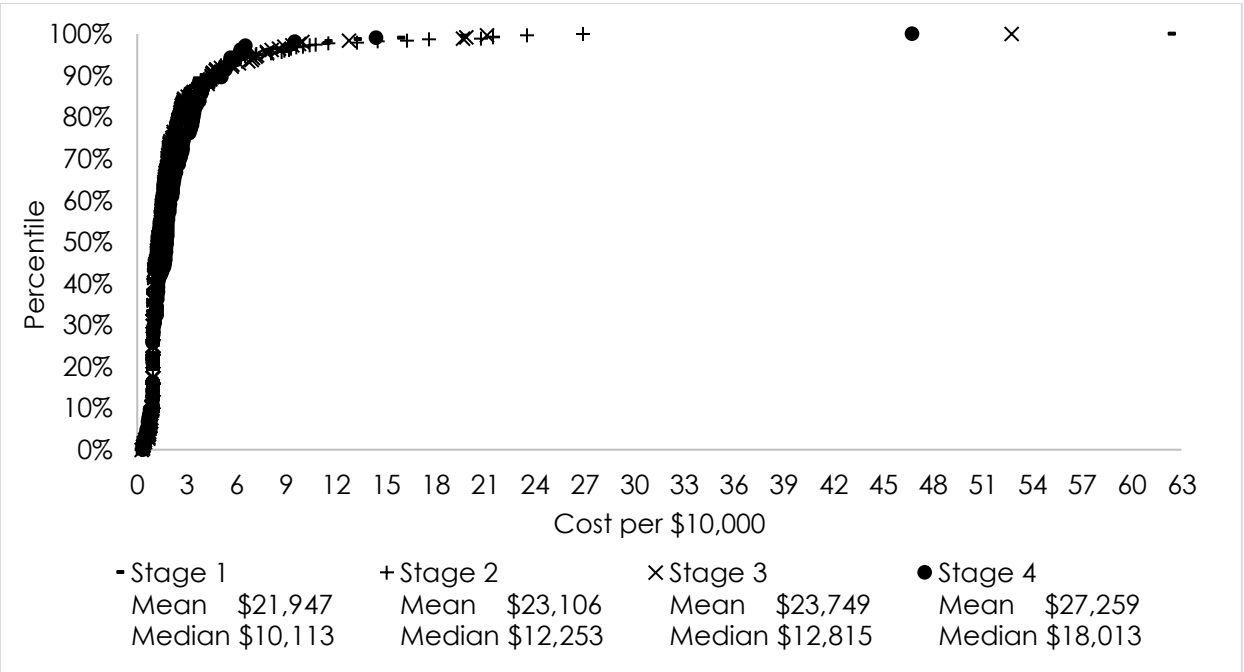


Figure 127: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with kidney cancer (2013 dollars)

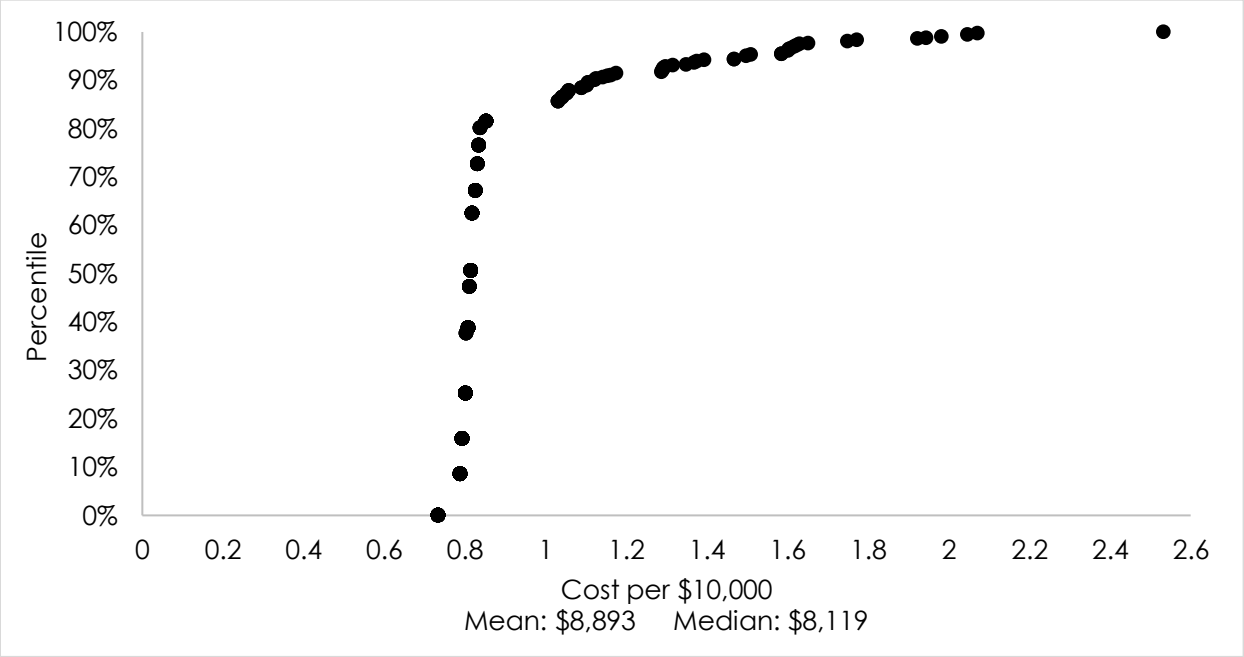


Figure 128: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with kidney cancer (2013 dollars)

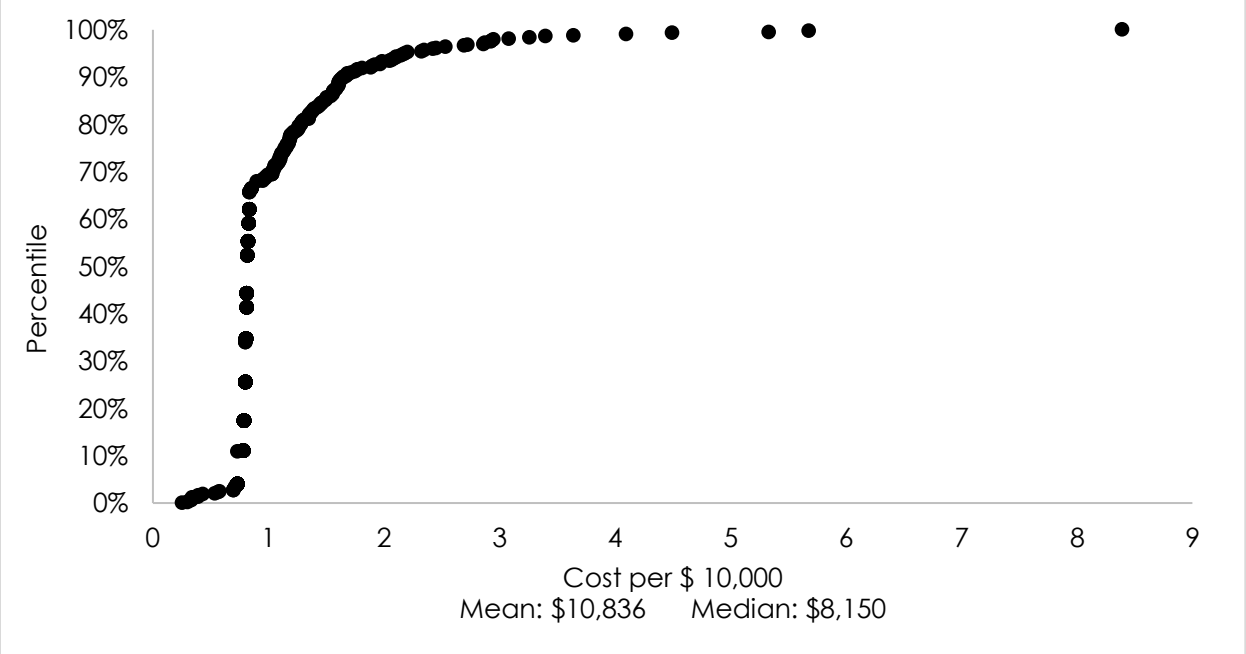


Figure 129: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with kidney cancer (2013 dollars)

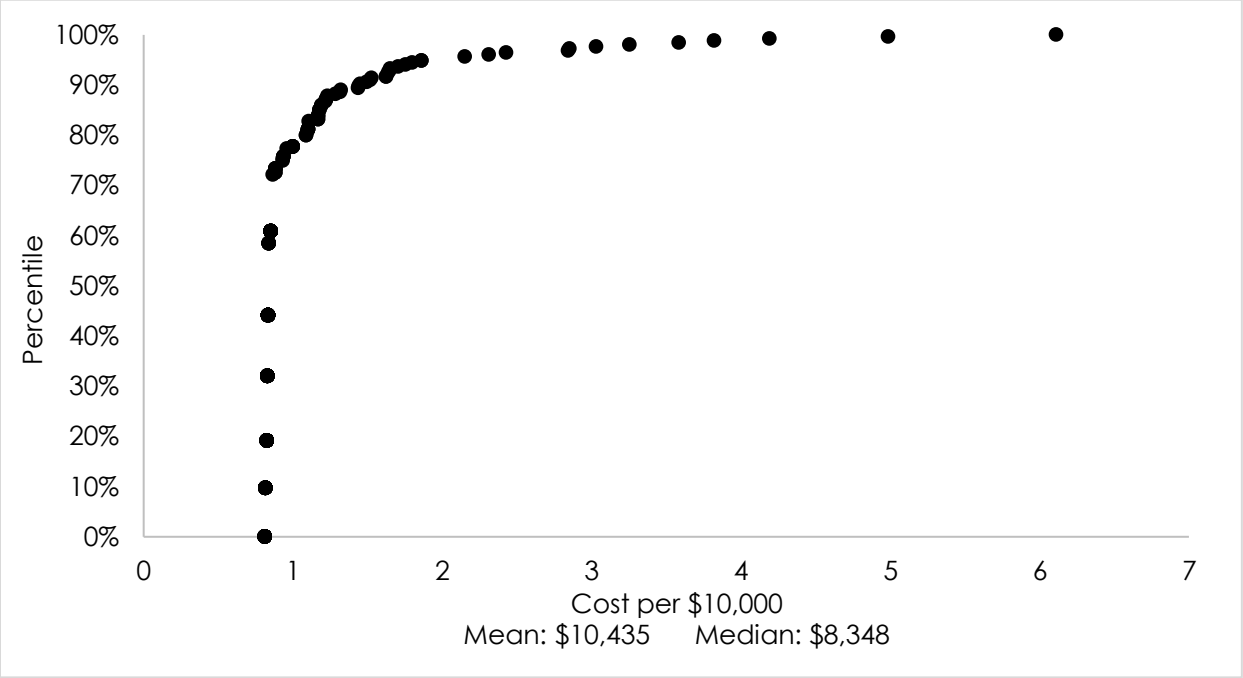


Figure 130: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with kidney cancer (2013 dollars)

Leukemia

Figure 131: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with leukemia (2013 dollars)

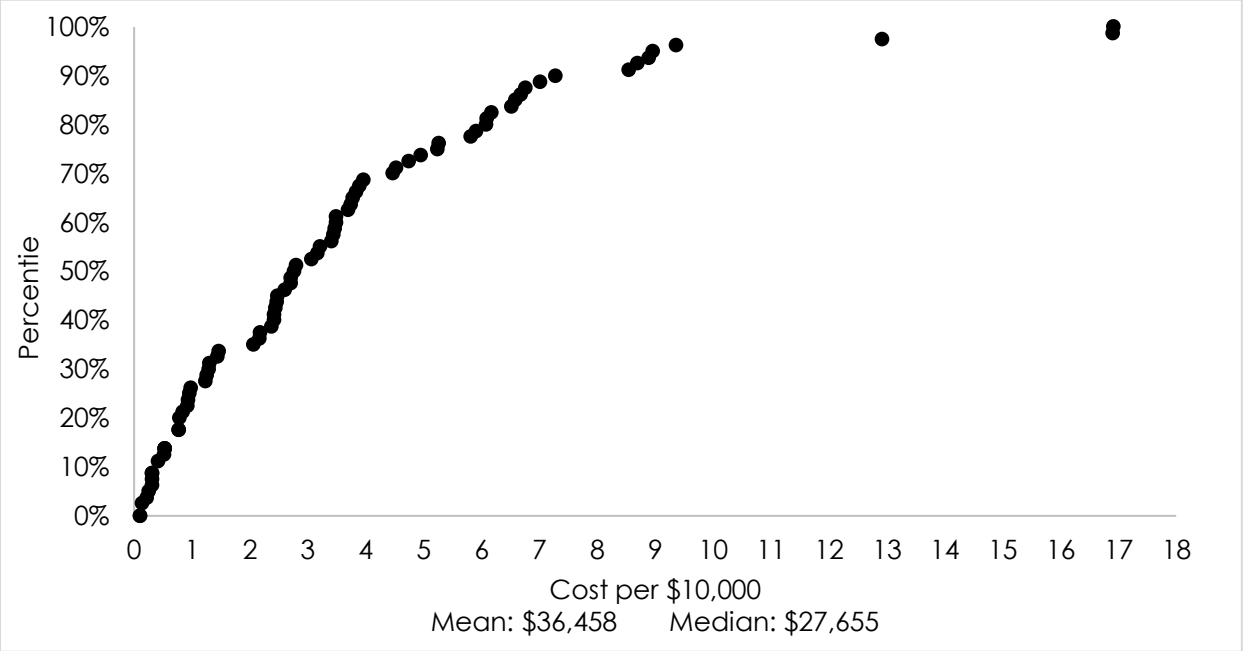


Figure 132: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with leukemia (2013 dollars)

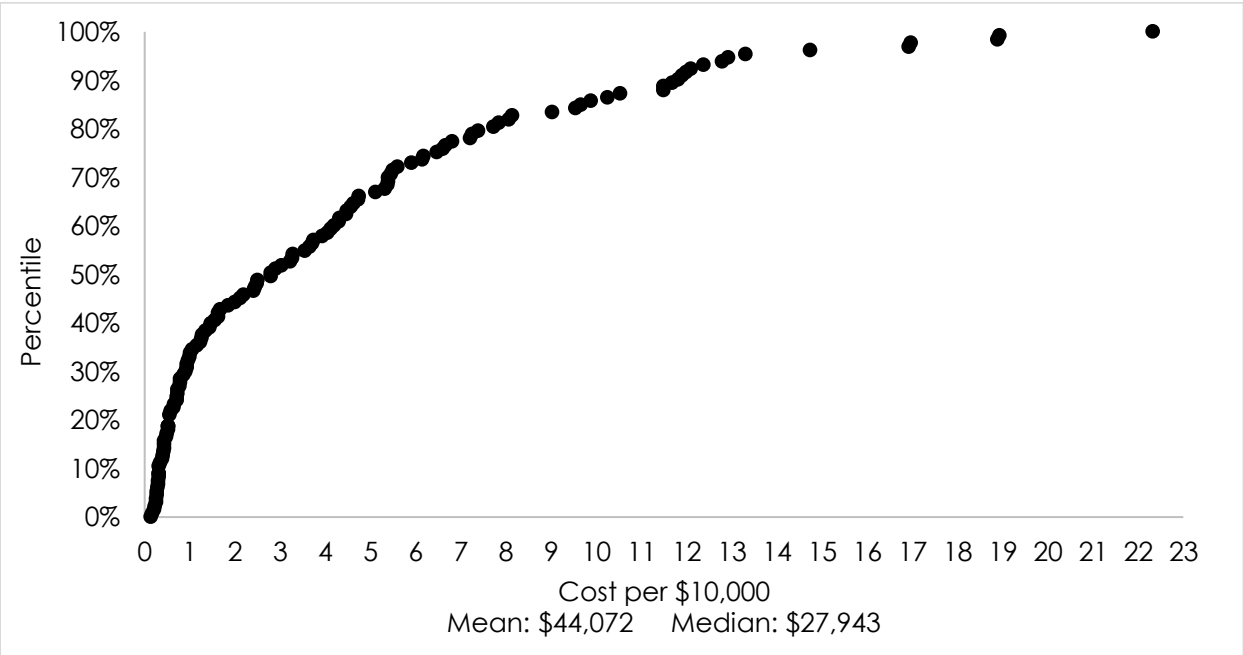


Figure 133: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with leukemia (2013 dollars)

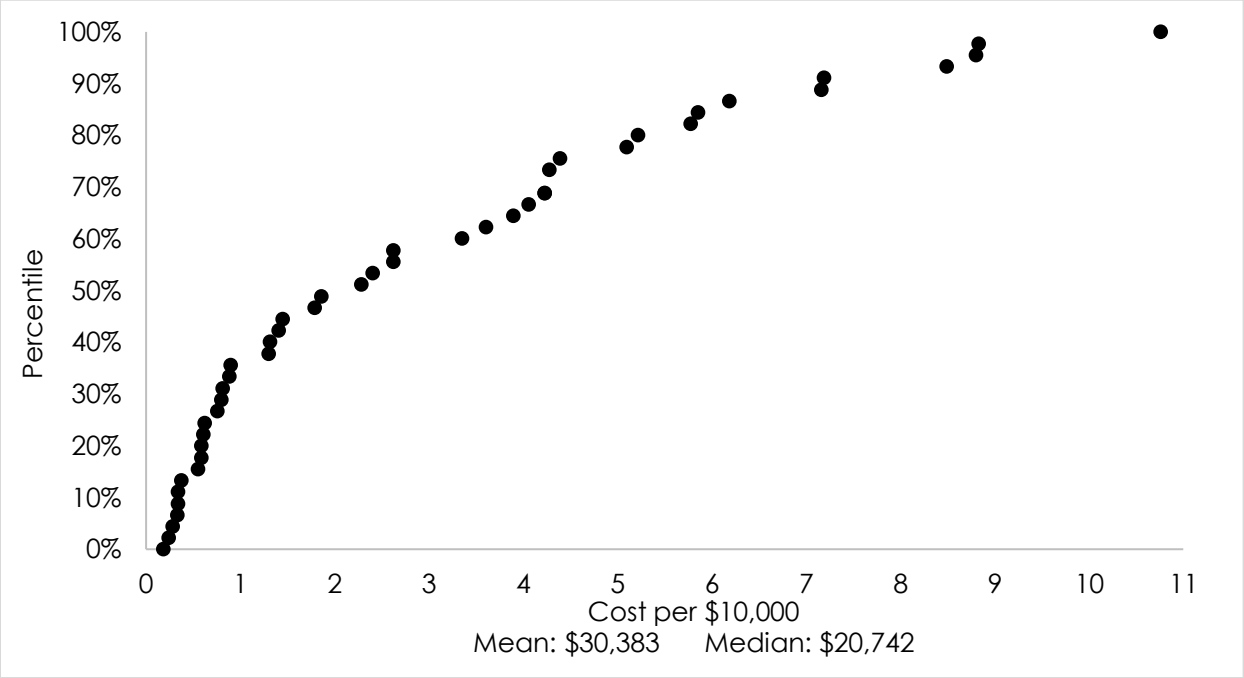


Figure 134: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with leukemia (2013 dollars)

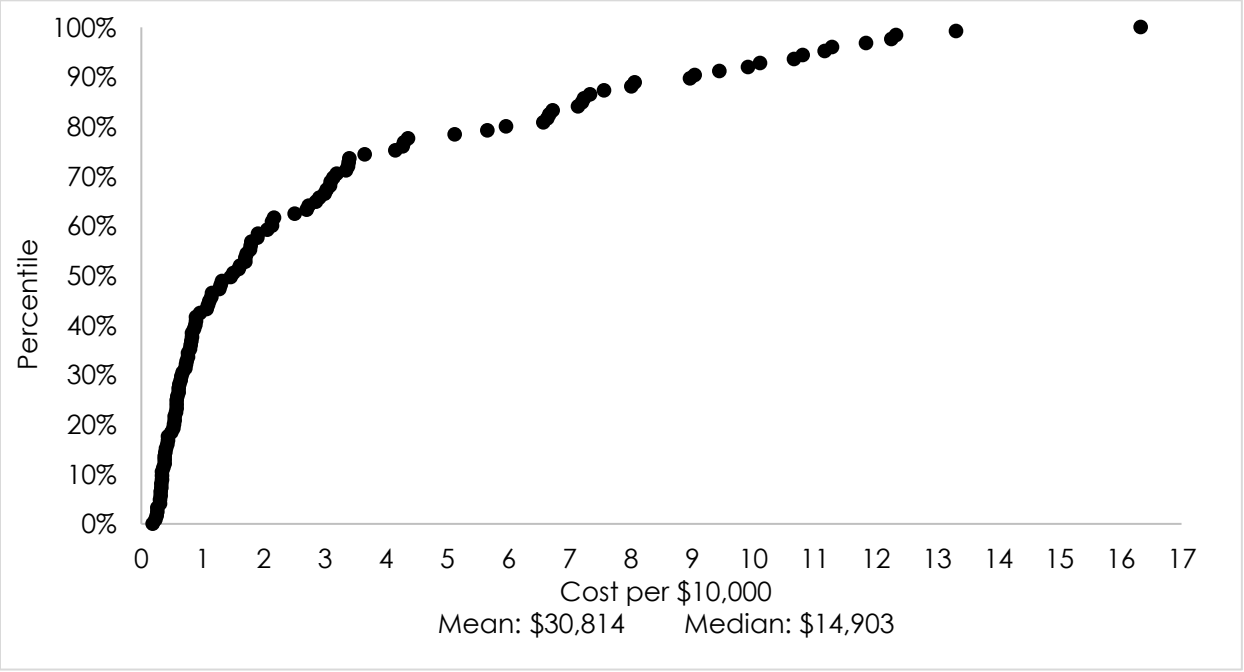


Figure 135: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with lung cancer (2013 dollars)

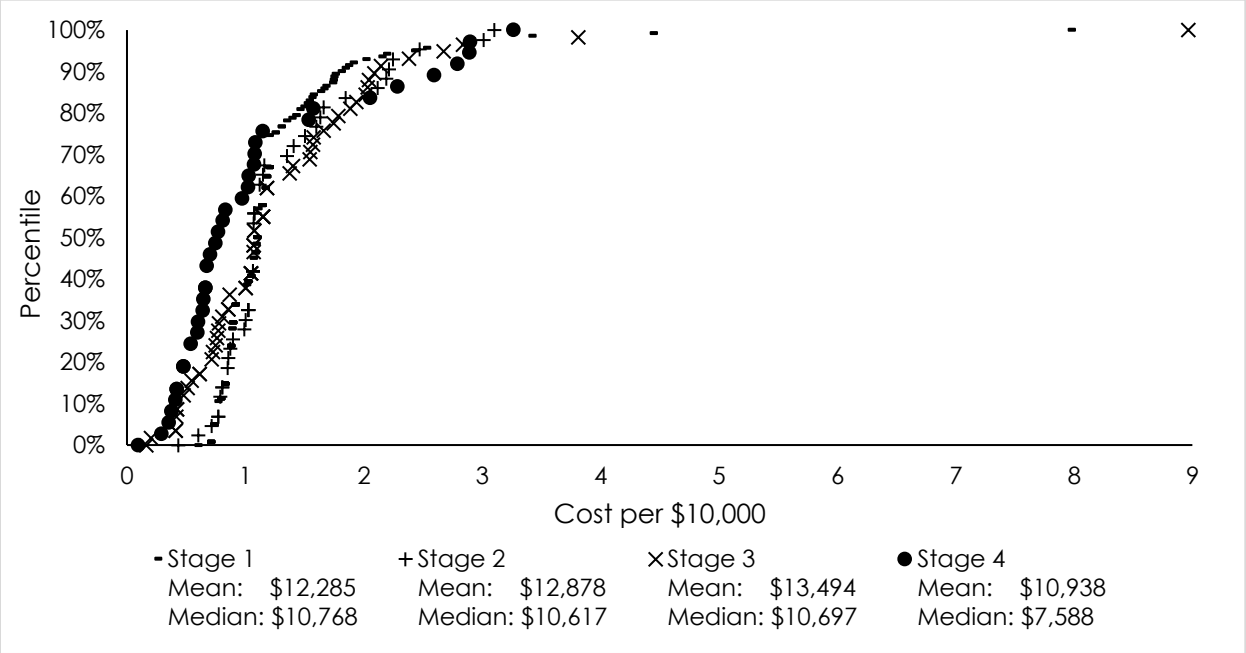


Figure 136: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with lung cancer (2013 dollars)

Figure 137: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with lung cancer (2013 dollars)

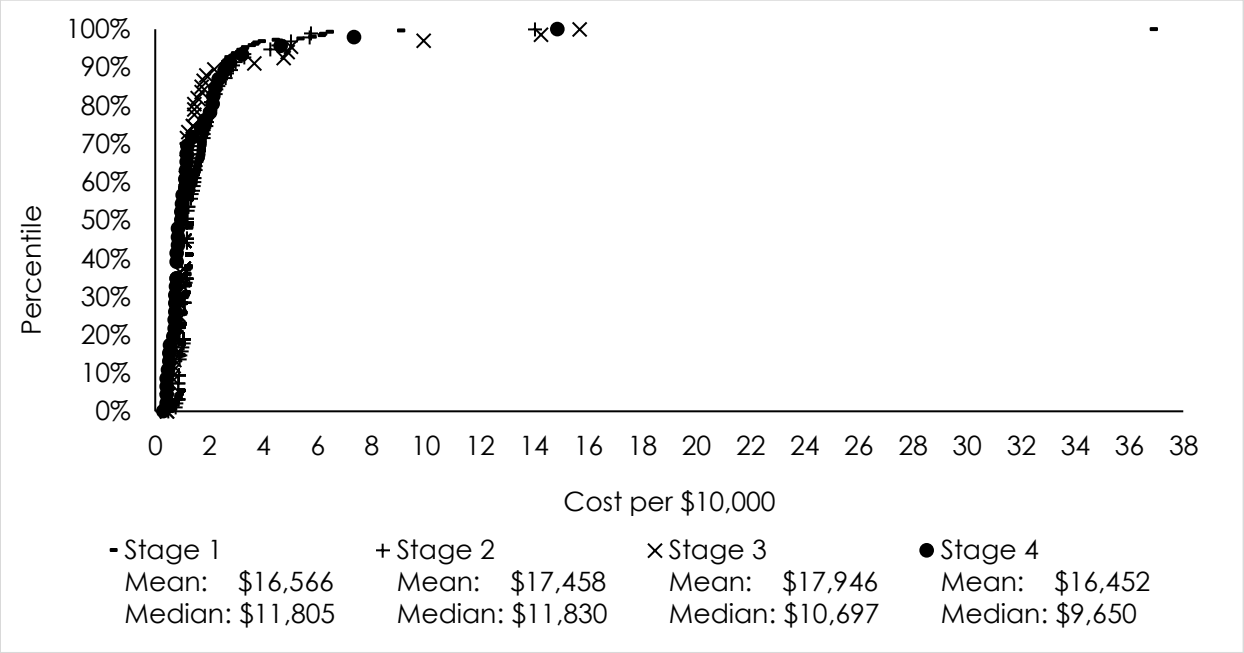


Figure 138: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with lung cancer (2013 dollars)

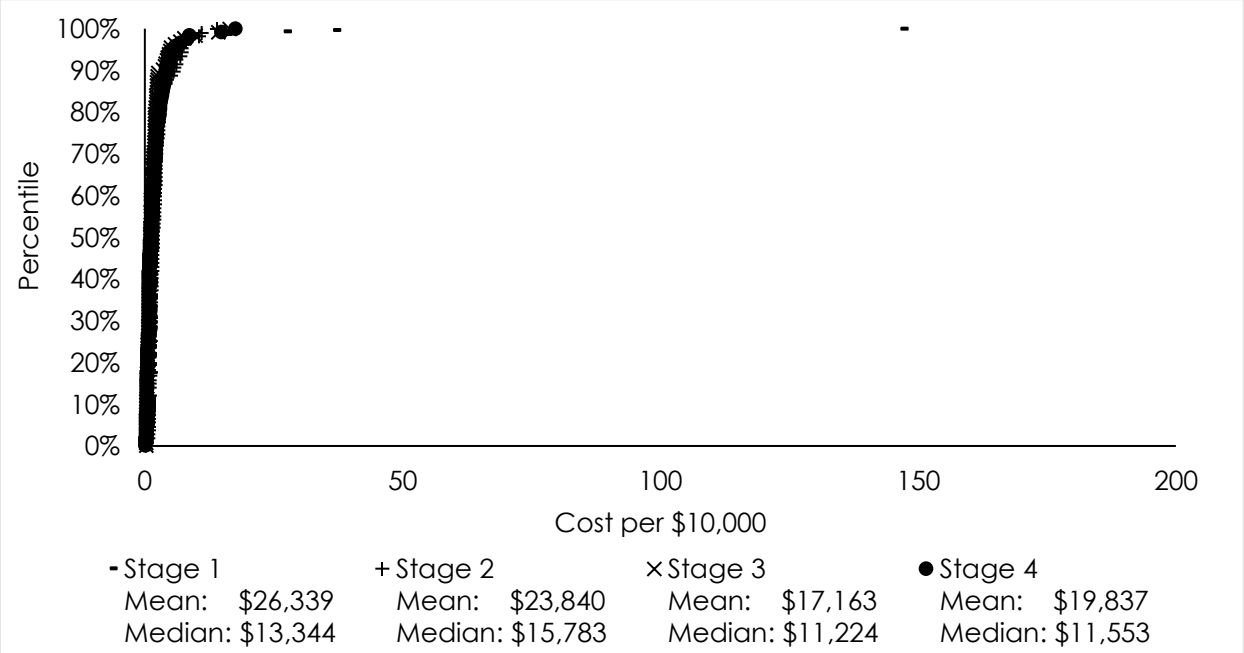


Figure 139: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with myeloma (2013 dollars)

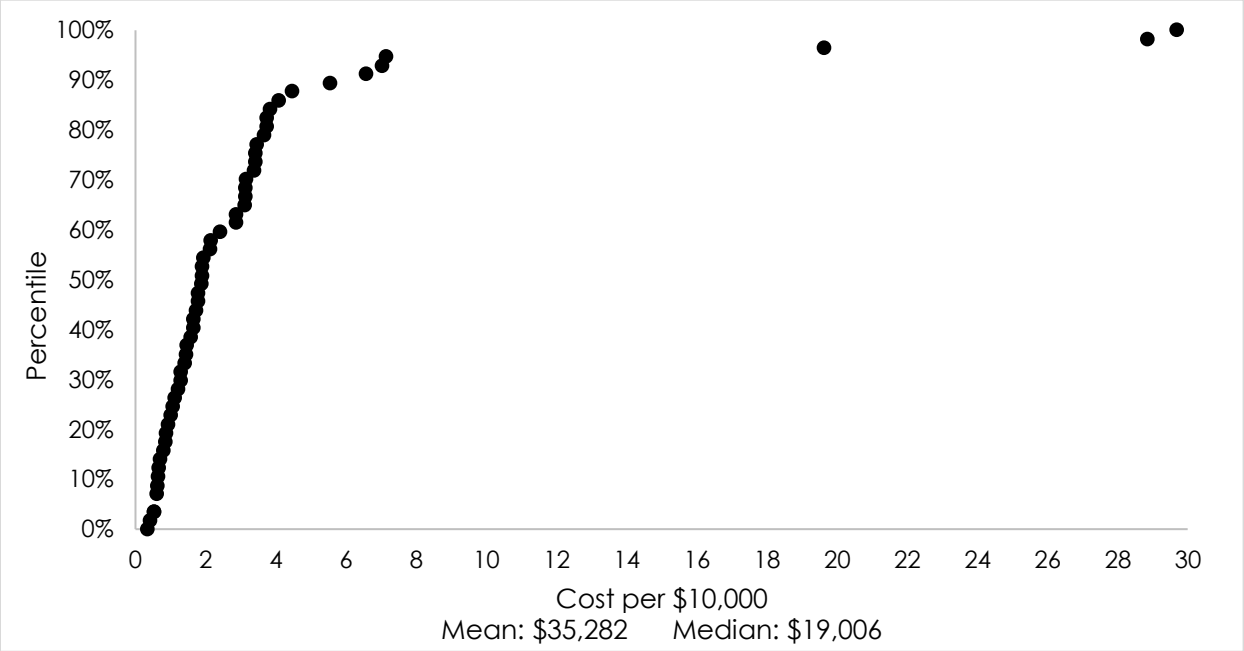


Figure 140: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients 18 to 64 years with myeloma (2013 dollars)

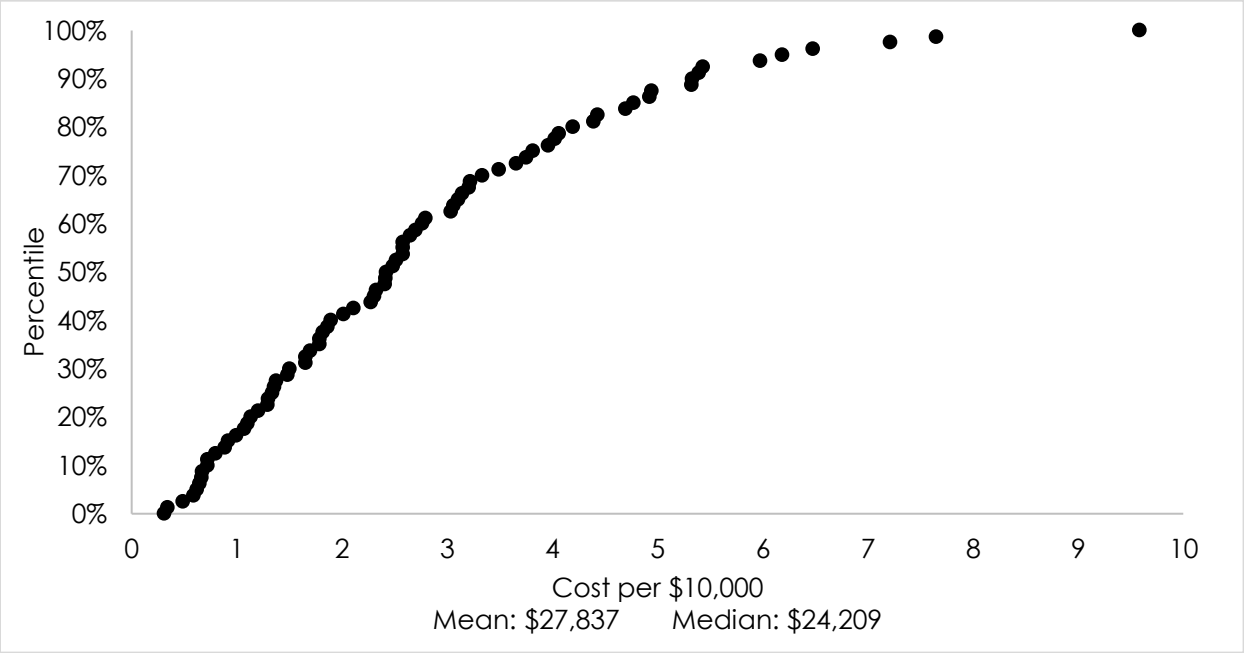


Figure 141: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with myeloma (2013 dollars)

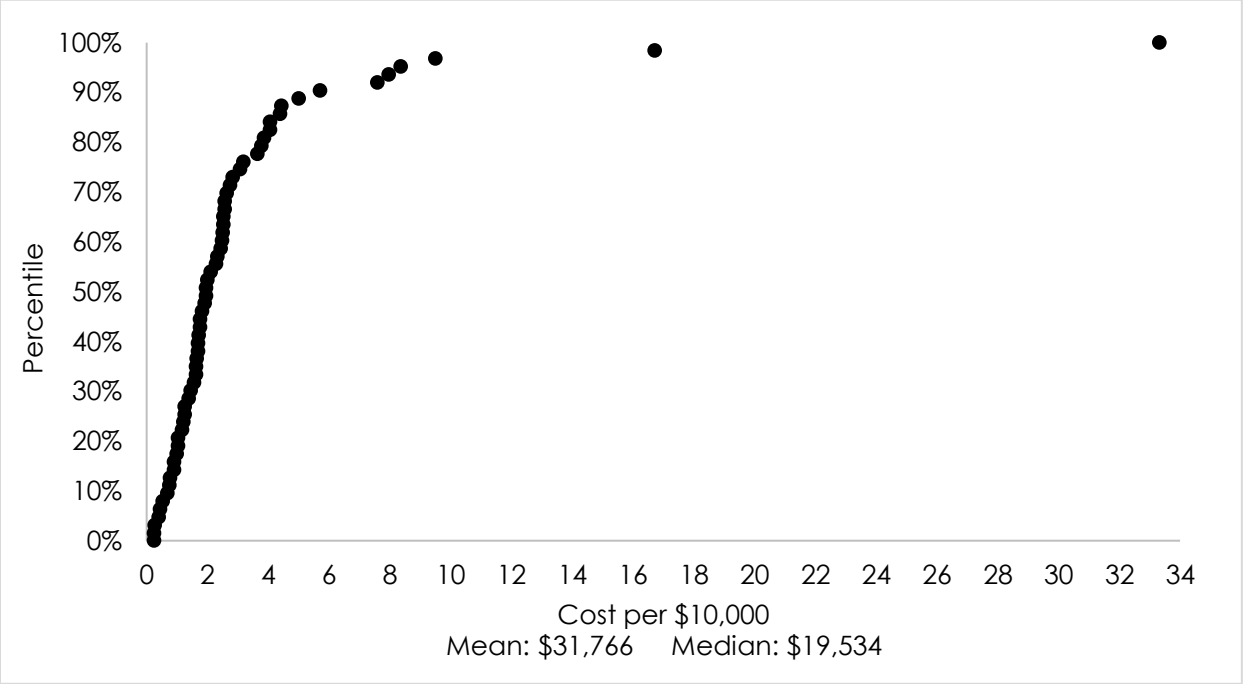
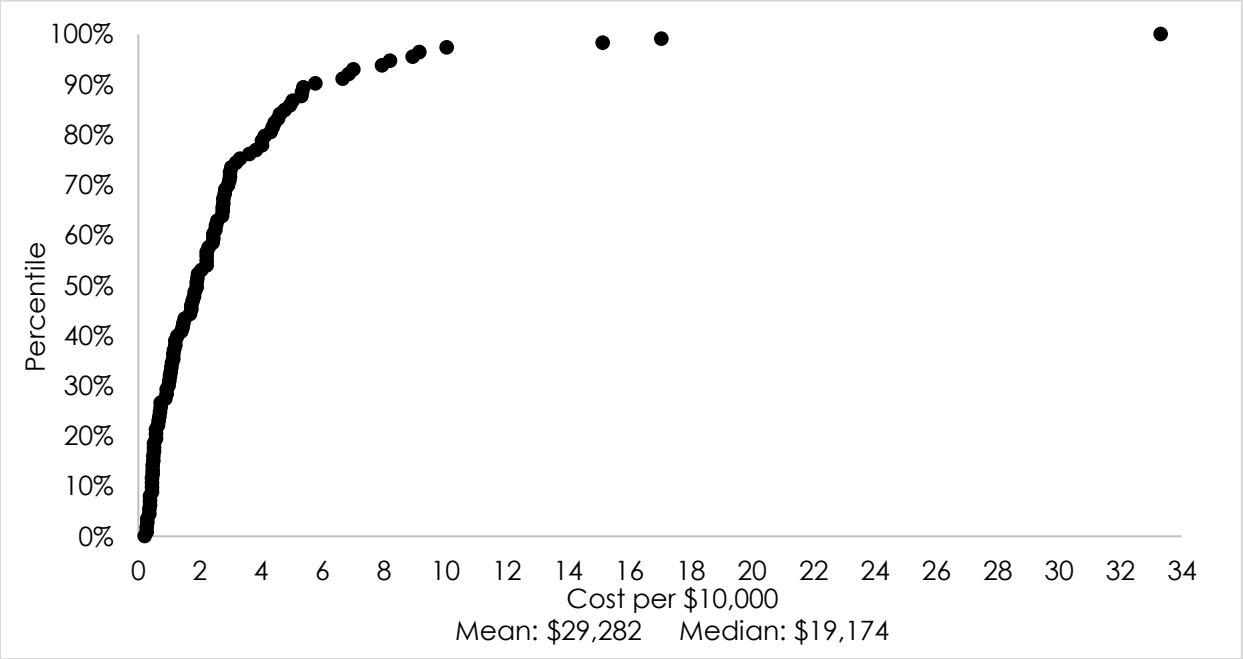


Figure 142: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with myeloma (2013 dollars)



Non-Hodgkin's lymphoma

Figure 143: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with non-Hodgkin's lymphoma (2013 dollars)

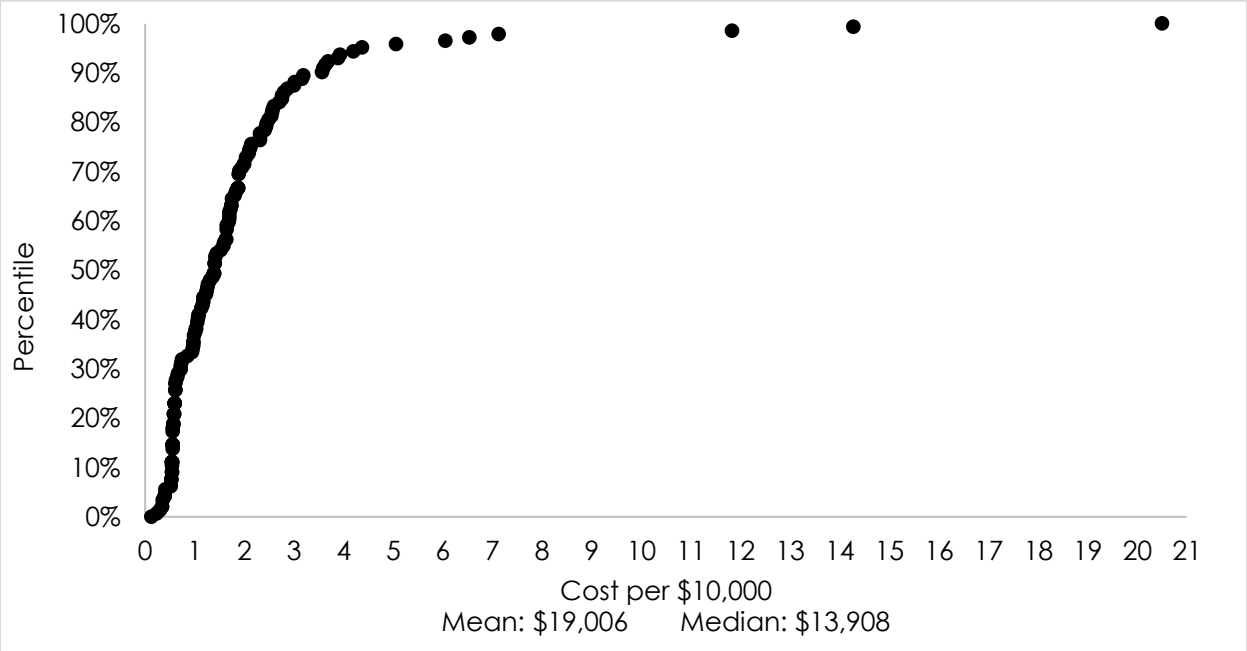


Figure 144: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18-64 years with non-Hodgkin's lymphoma (2013 dollars)

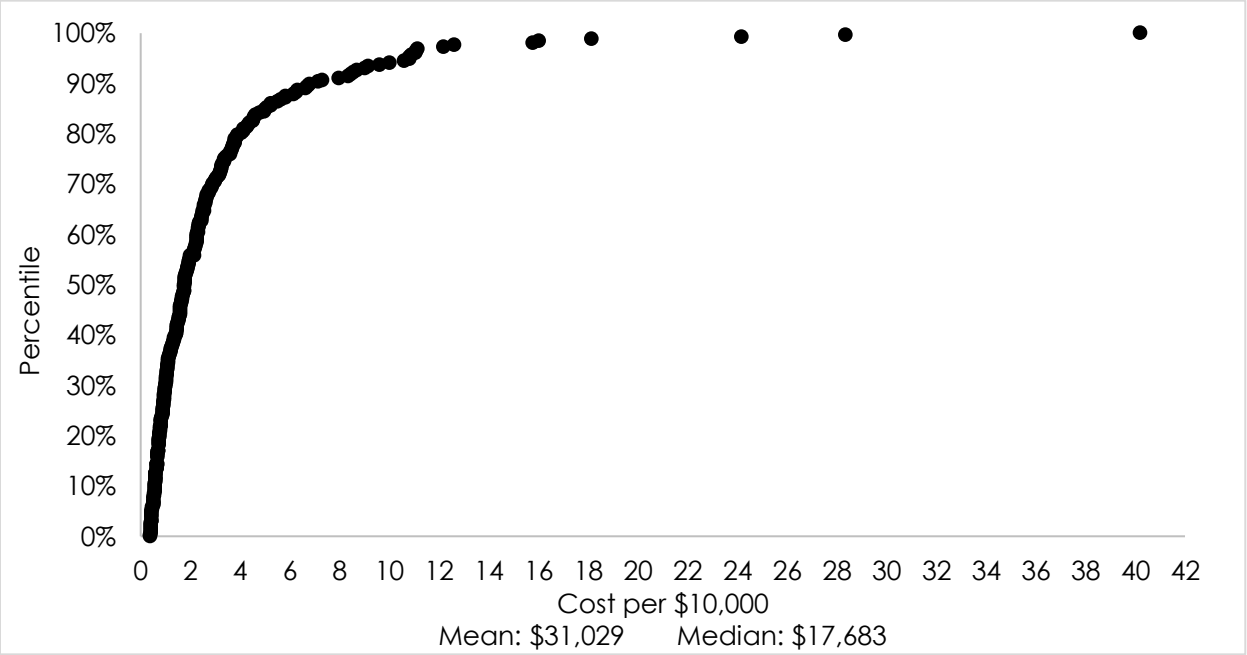


Figure 145: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with non-Hodgkin's lymphoma (2013 dollars)

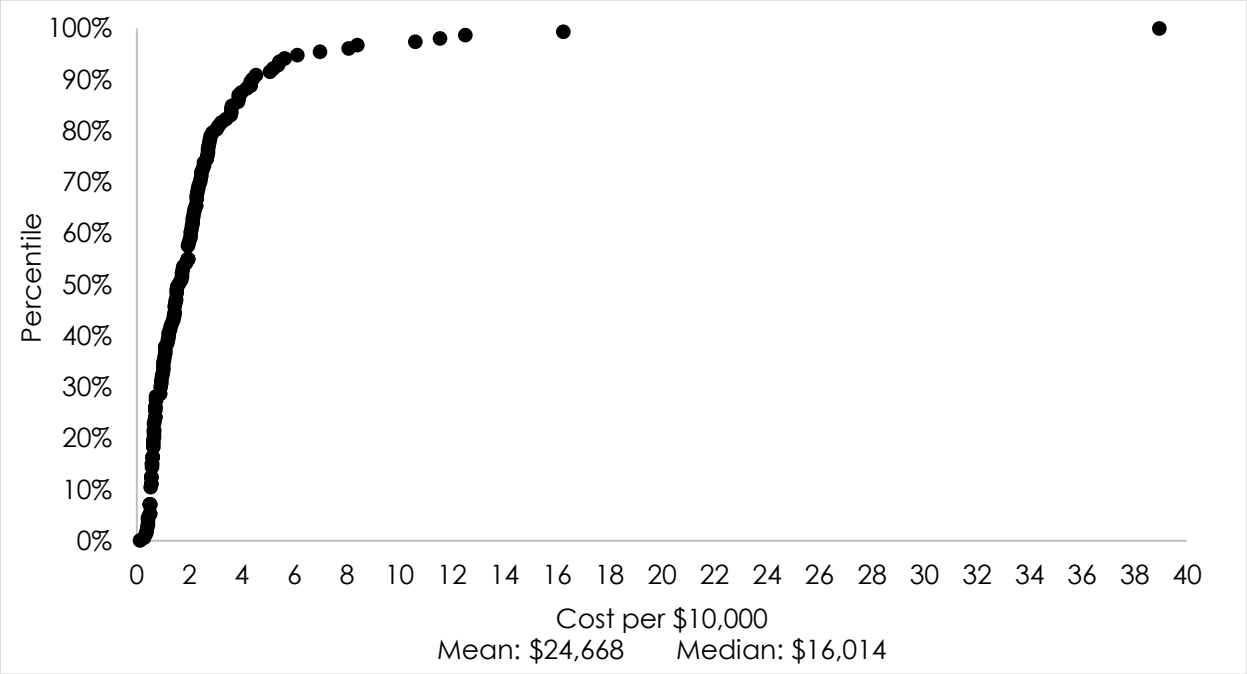
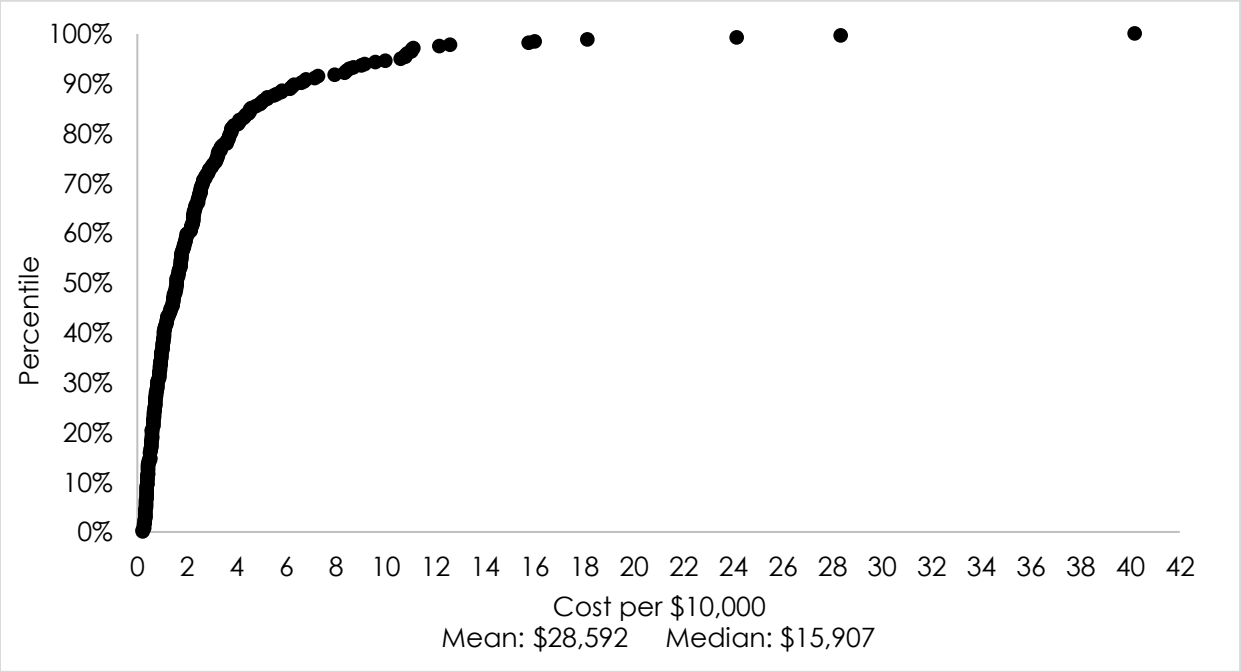


Figure 146: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with non-Hodgkin's lymphoma (2013 dollars)



Oesophageal cancer

Figure 147: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

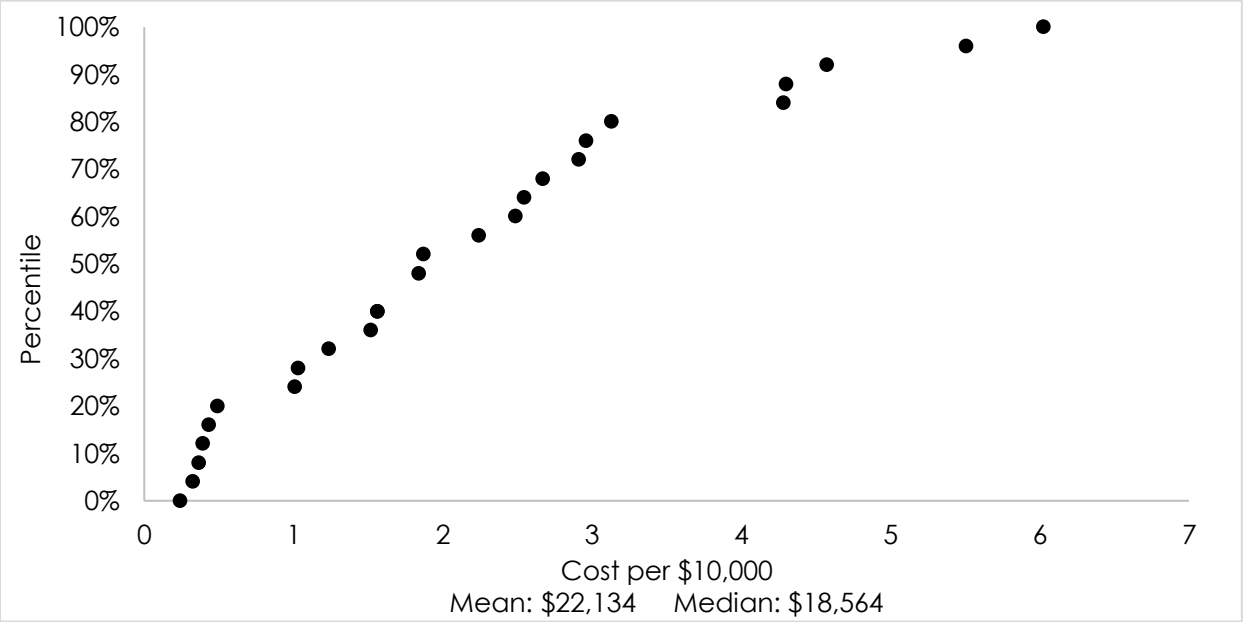


Figure 148: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

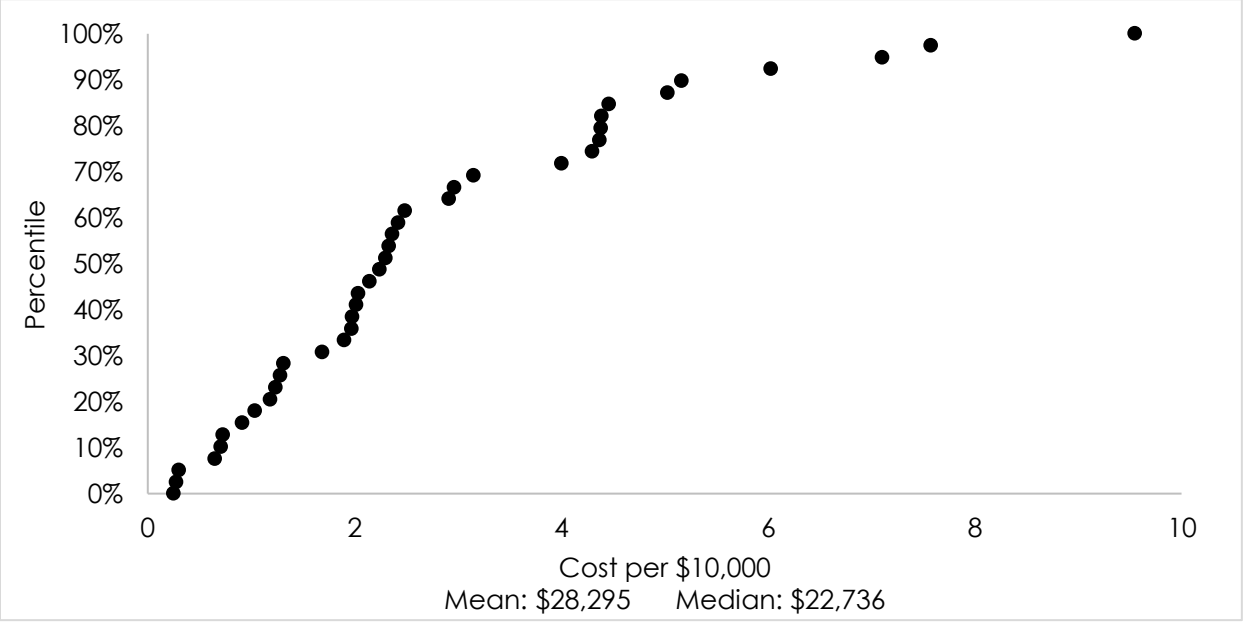


Figure 149: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with oesophageal cancer (2013 dollars)

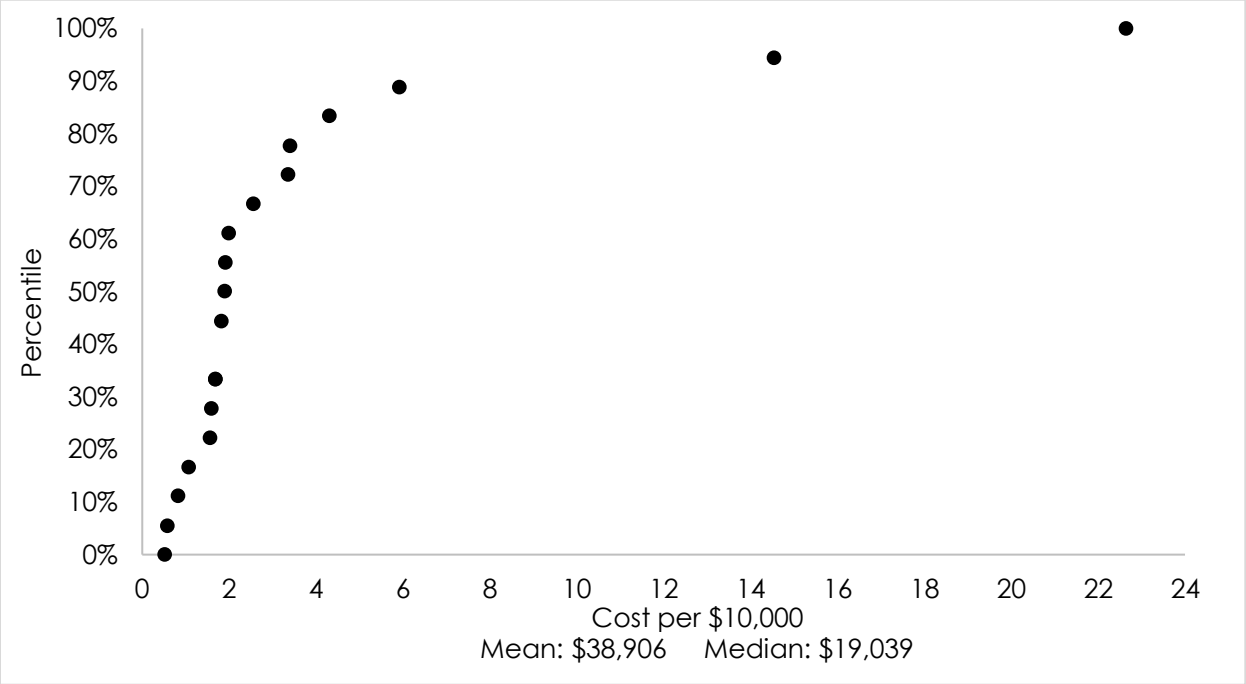


Figure 150: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with oesophageal cancer (2013 dollars)

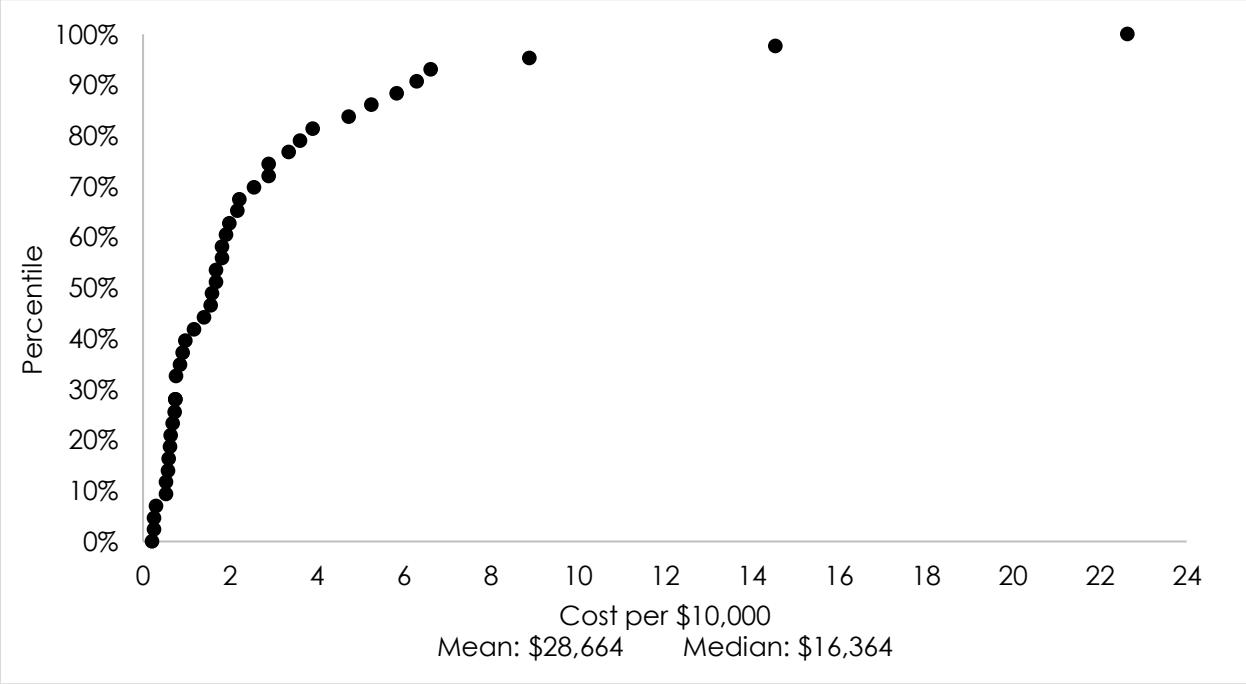


Figure 151: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with prostate cancer (2013 dollars)

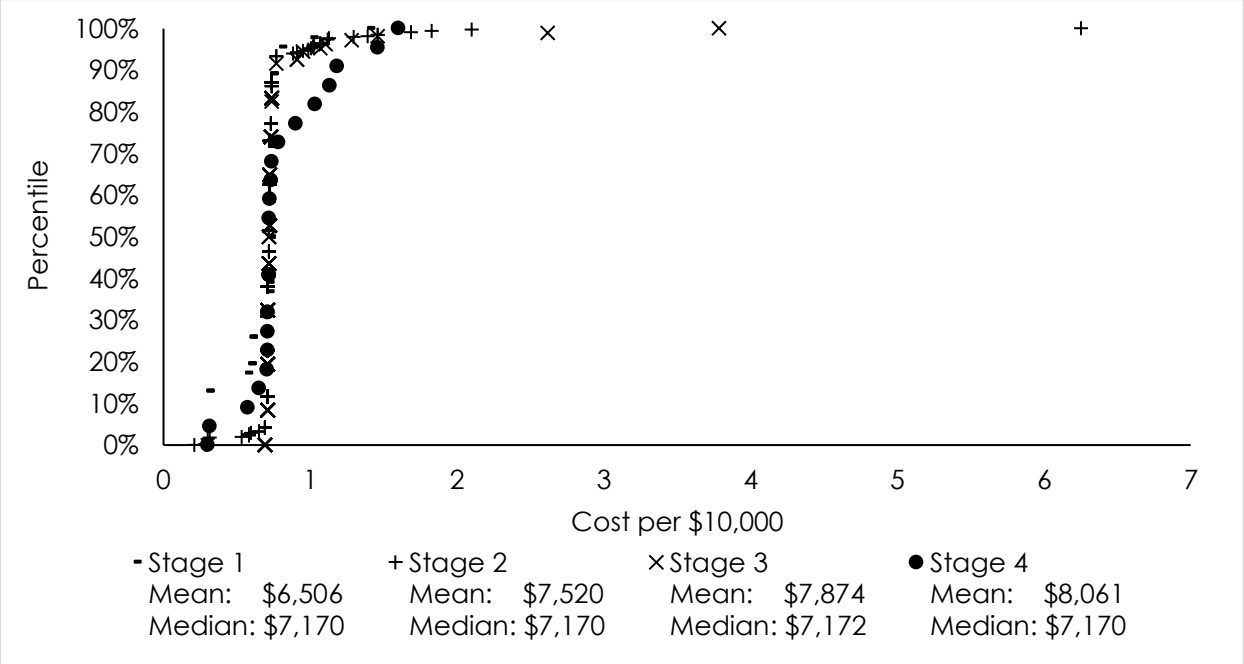


Figure 152: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with prostate cancer (2013 dollars)

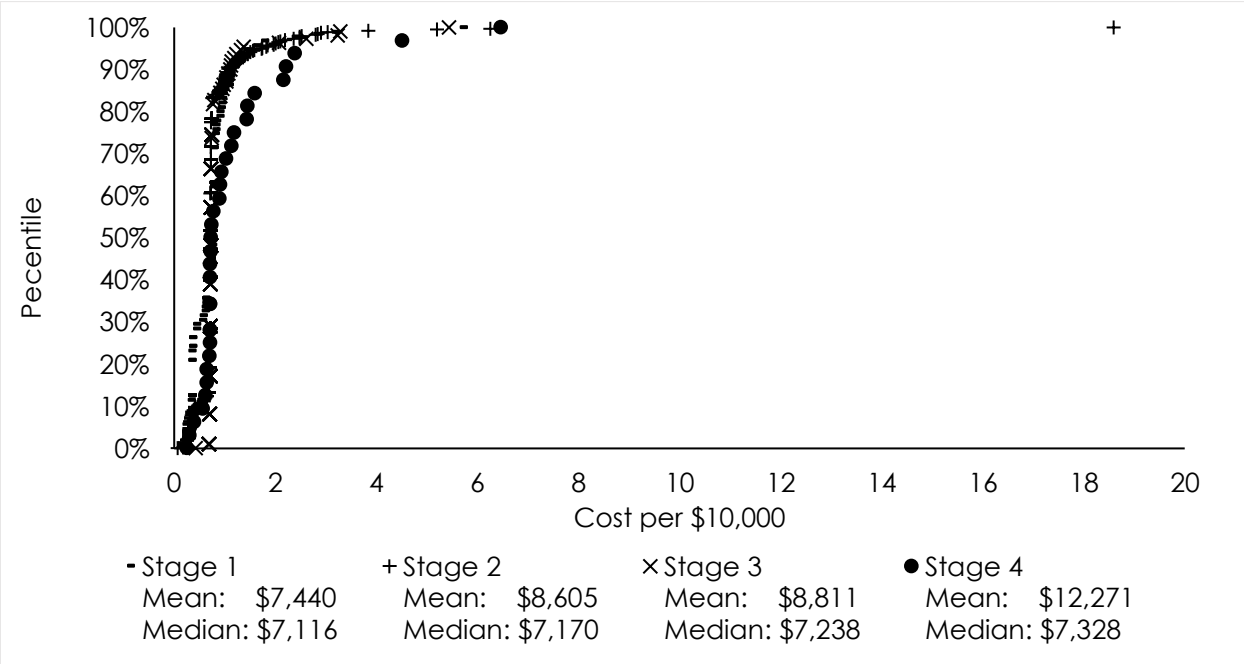


Figure 153: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with prostate cancer (2013 dollars)

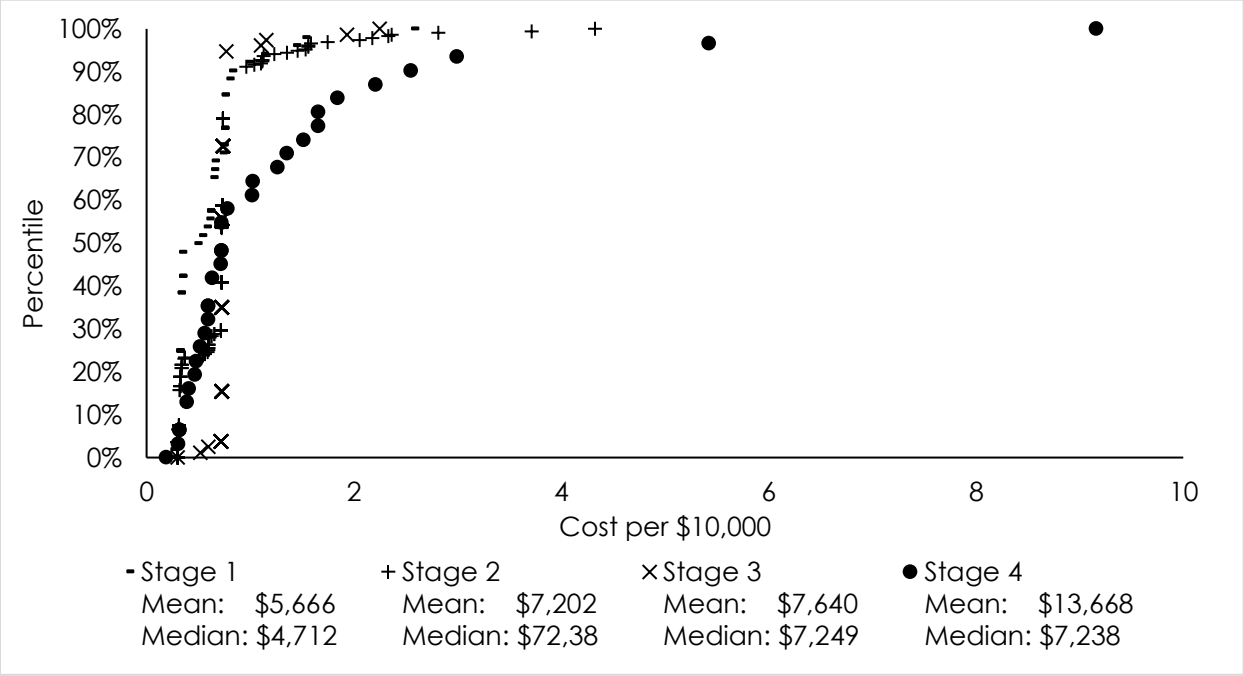
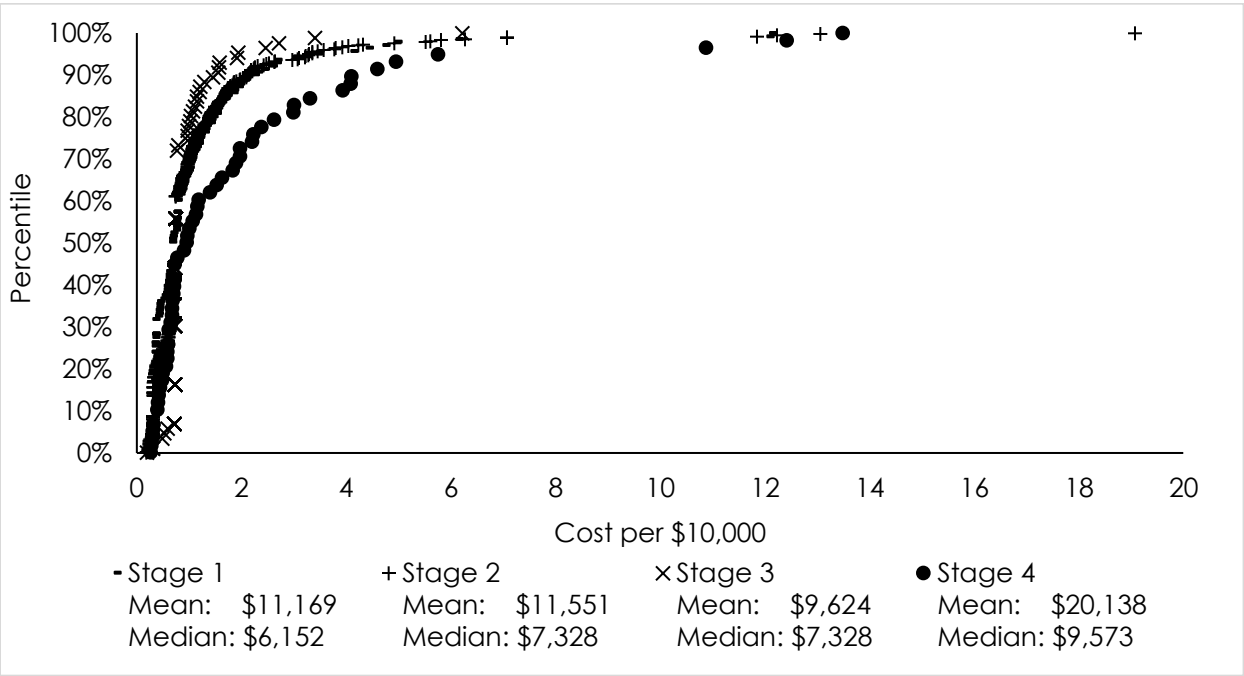


Figure 154: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with prostate cancer (2013 dollars)



Rectal cancer

Figure 155: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with rectal cancer (2013 dollars)

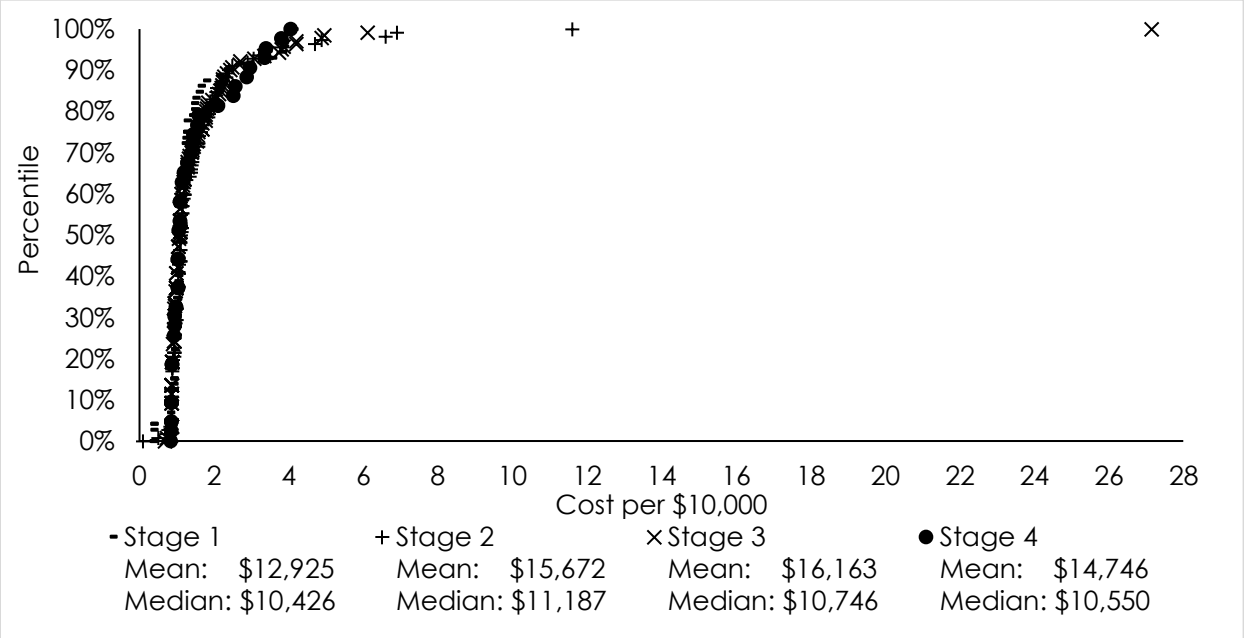


Figure 156: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with rectal cancer (2013 dollars)

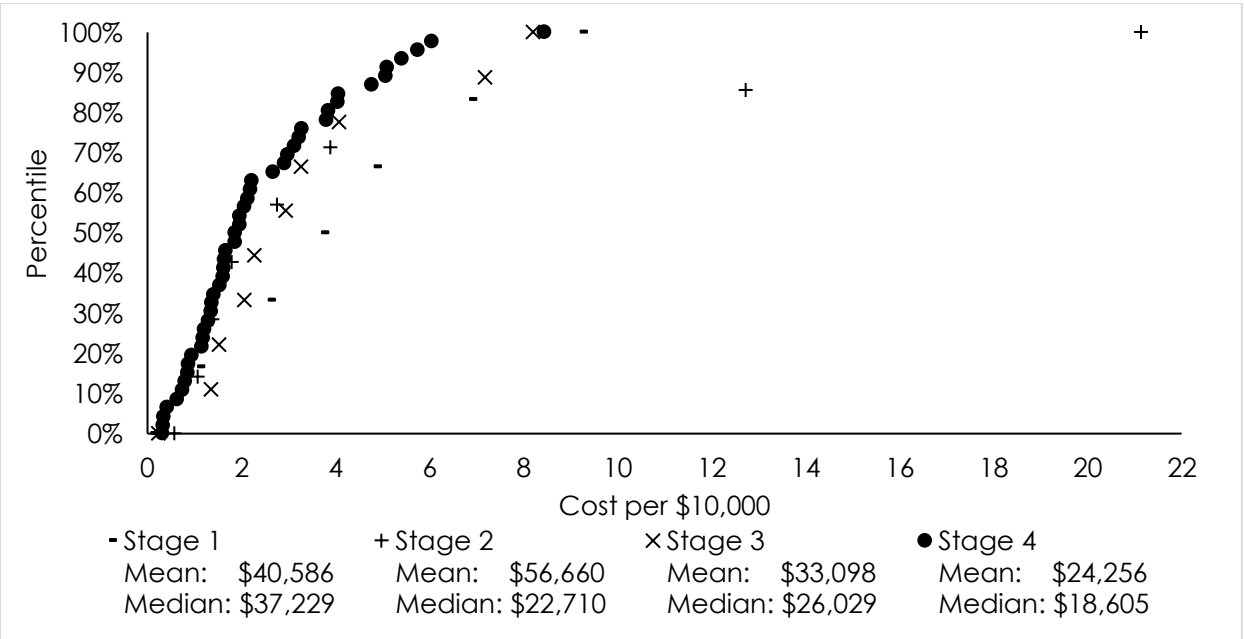


Figure 157: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with rectal cancer (2013 dollars)

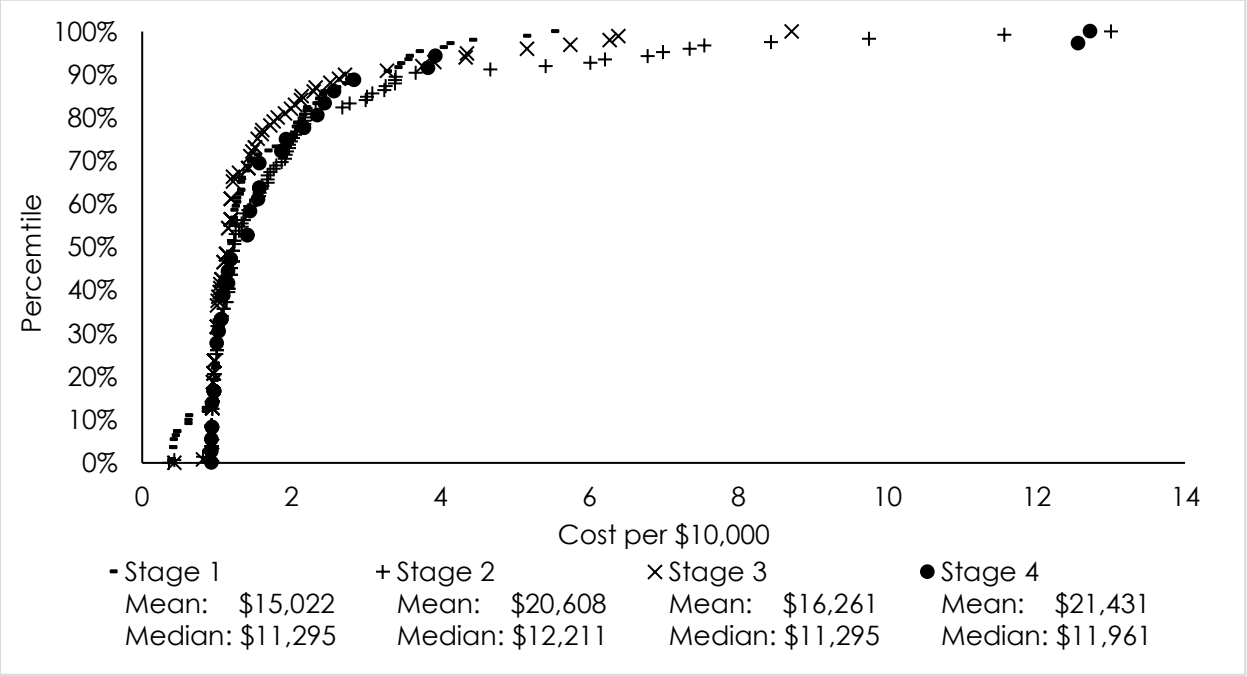


Figure 158: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with rectal cancer (2013 dollars)

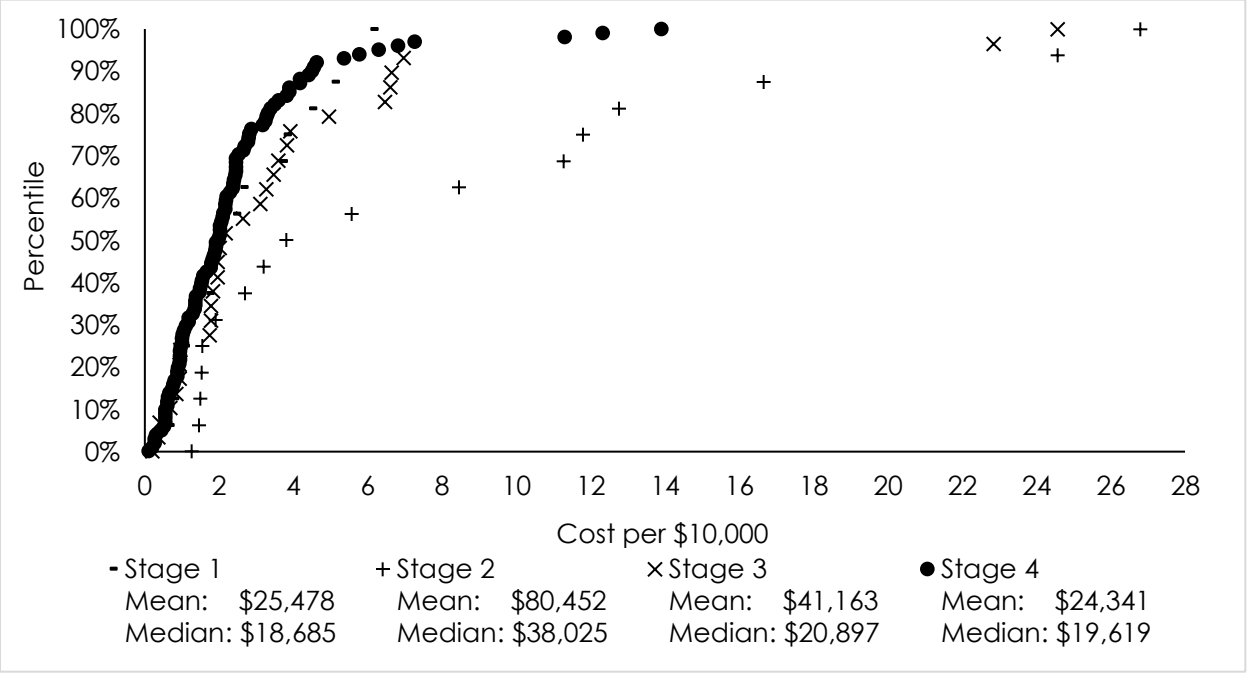


Figure 159: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with skin cancer (2013 dollars)

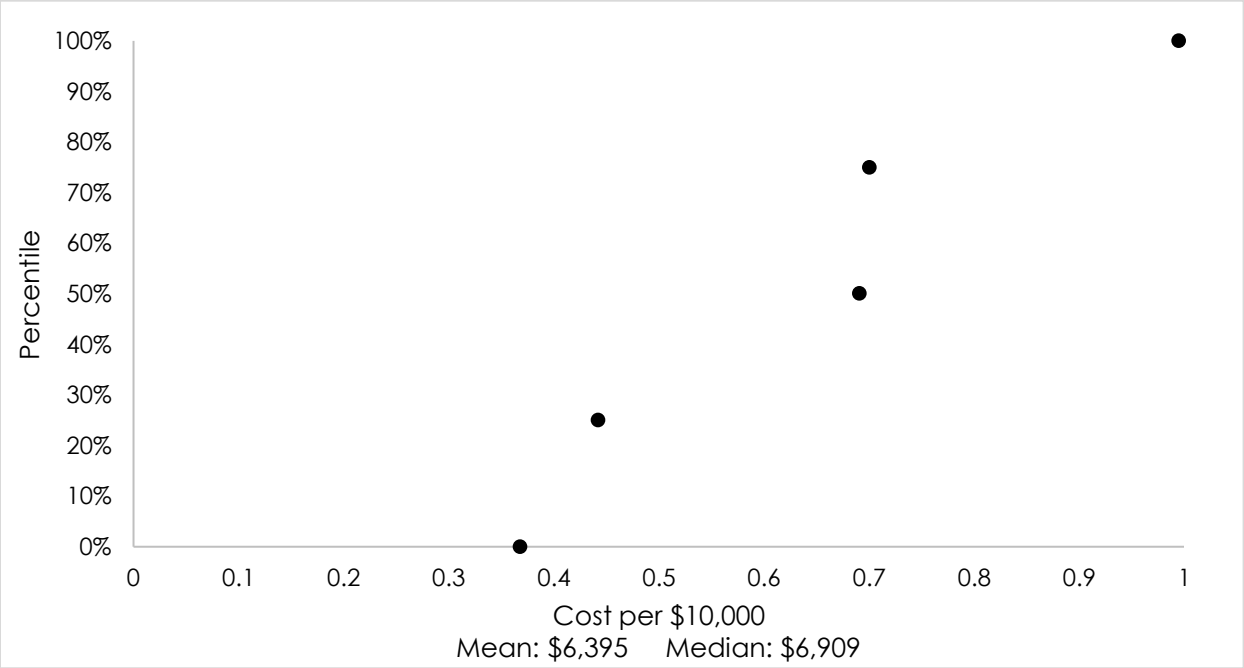


Figure 160. Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with skin cancer (2013 dollars)

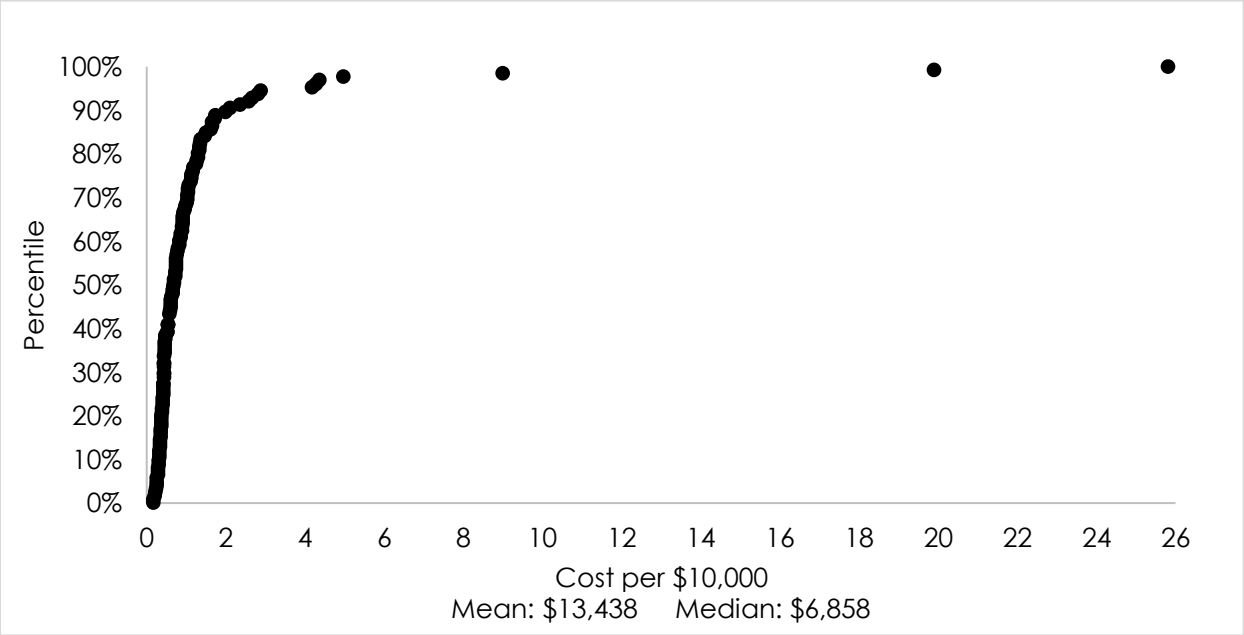


Figure 161: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with skin cancer (2013 dollars)

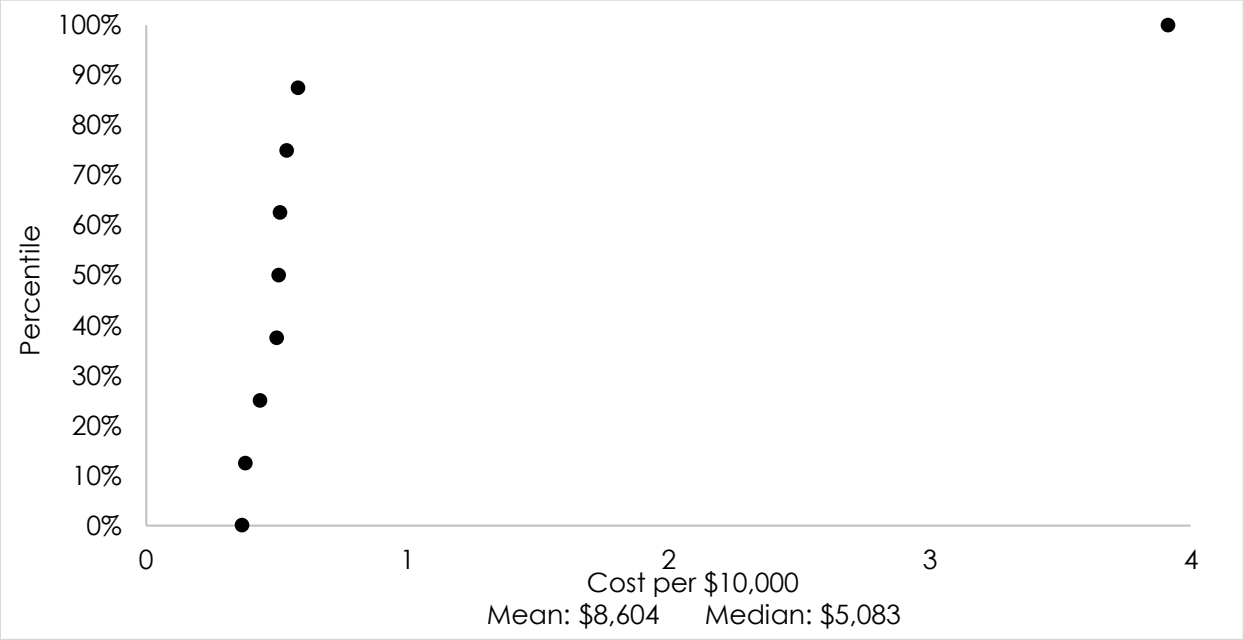


Figure 162: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with skin cancer (2013 dollars)

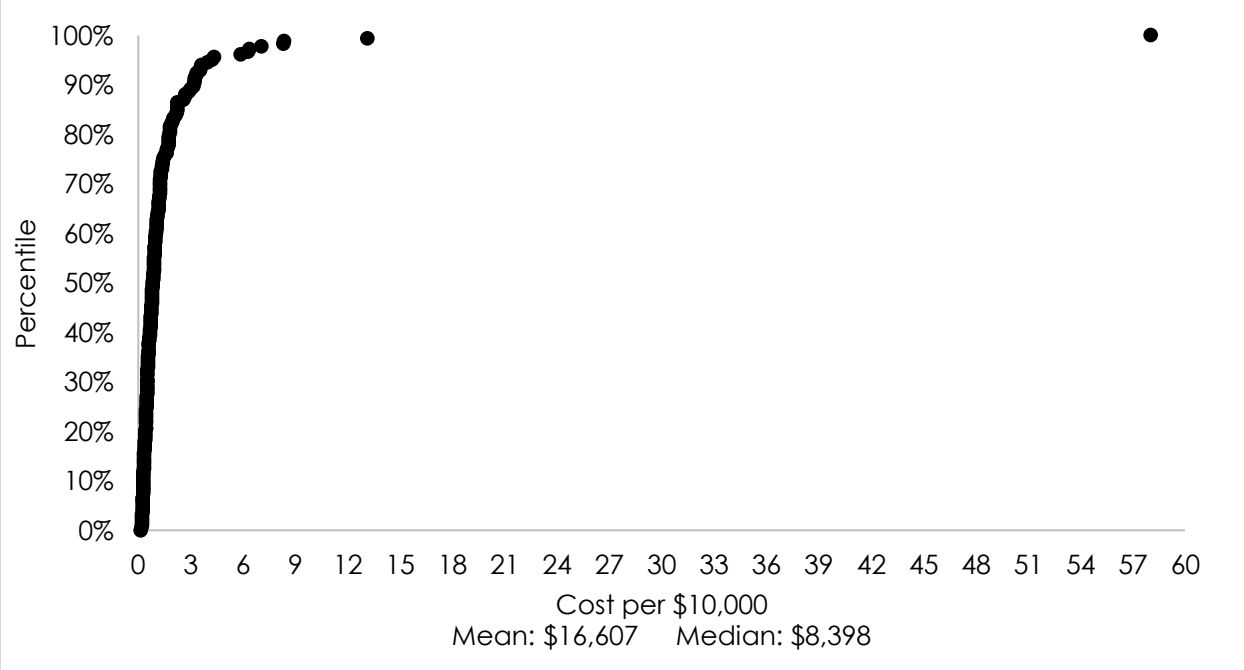


Figure 163: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with testicular cancer (2013 dollars)

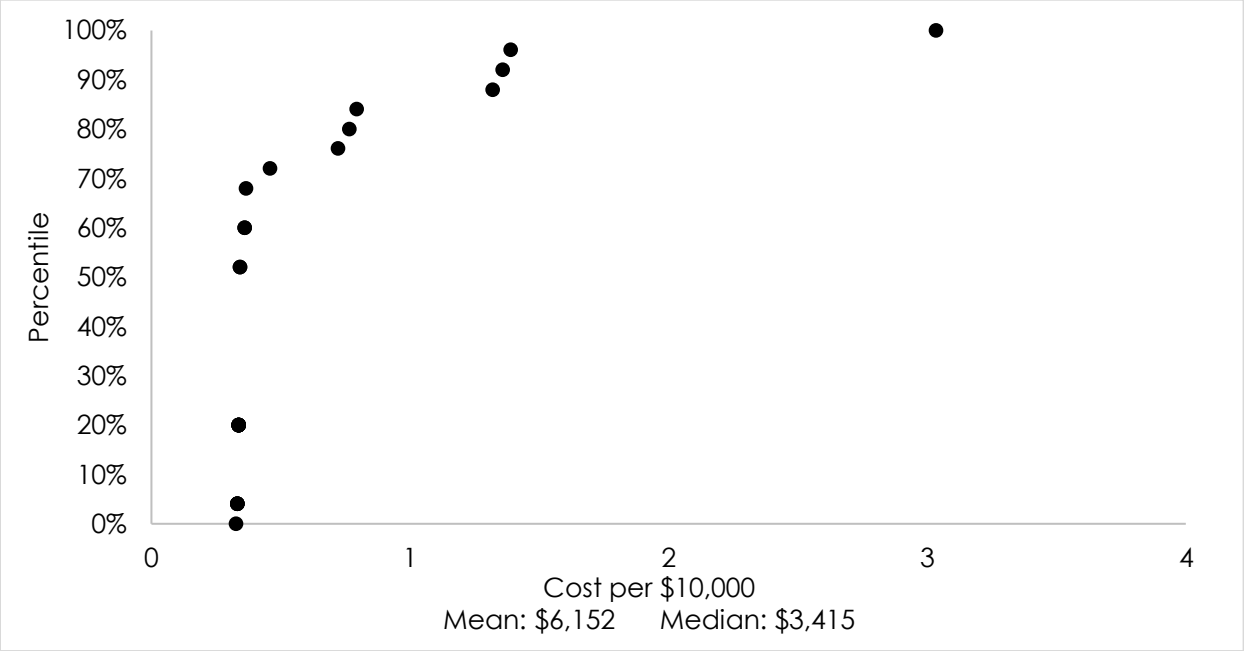
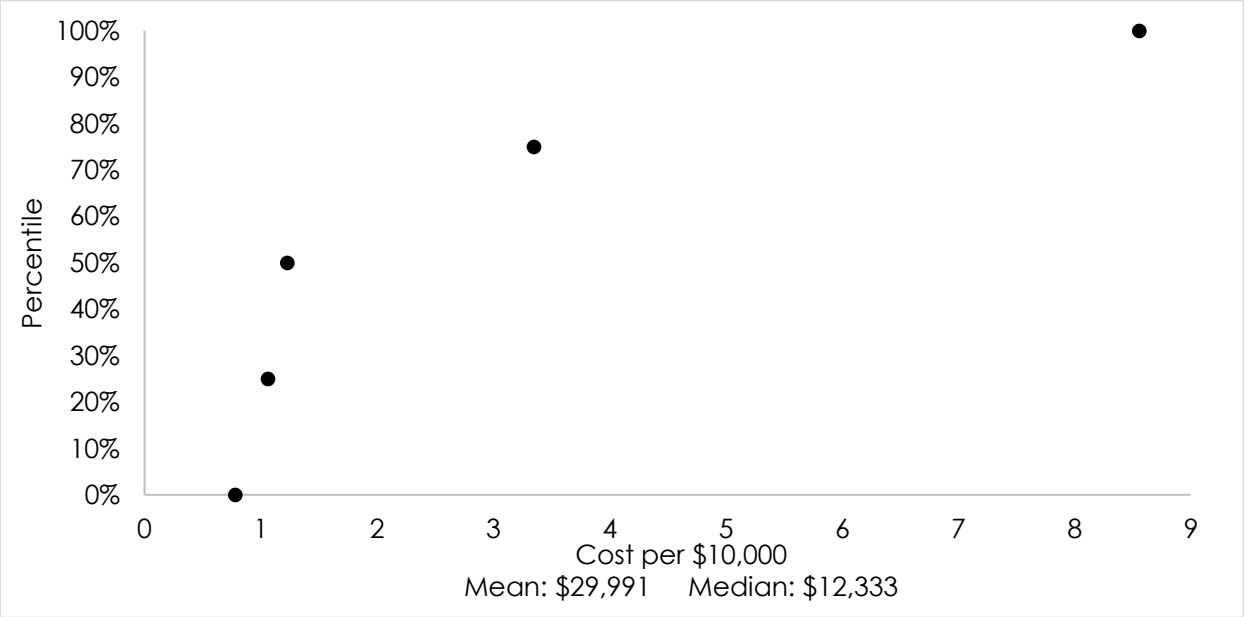


Figure 164: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with testicular cancer (2013 dollars)

*Testicular cancer 18 months conservative estimate suppressed. No mean available.

Figure 165: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with testicular cancer (2013 dollars)



Ureter cancer

Figure 166: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with ureter cancer (2013 dollars)

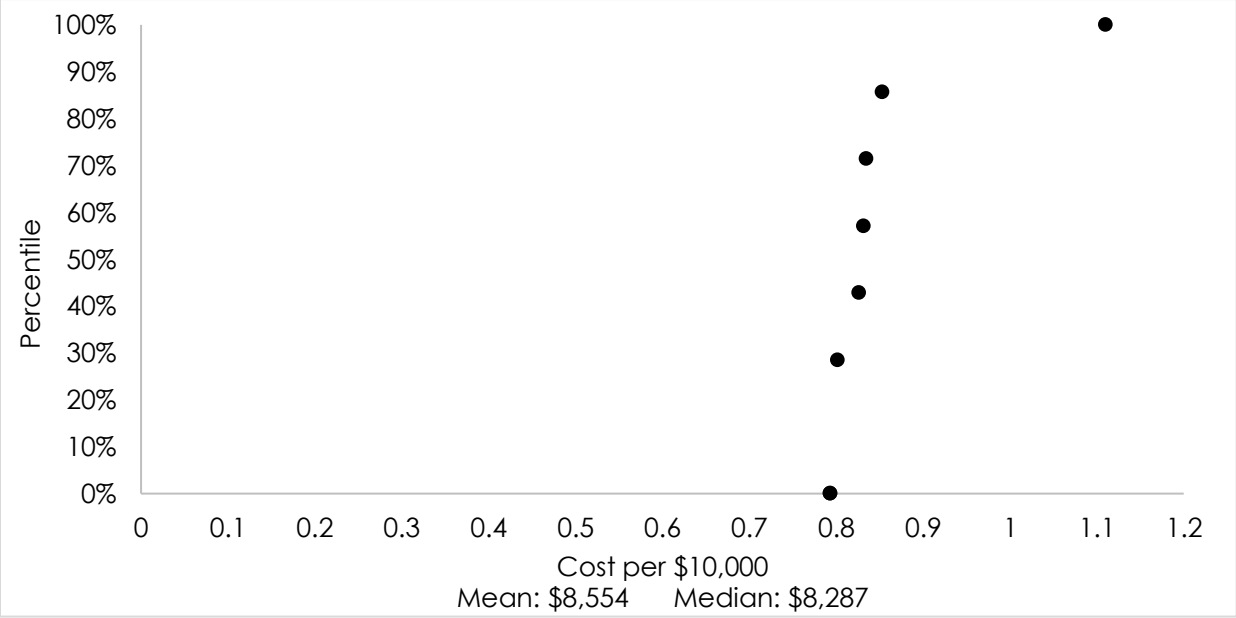


Figure 167: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 18 to 64 years with ureter cancer (2013 dollars)

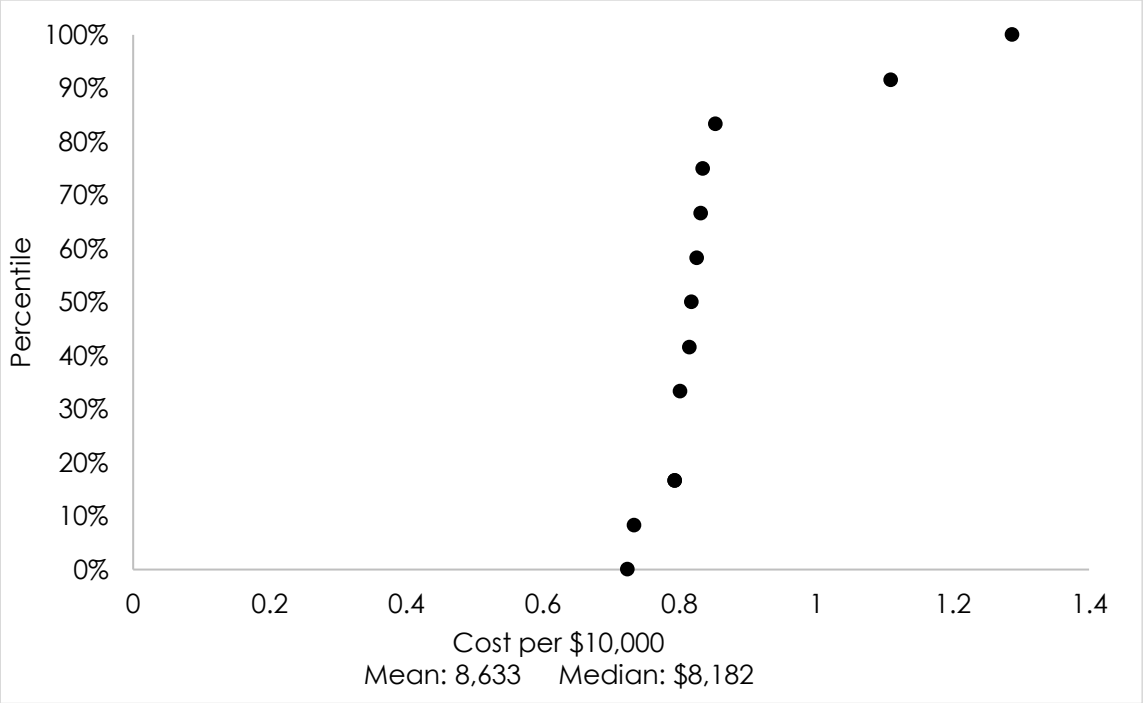


Figure 168: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with ureter cancer (2013 dollars)

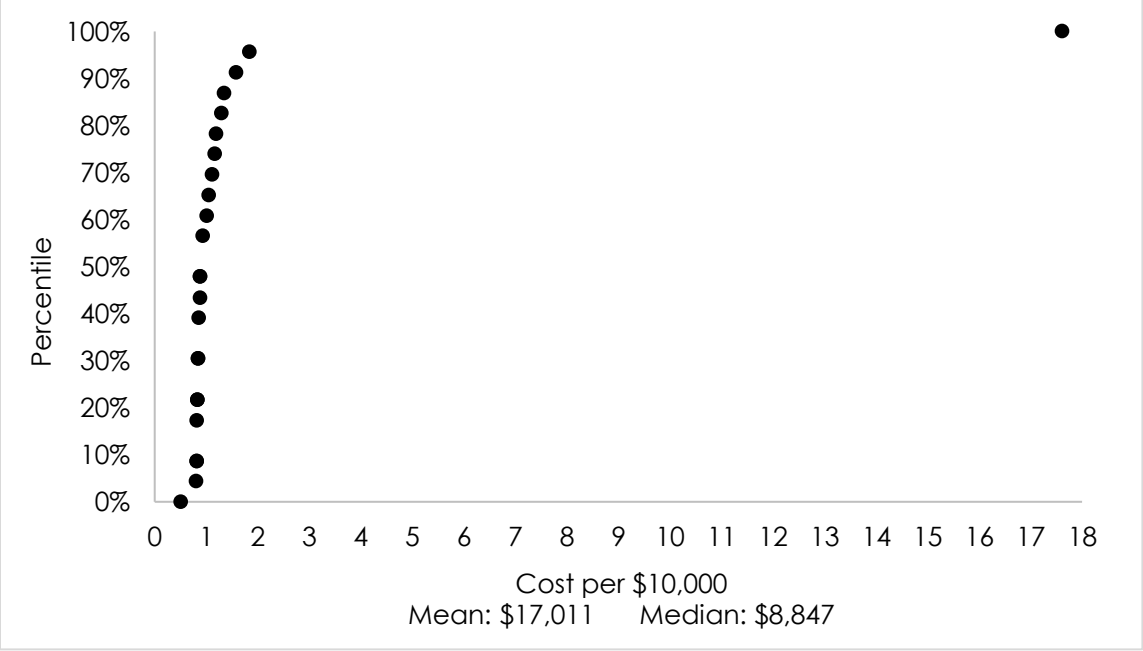
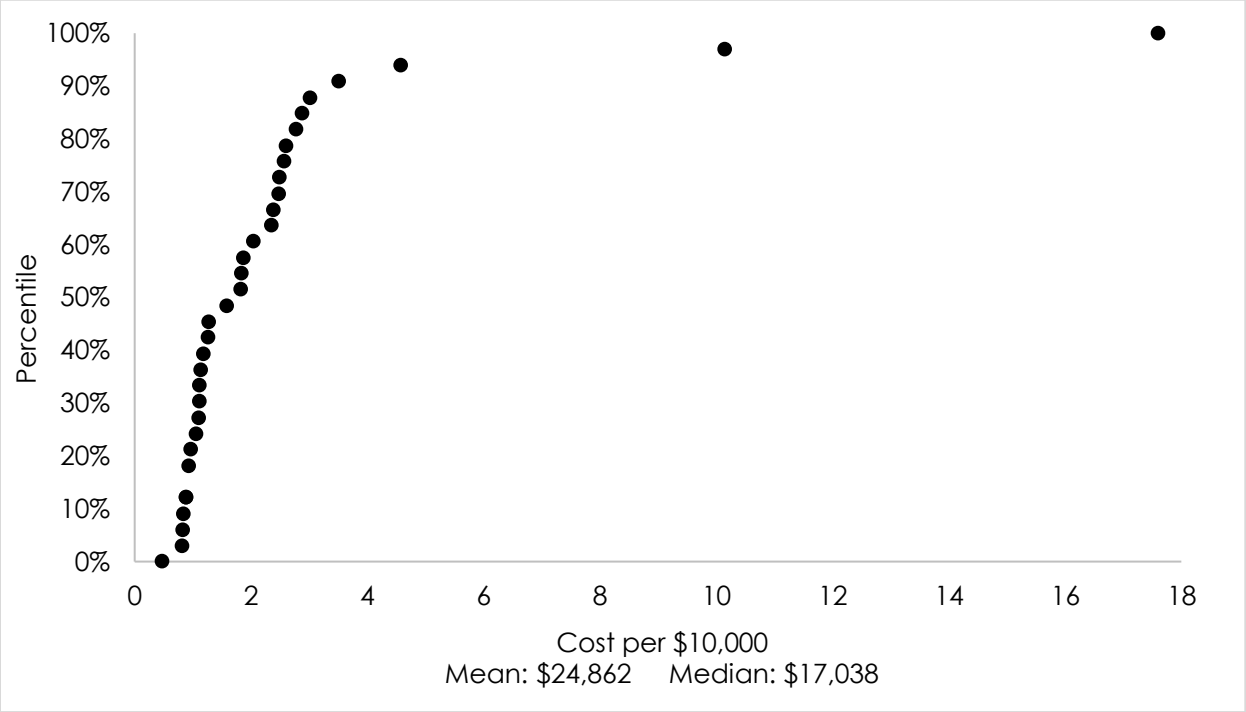


Figure 169: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the 18-month period after date of diagnosis for patients aged 65 years and older with ureter cancer (2013 dollars)



APPENDIX 5. 12-month untrimmed graphs

Bladder

Figure 170: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with bladder cancer (2013 dollars)

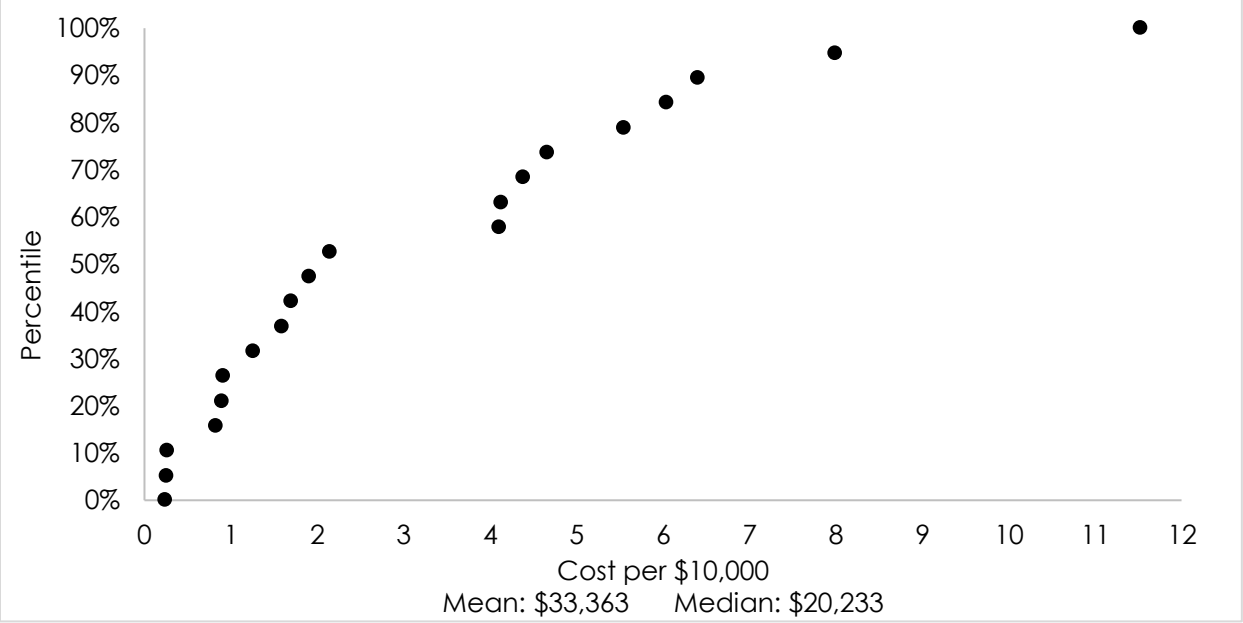


Figure 171: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with bladder cancer (2013 dollars)

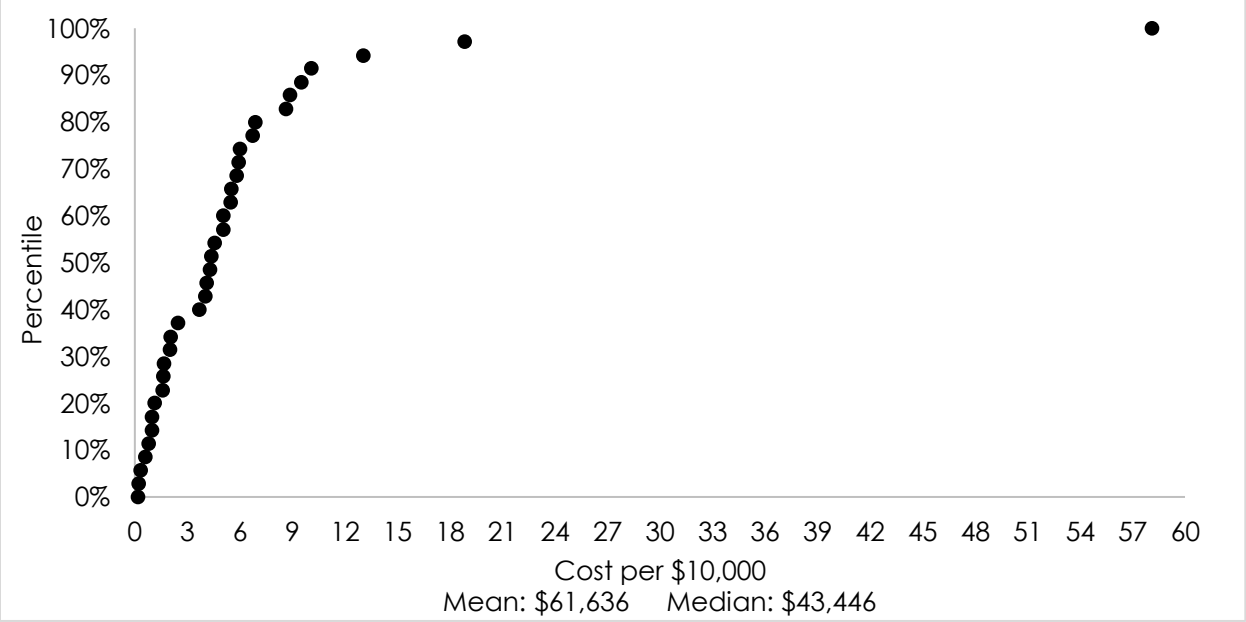


Figure 172: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with bladder cancer (2013 dollars)

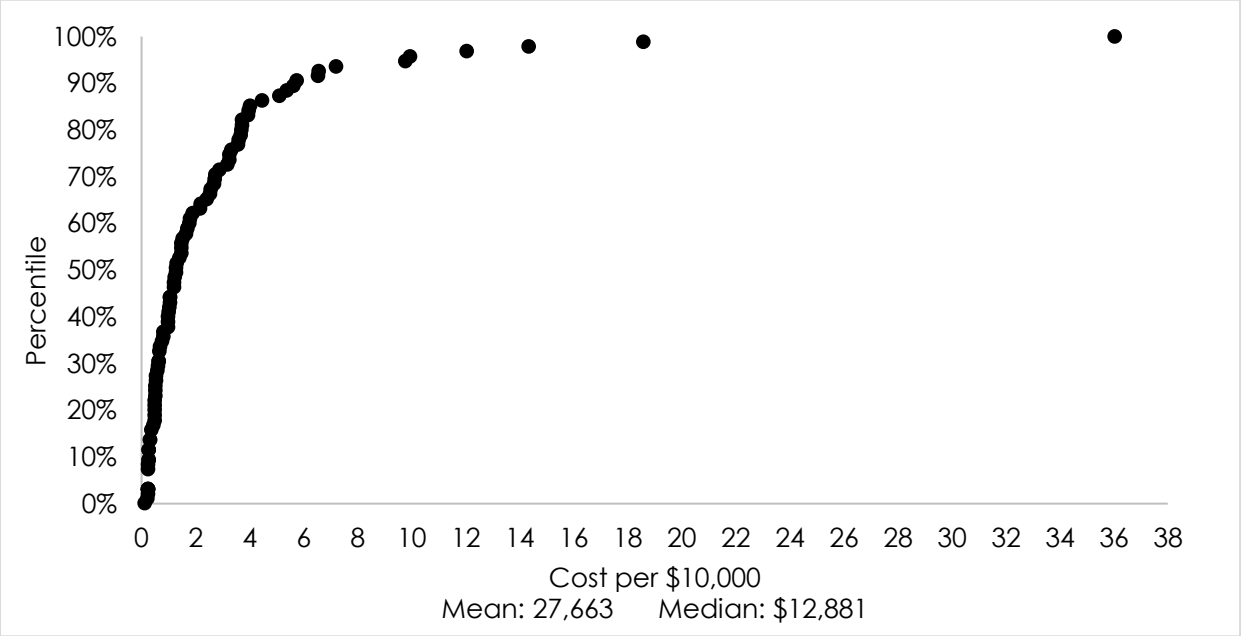


Figure 173: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with bladder cancer (2013 dollars)

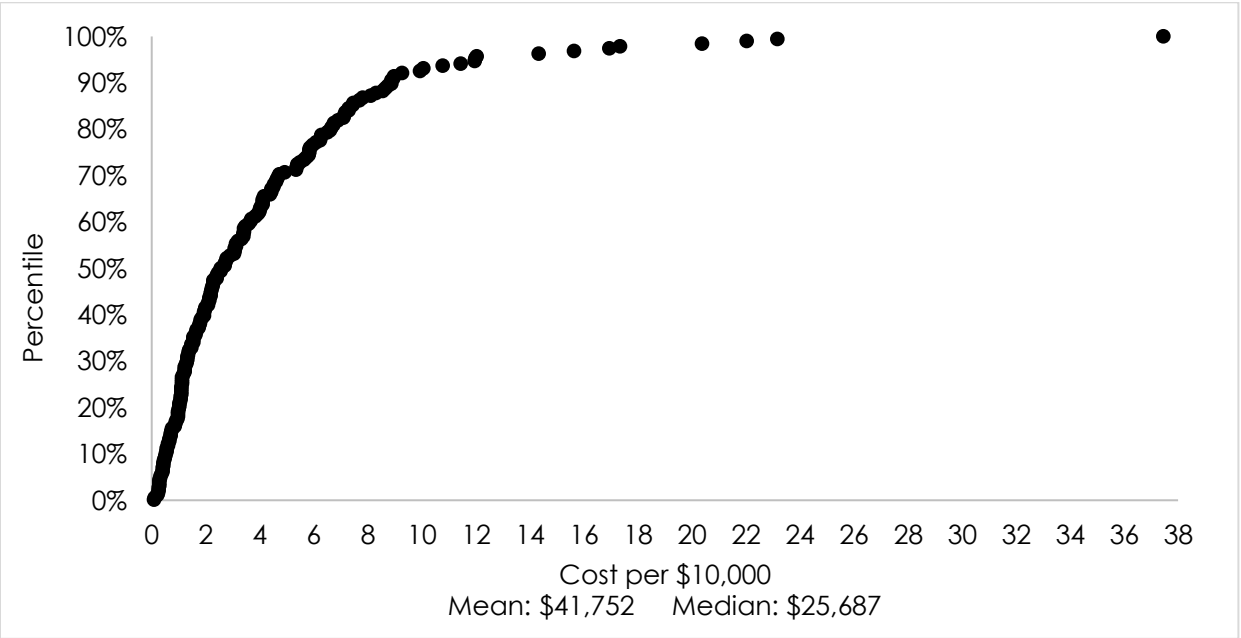


Figure 174: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with brain cancer (2013 dollars)

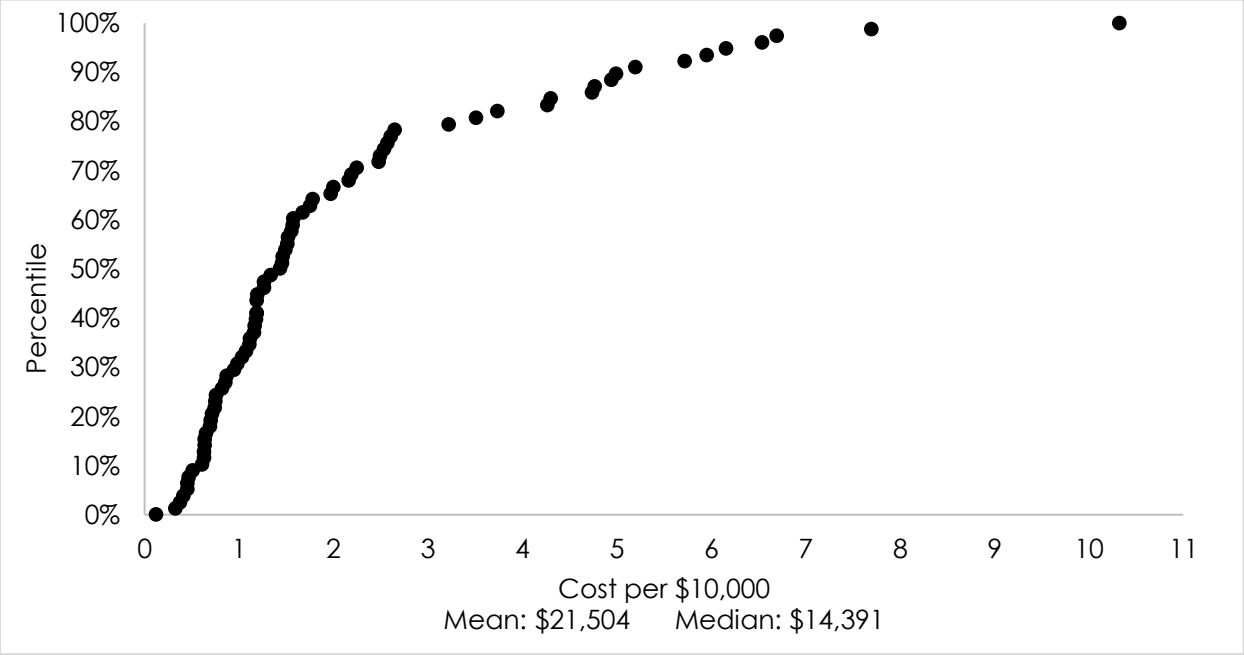


Figure 175: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with brain cancer (2013 dollars)

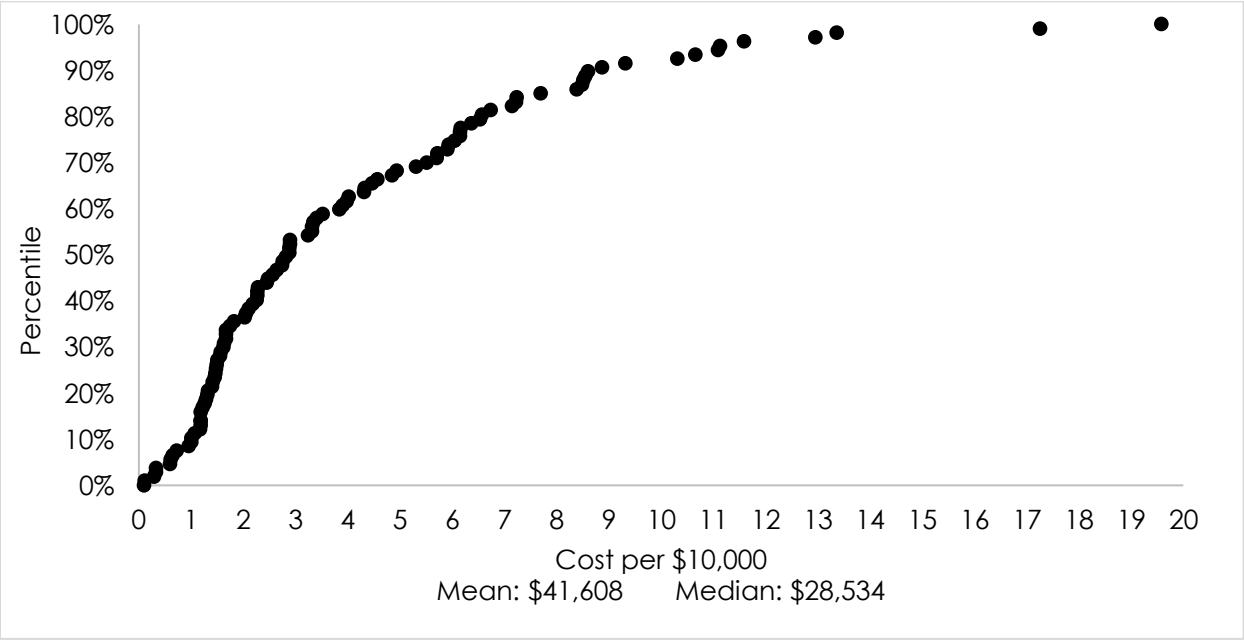


Figure 176: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with brain cancer (2013 dollars)

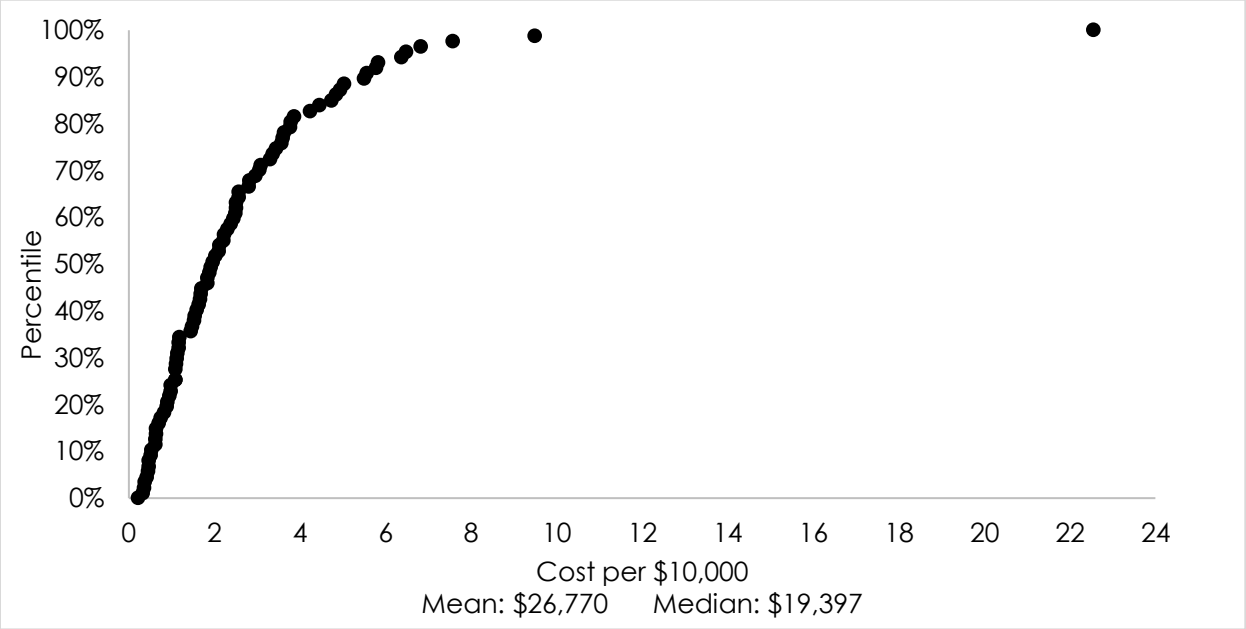


Figure 177: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with brain cancer (2013 dollars)

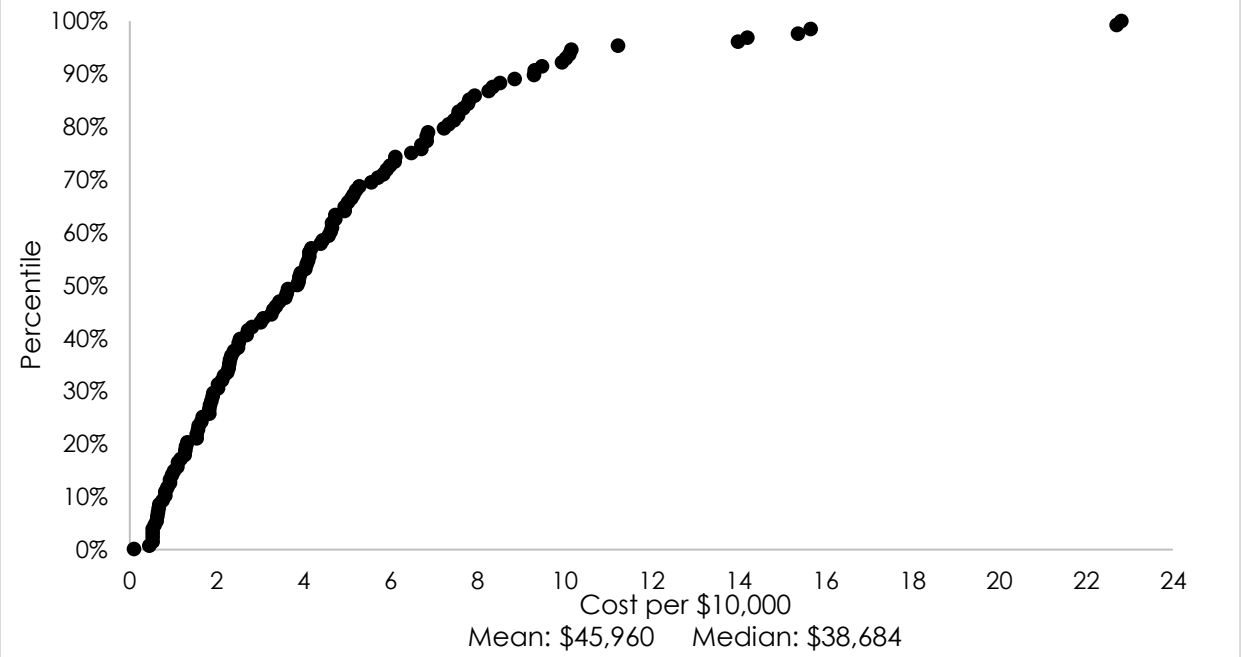


Figure 178: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with breast cancer (2013 dollars)

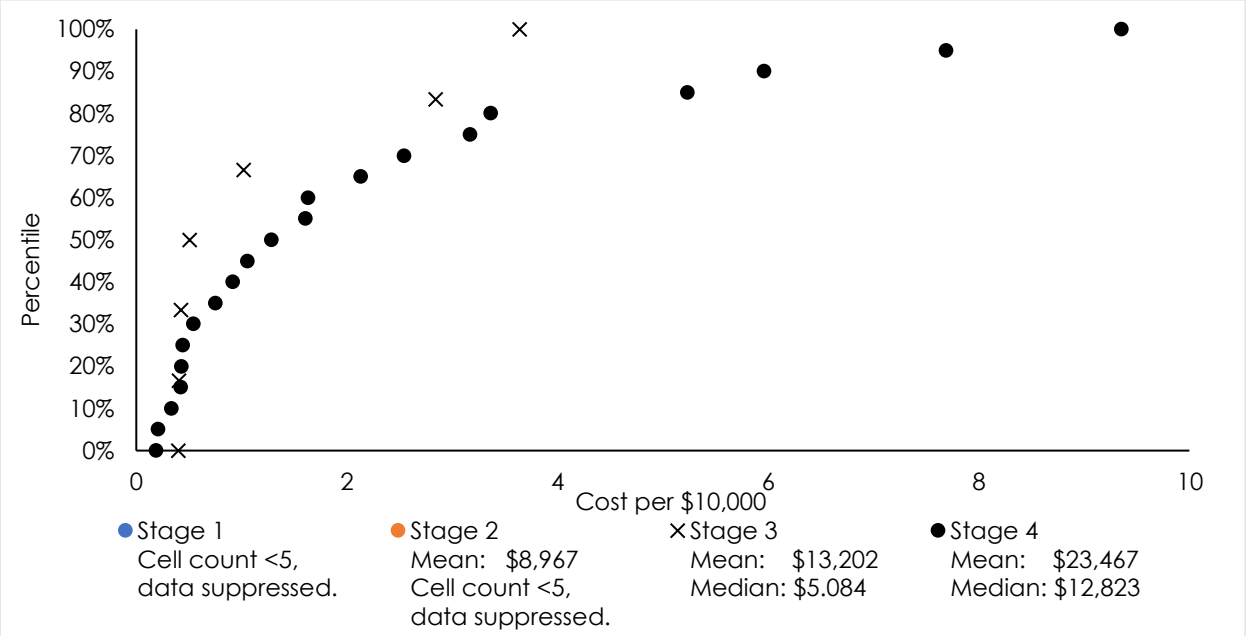


Figure 179: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with breast cancer (2013 dollars)

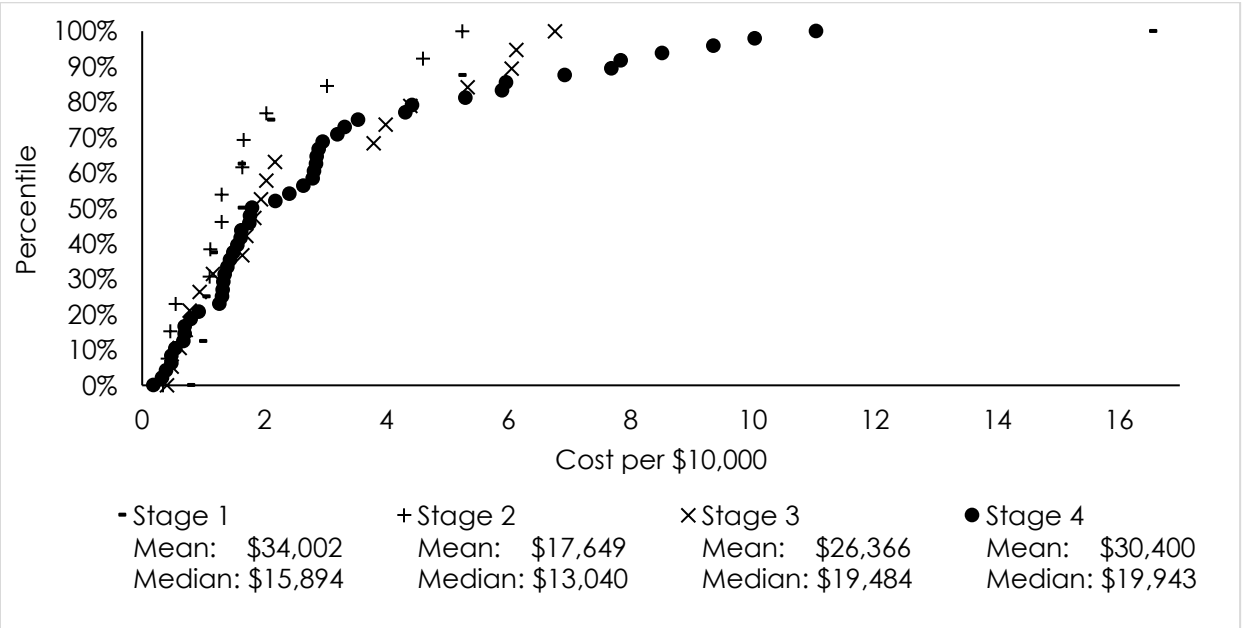


Figure 180: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with breast cancer (2013 dollars)

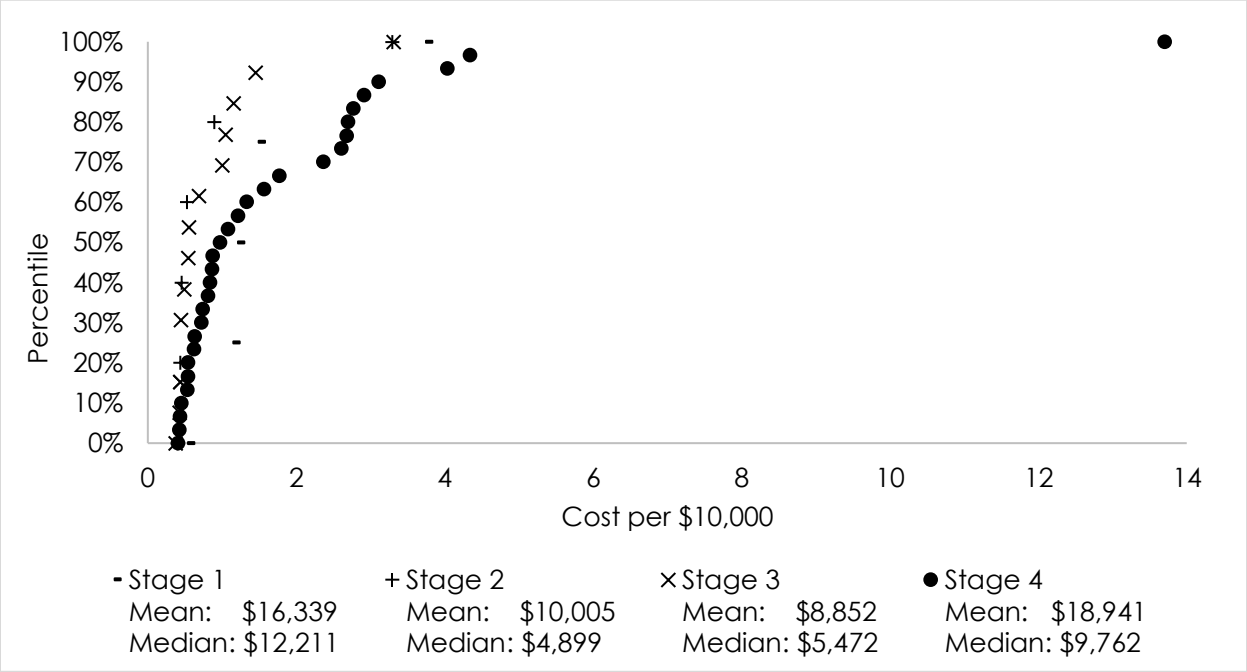


Figure 181: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with breast cancer (2013 dollars)

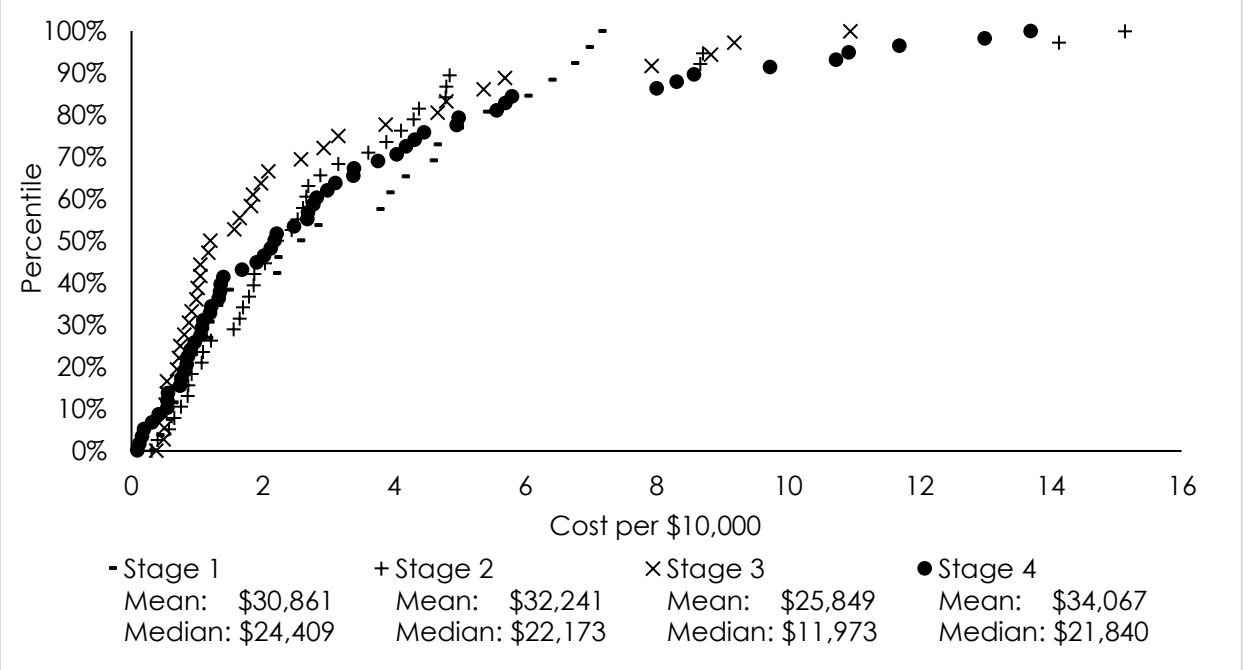


Figure 182: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with colon cancer (2013 dollars)

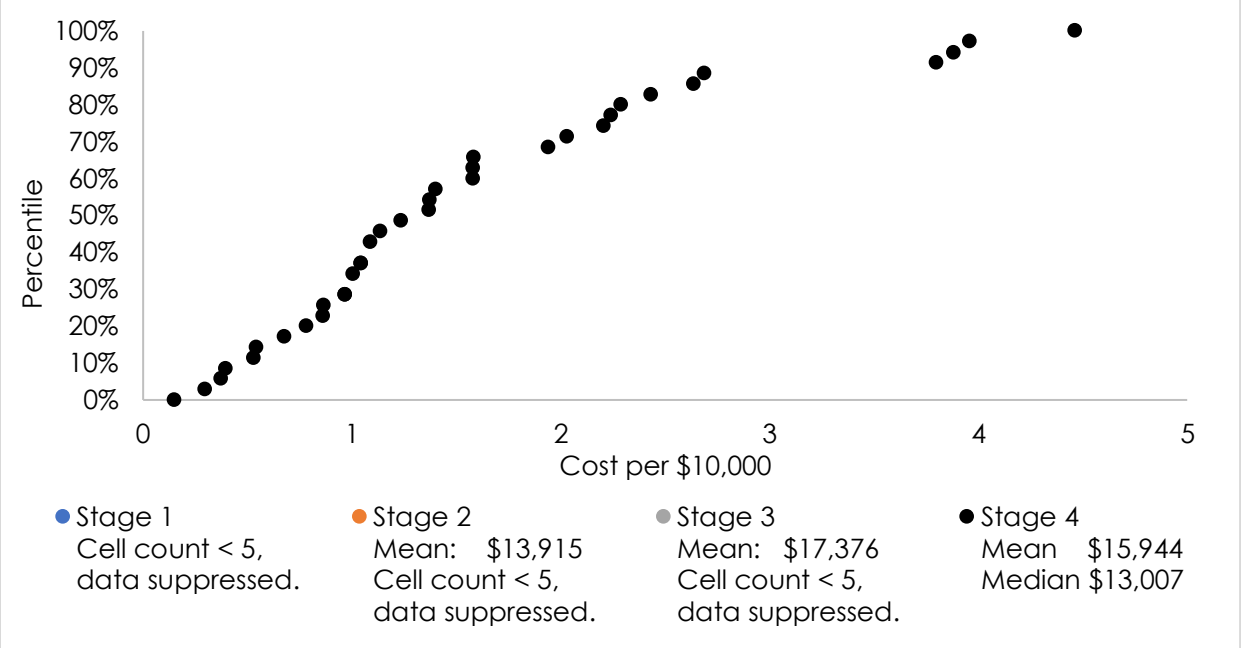


Figure 183: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with colon cancer (2013 dollars)

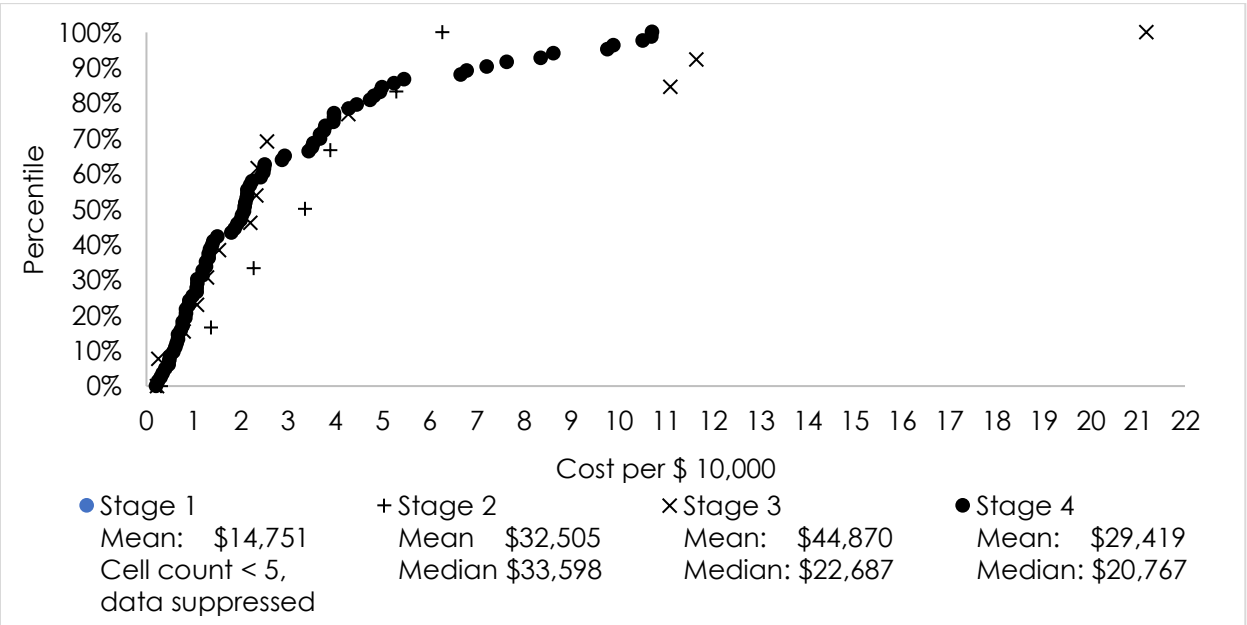


Figure 184: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with colon cancer (2013 dollars)

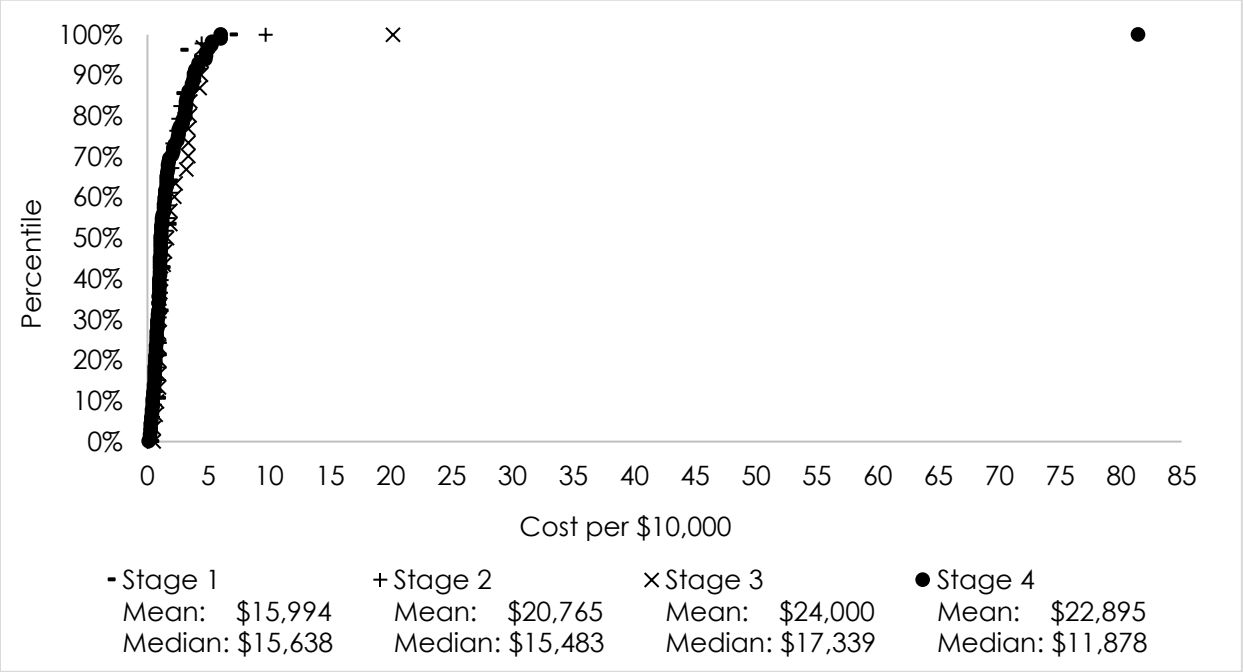


Figure 185: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with colon cancer (2013 dollars)

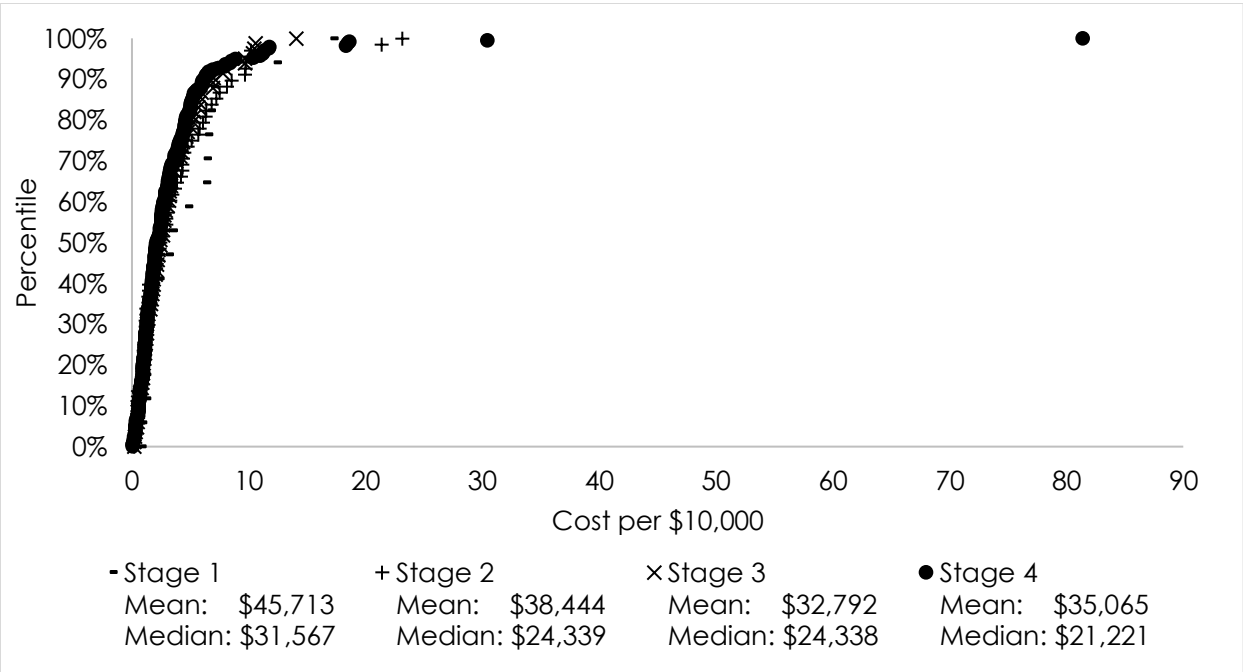


Figure 186: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with kidney cancer (2013 dollars)

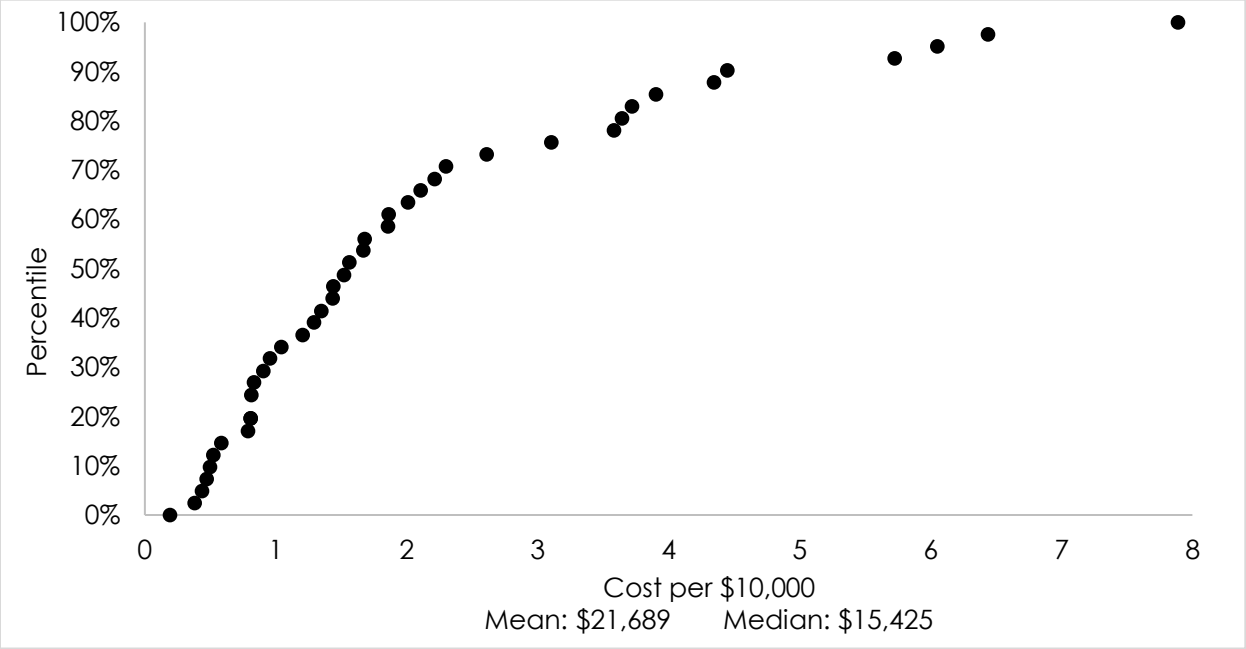


Figure 187: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with kidney cancer (2013 dollars)

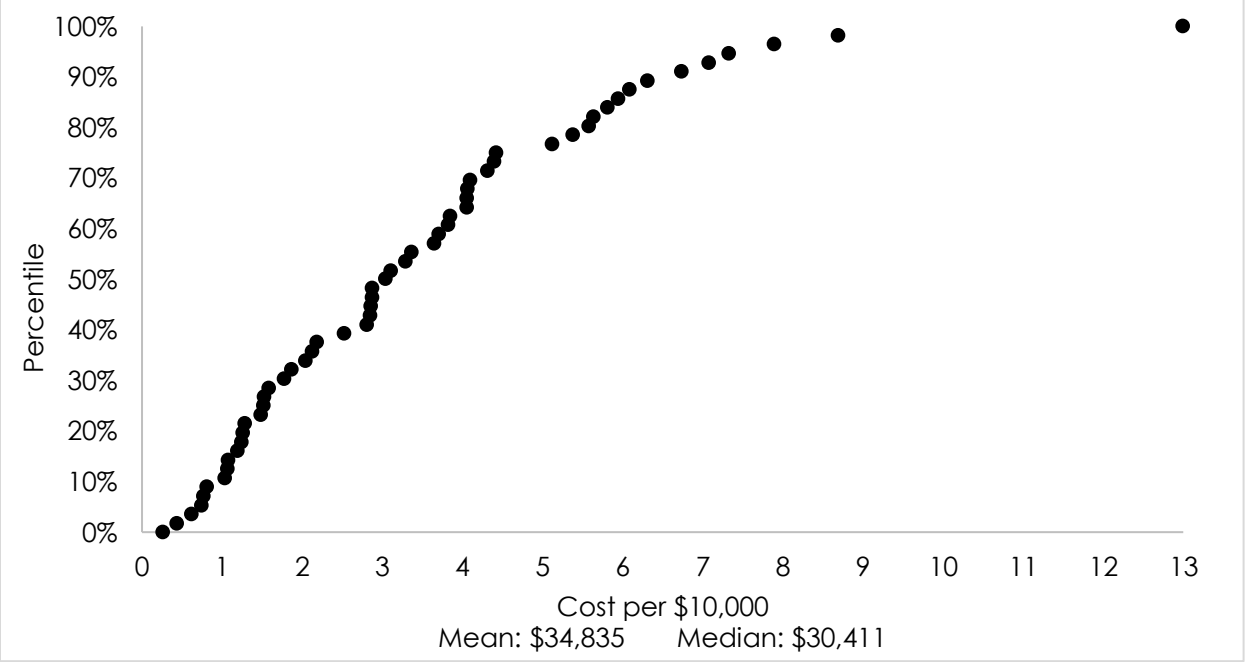


Figure 188: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with kidney cancer (2013 dollars)

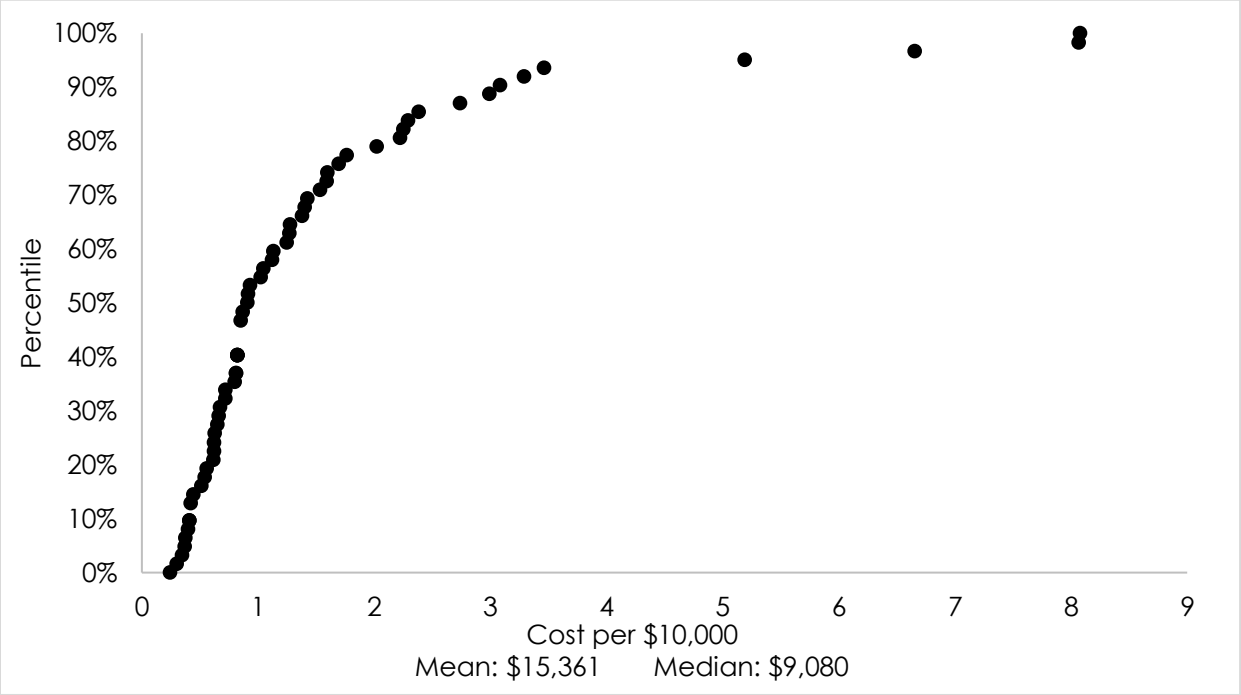
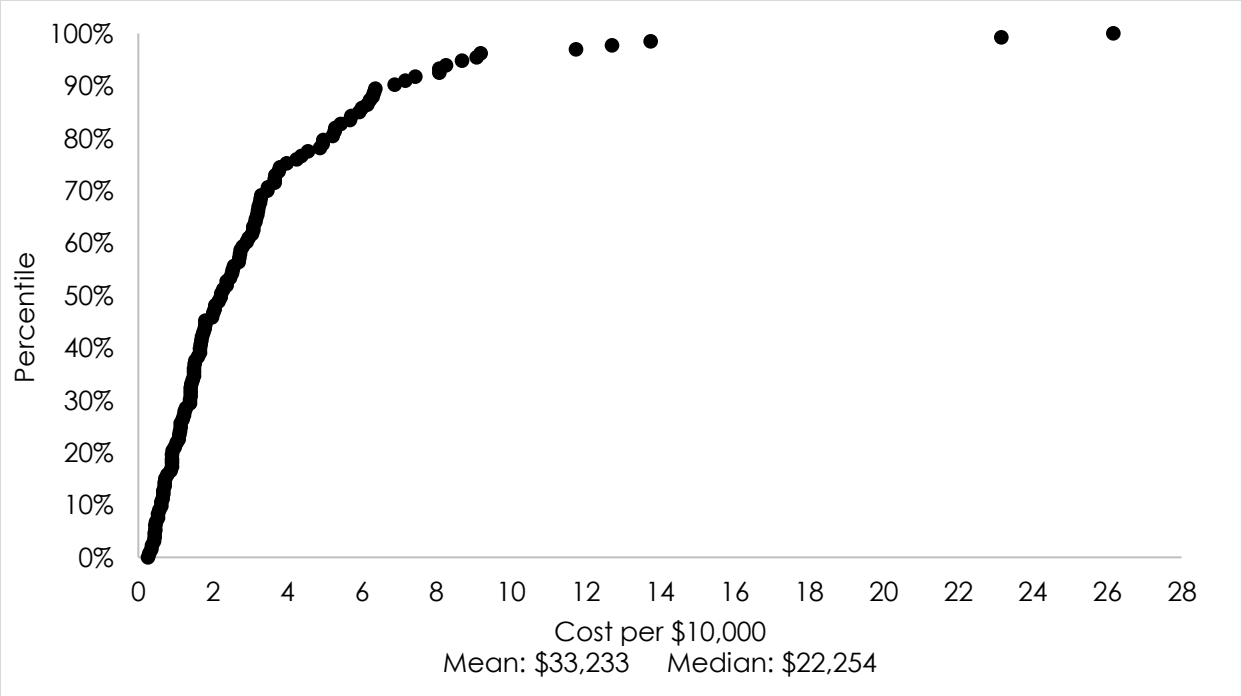


Figure 189: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with kidney cancer (2013 dollars)



Leukemia

Figure 190: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with leukemia (2013 dollars)

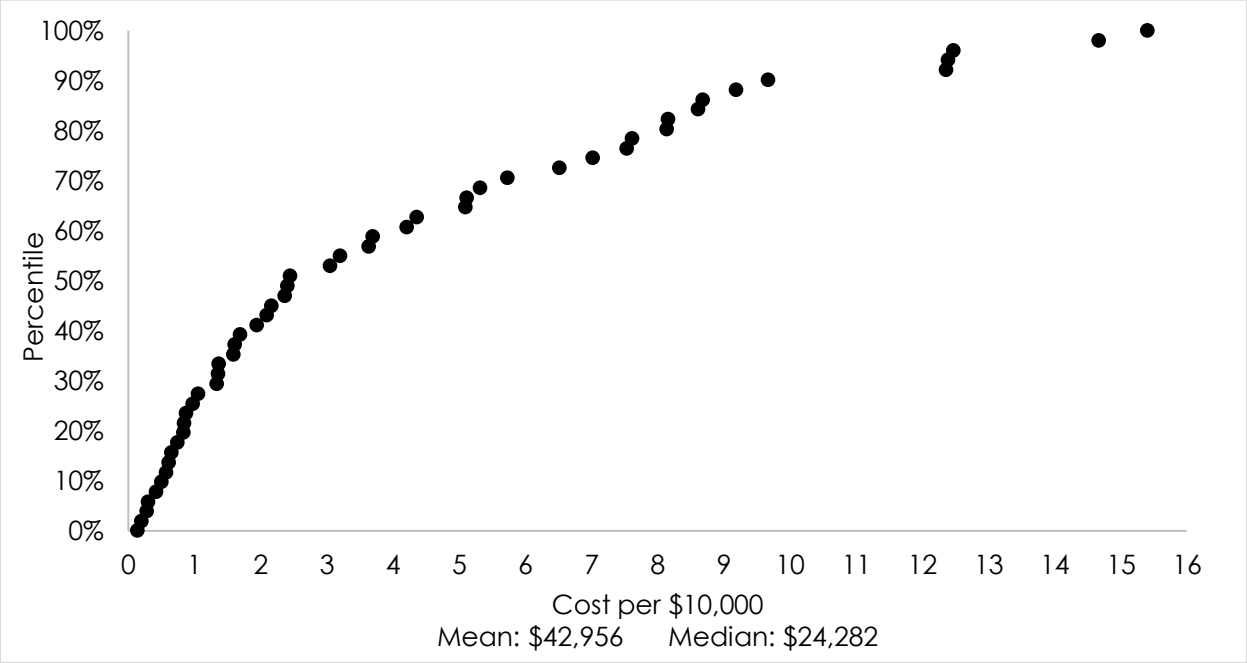


Figure 191: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with leukemia (2013 dollars)

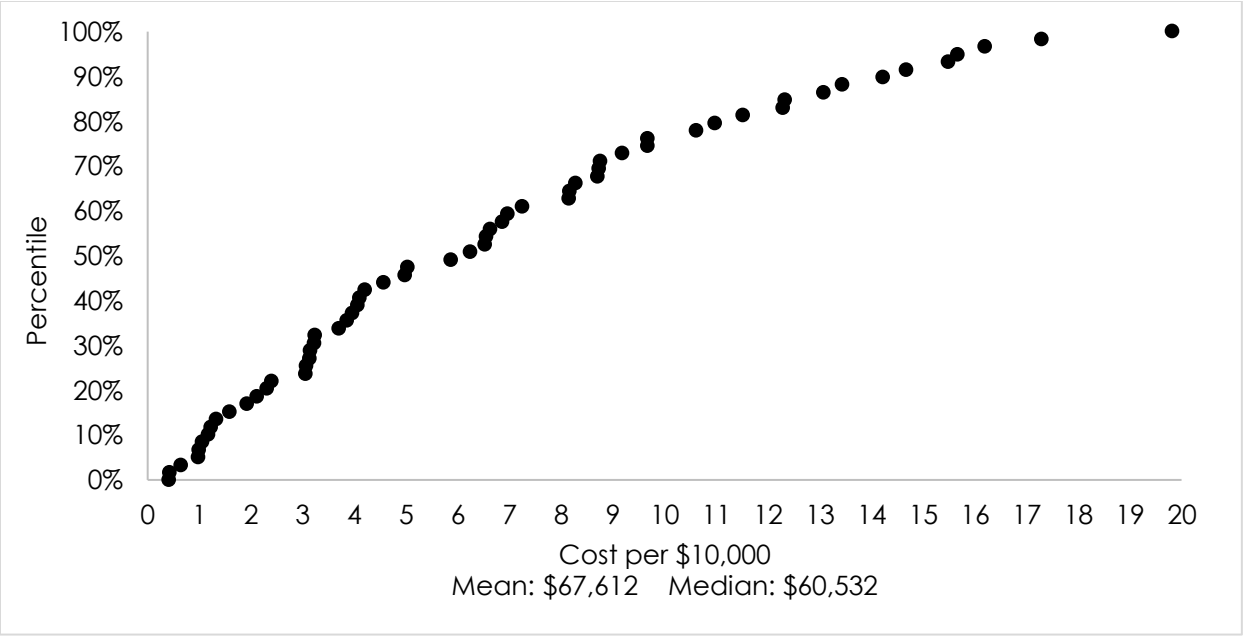


Figure 192: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with leukemia (2013 dollars)

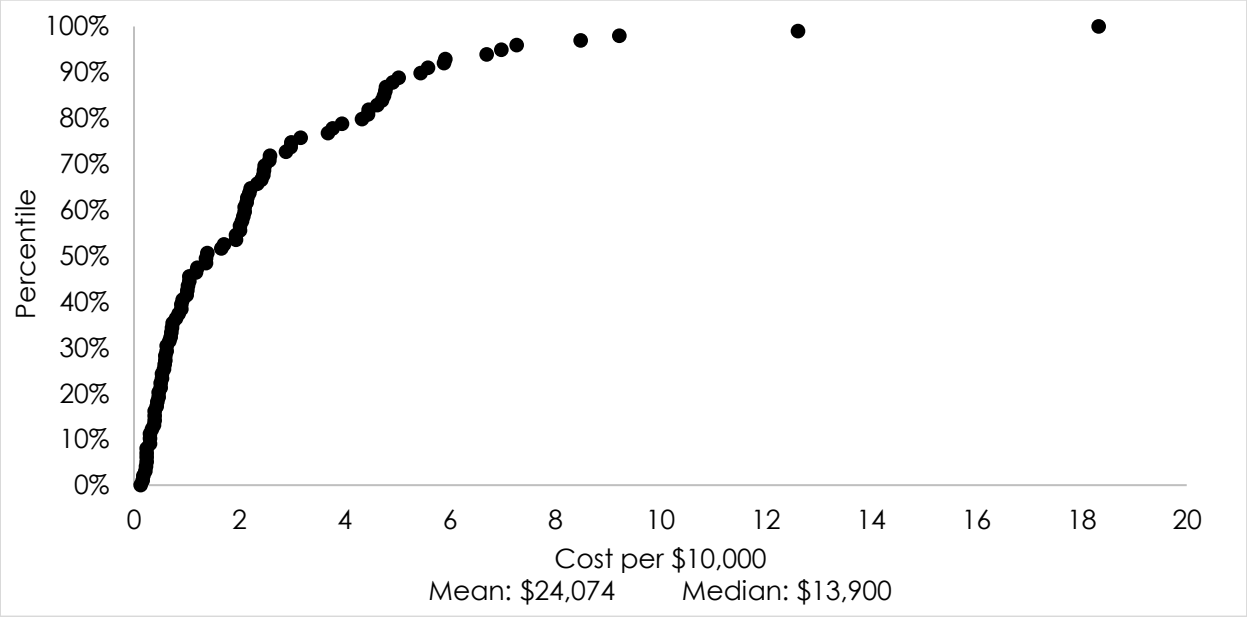


Figure 193: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with leukemia (2013 dollars)

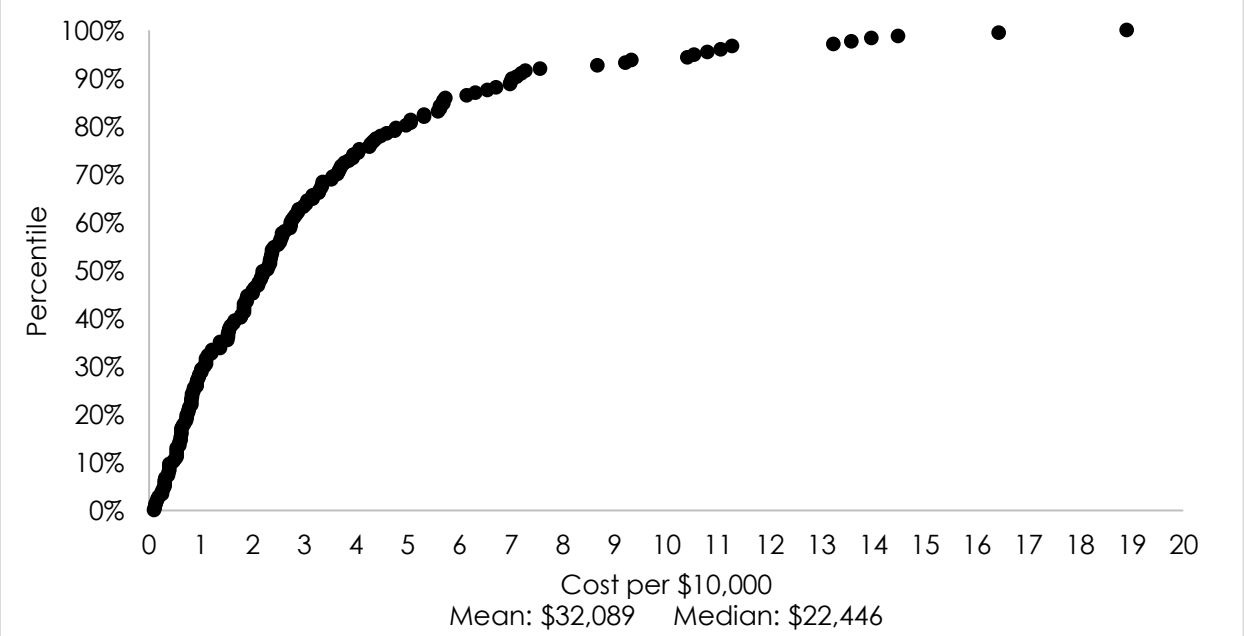


Figure 194: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with lung cancer (2013 dollars)

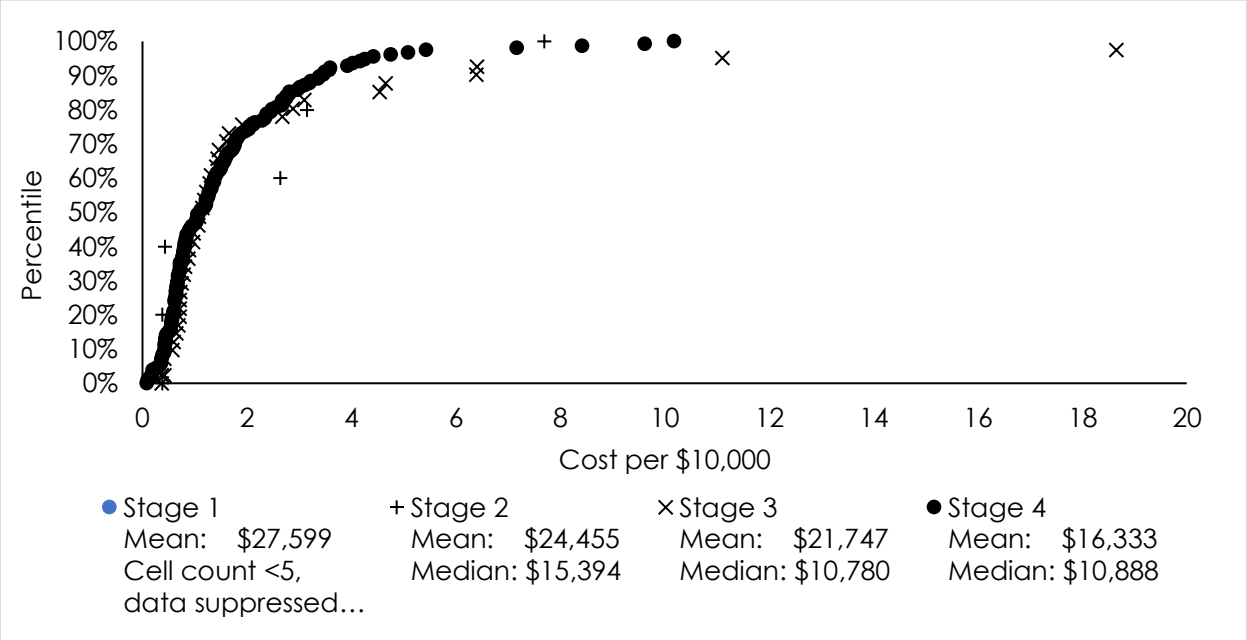


Figure 195: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with lung cancer (2013 dollars)

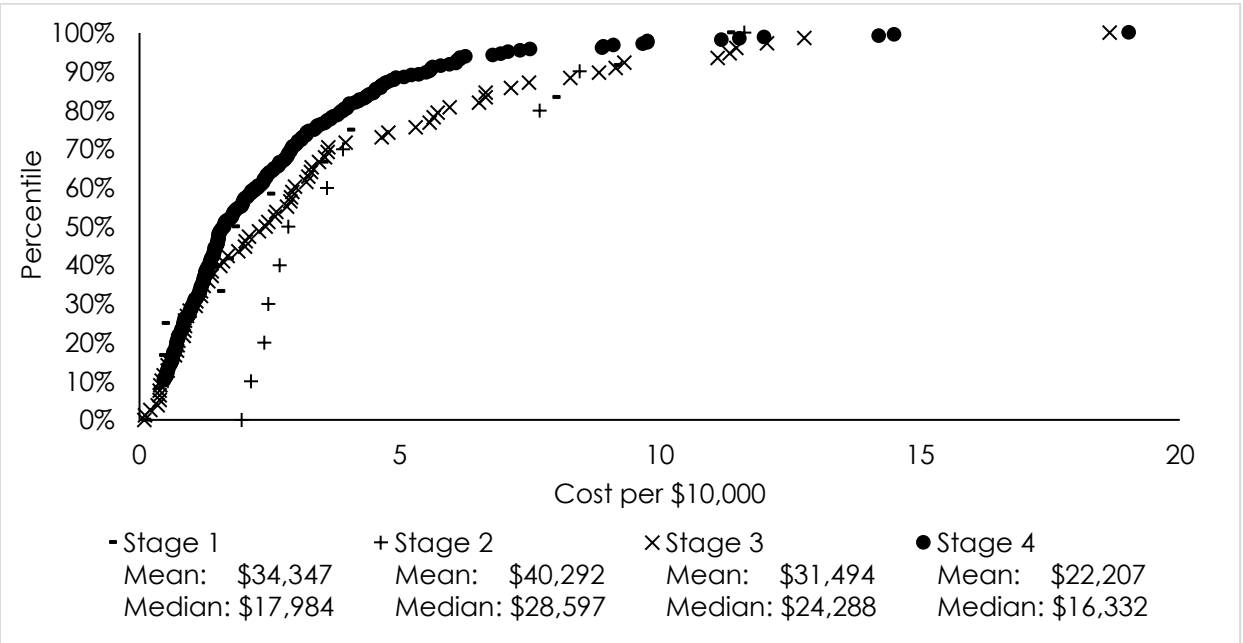


Figure 196: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with lung cancer (2013 dollars)

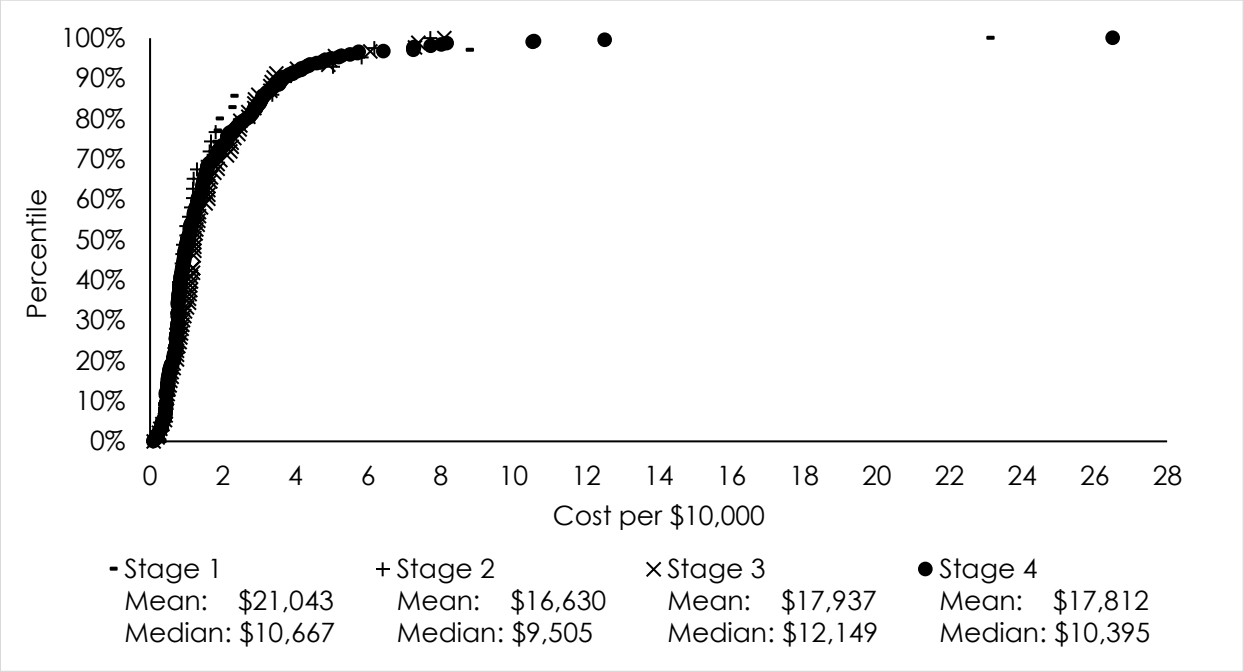


Figure 197: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with lung cancer (2013 dollars)

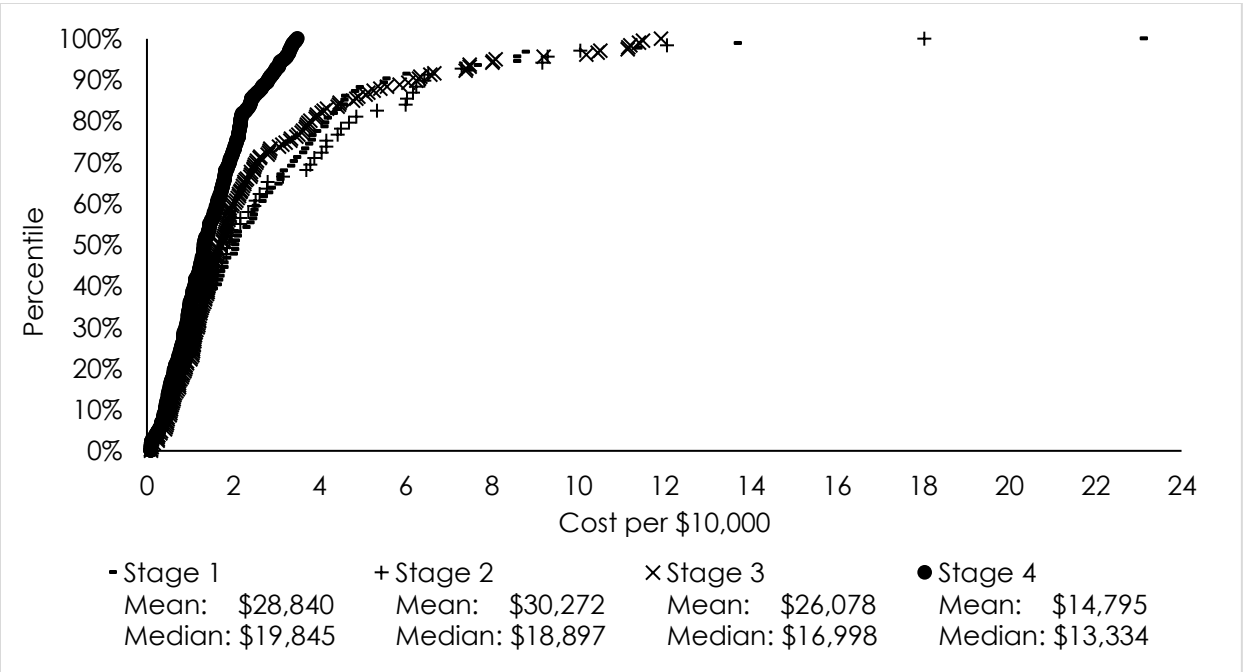


Figure 198: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with myeloma (2013 dollars)

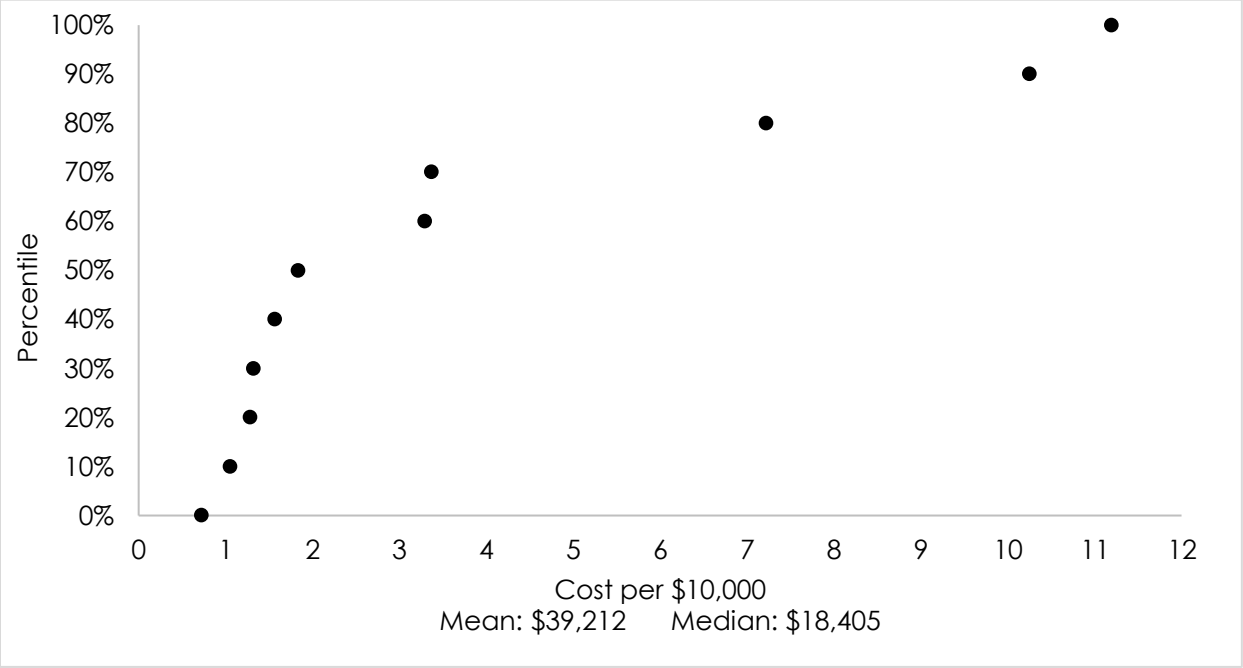


Figure 199: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with myeloma (2013 dollars)

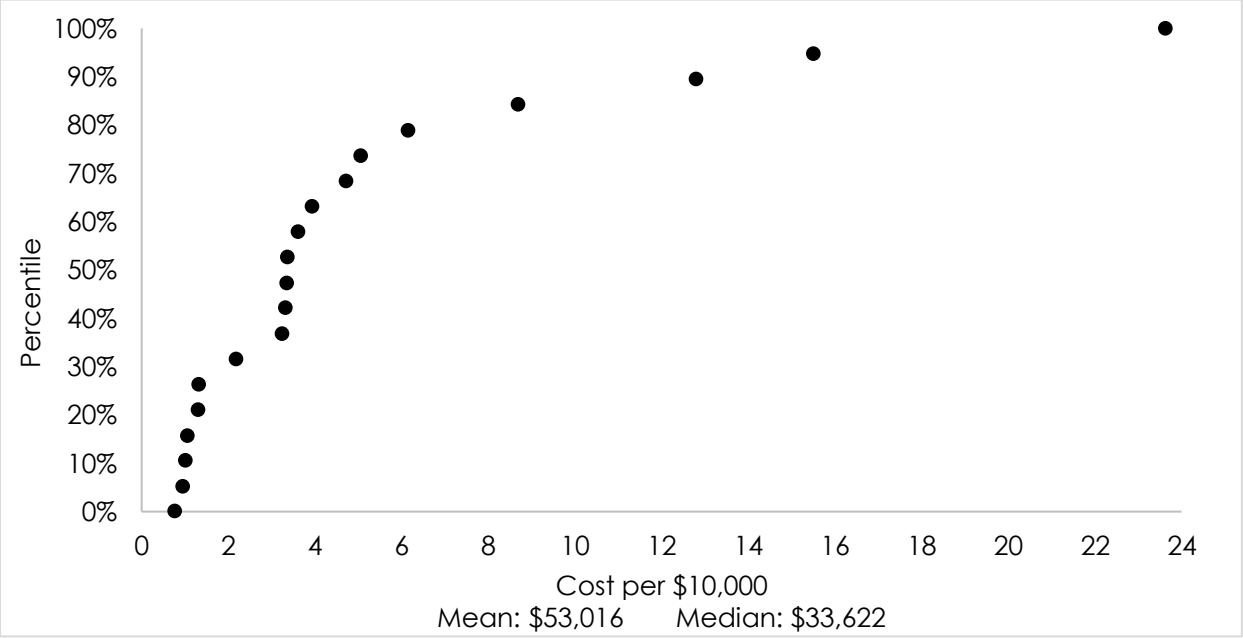


Figure 200: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with myeloma (2013 dollars)

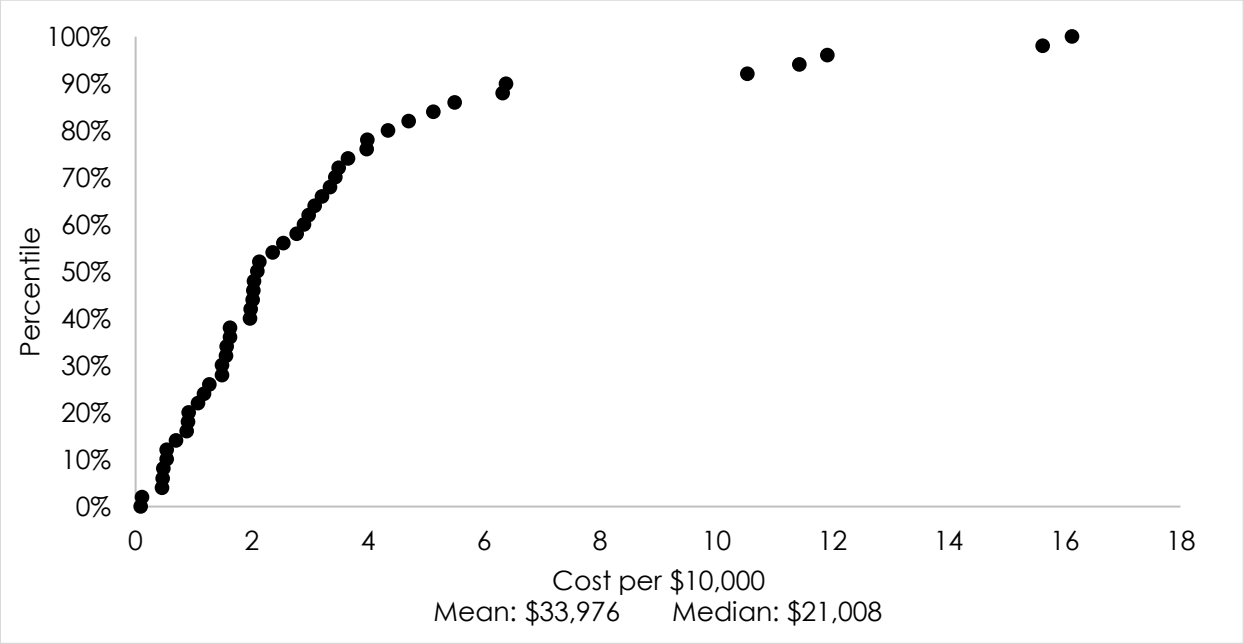


Figure 201: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with myeloma (2013 dollars)

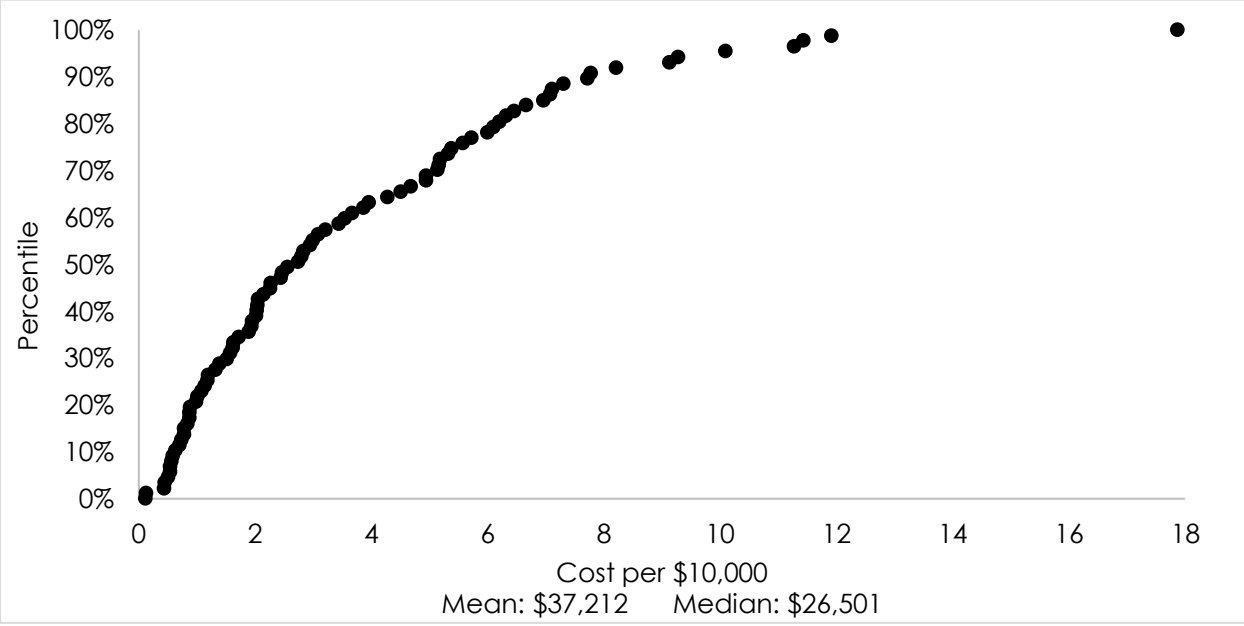


Figure 202: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with non-Hodgkin's lymphoma (2013 dollars)

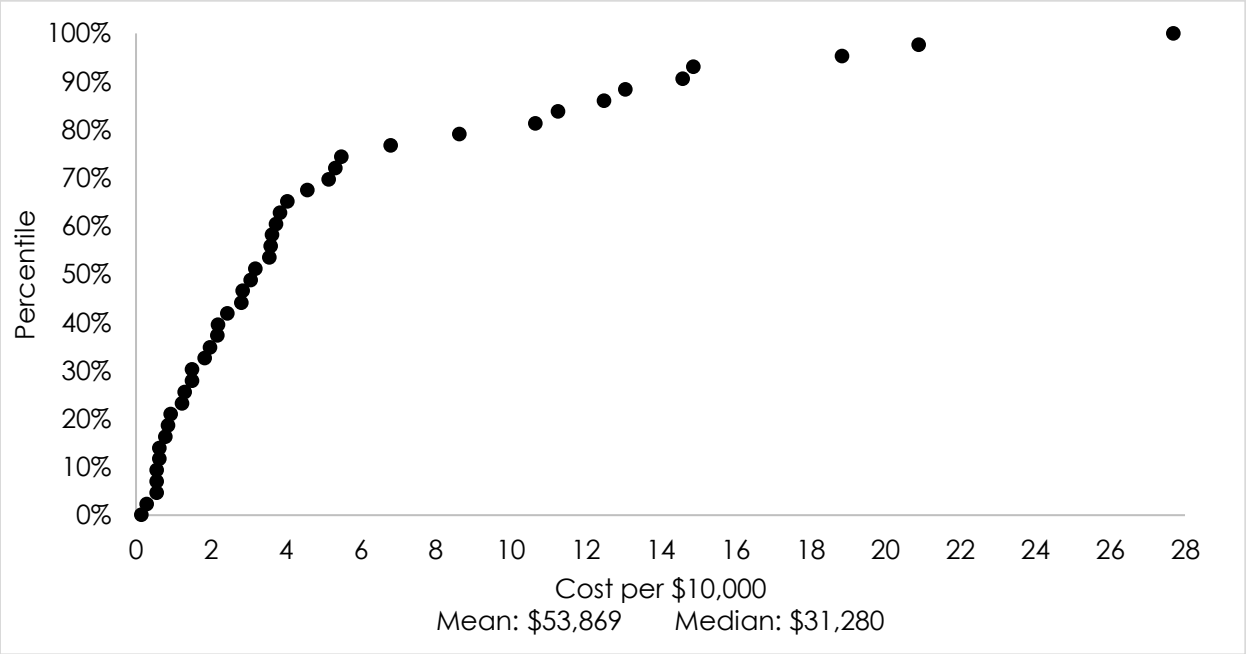


Figure 203: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with non-Hodgkin's lymphoma (2013 dollars)

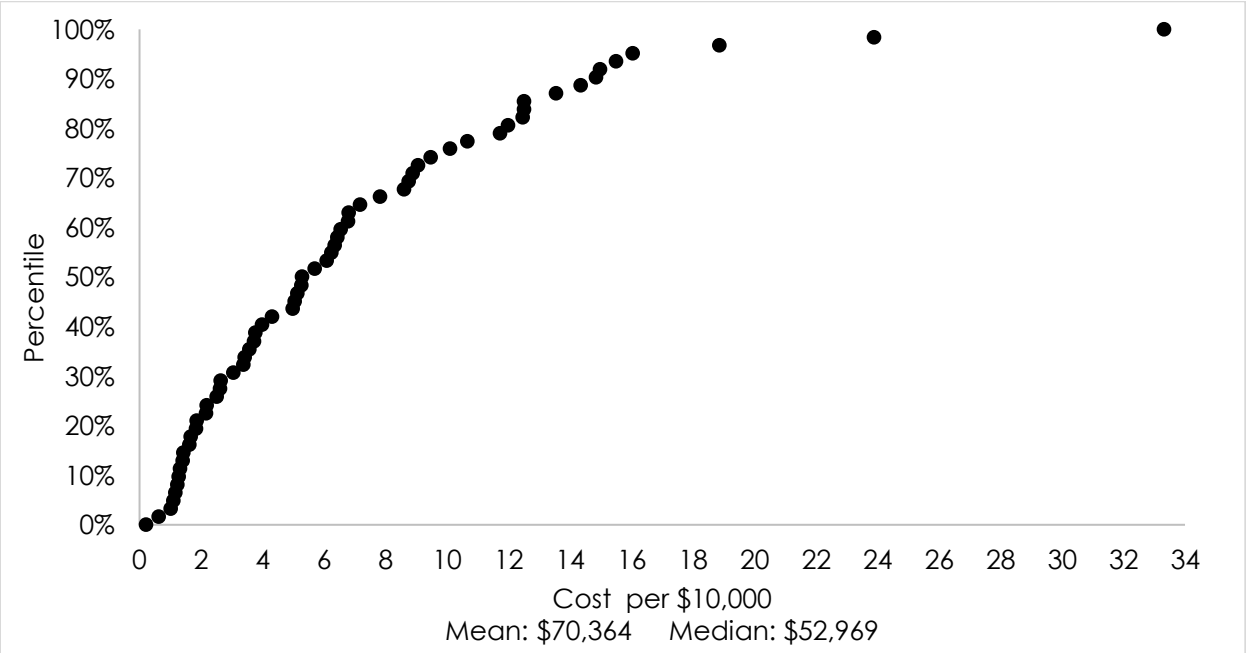


Figure 204: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with non-Hodgkin's lymphoma (2013 dollars)

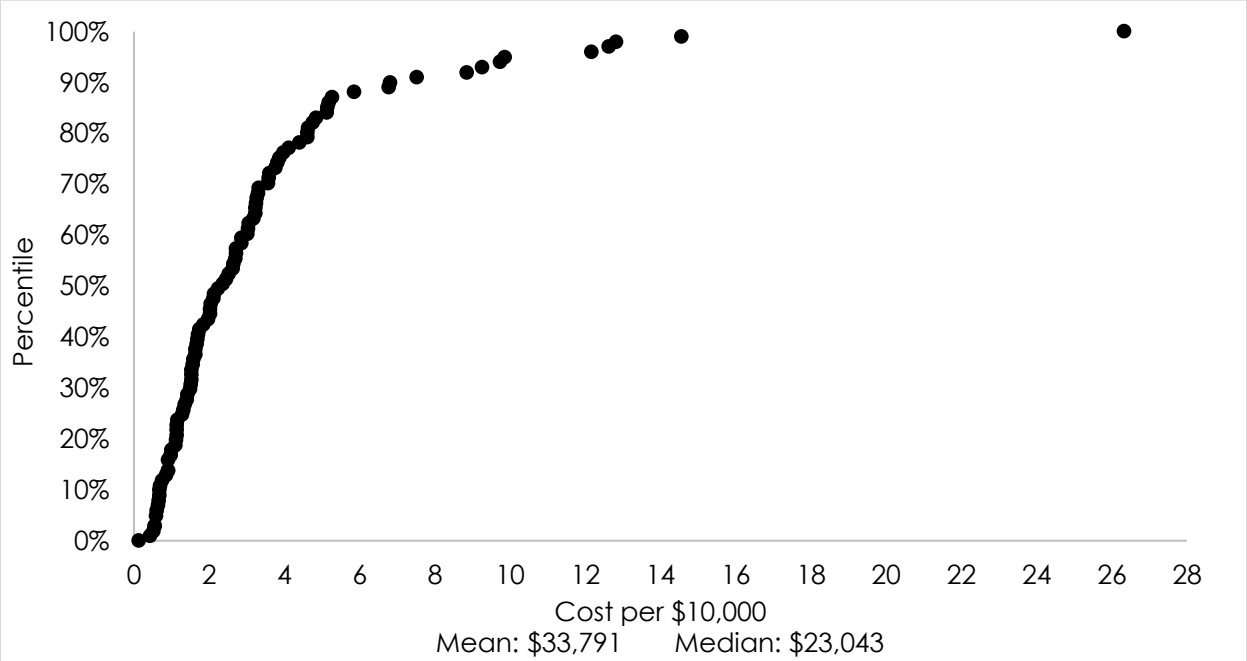


Figure 205: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with non-Hodgkin's lymphoma (2013 dollars)

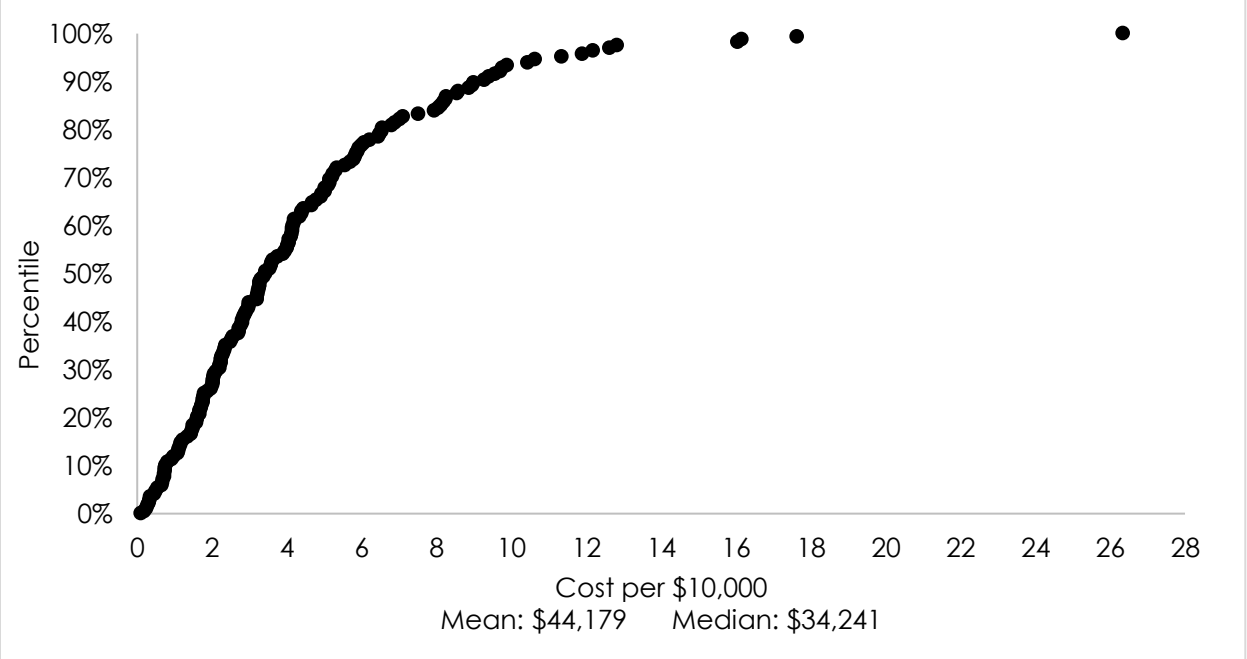


Figure 206: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

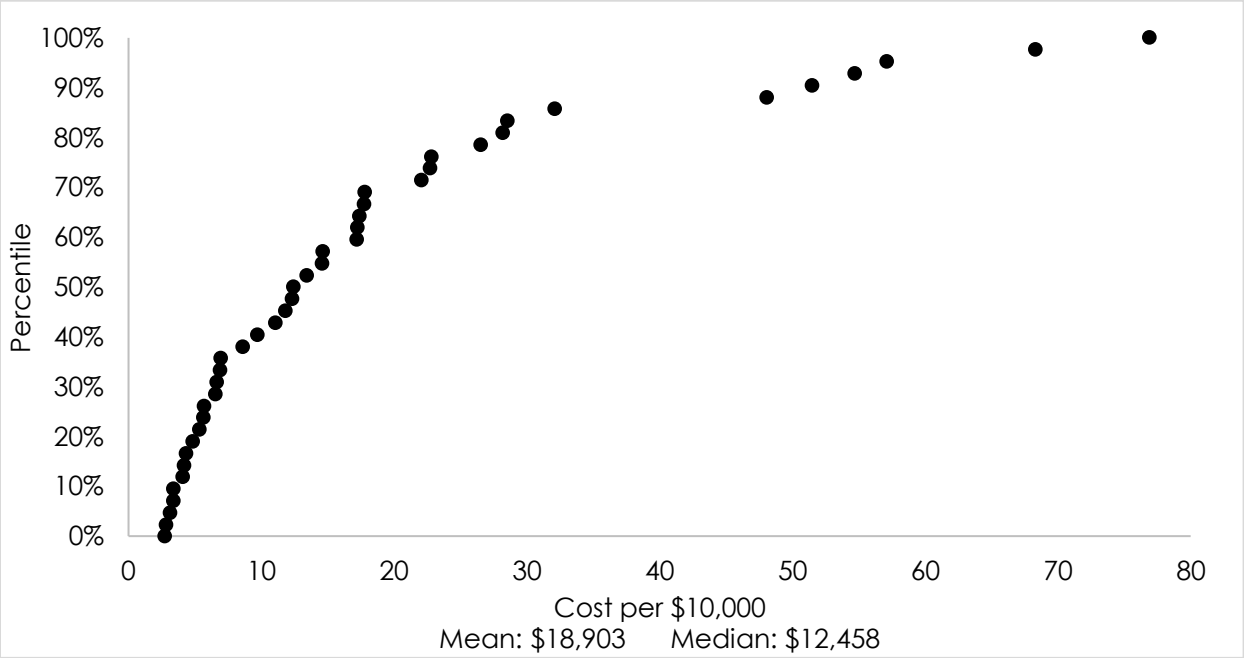


Figure 207: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with oesophageal cancer (2013 dollars)

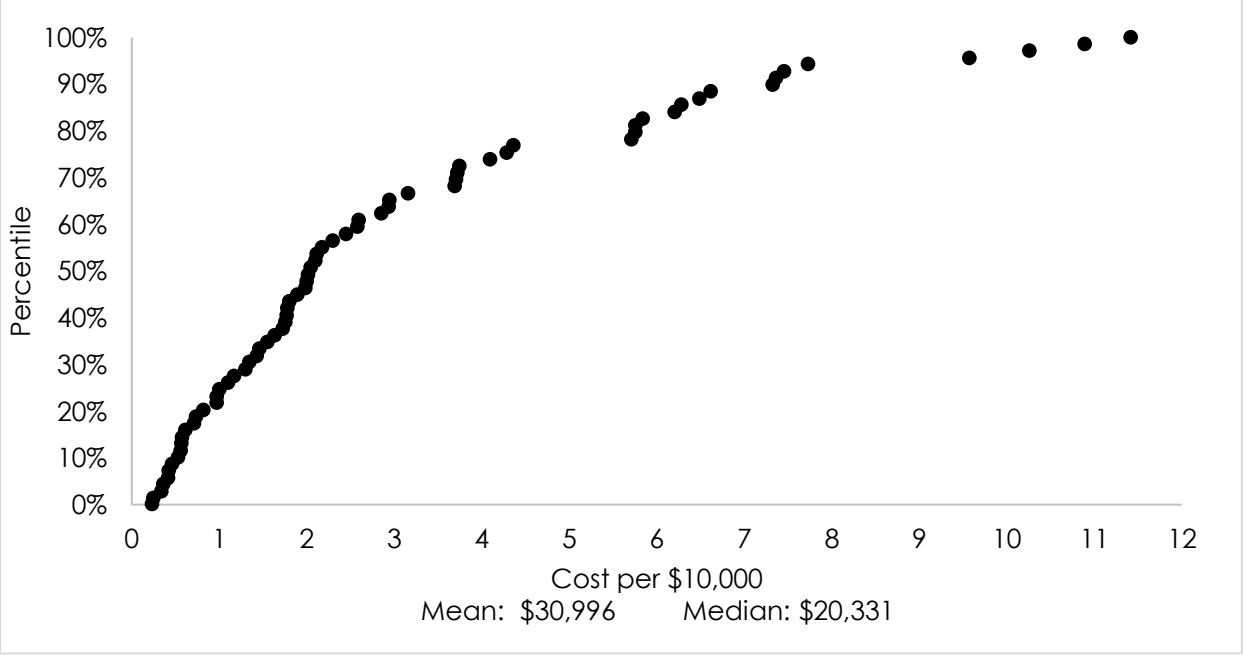


Figure 208: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with oesophageal cancer (2013 dollars)

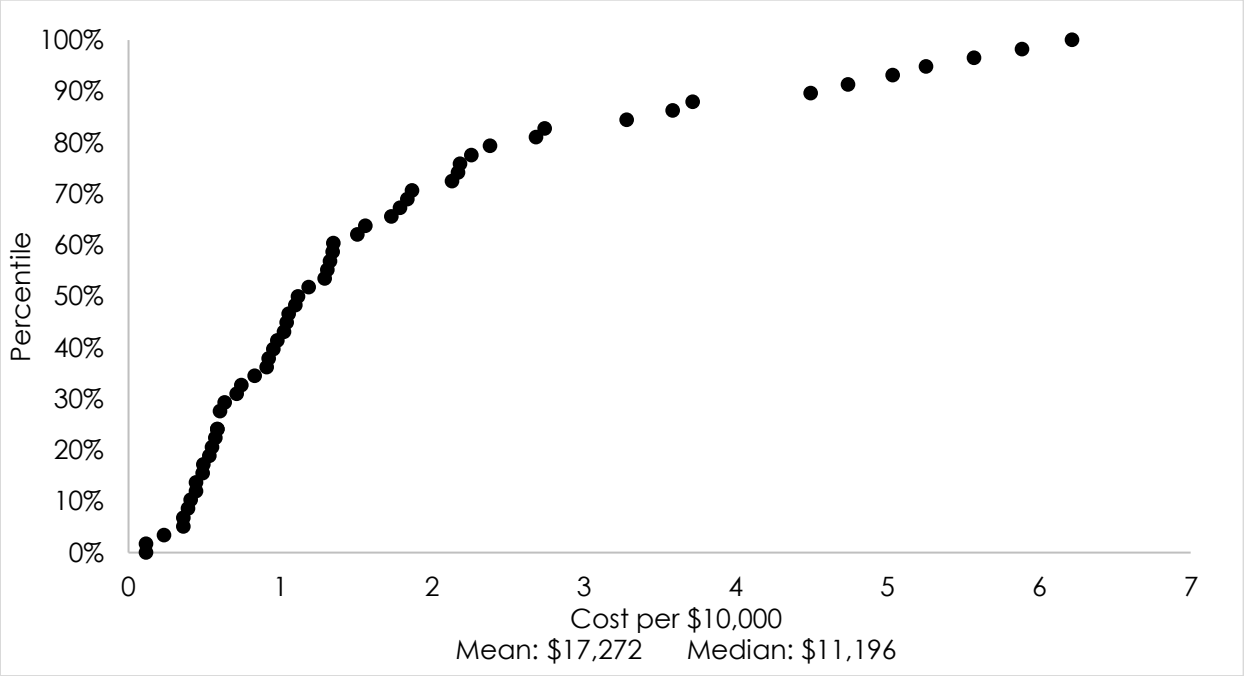
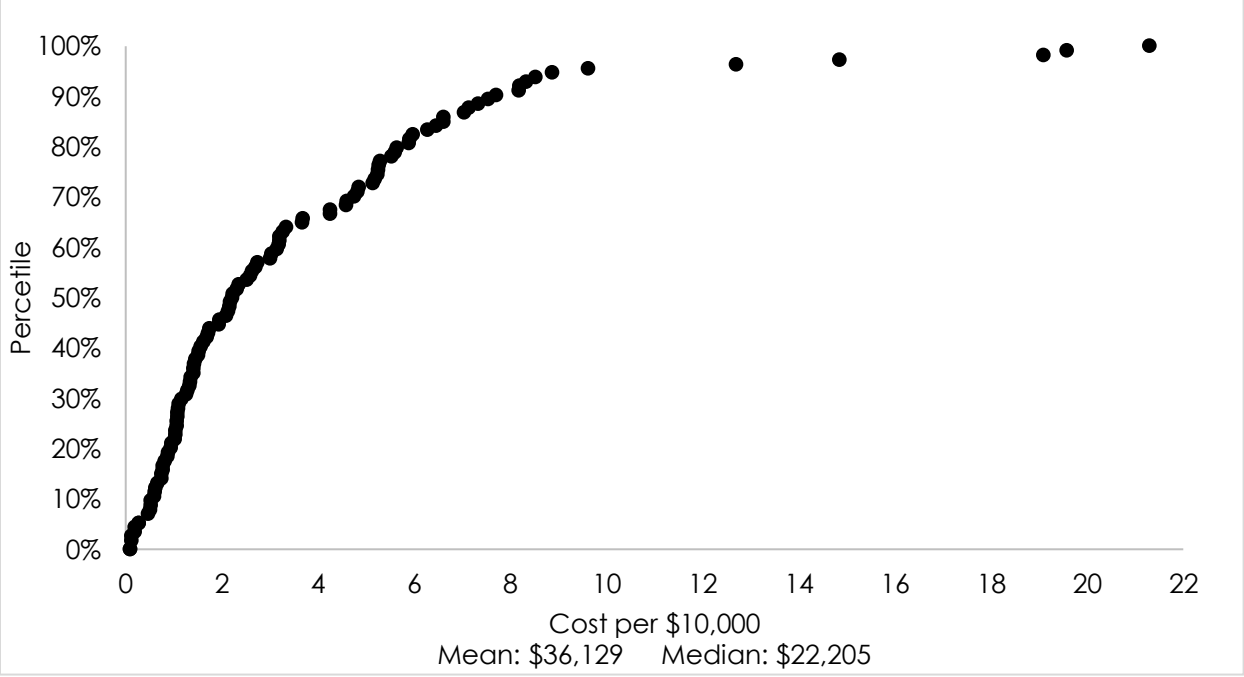


Figure 209: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with oesophageal cancer (2013 dollars)



Prostate cancer

* Prostate 12 months 18-64 conservative estimates suppressed. **Stage 4 Mean: $18,710**

Figure 210: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with prostate cancer (2013 dollars)

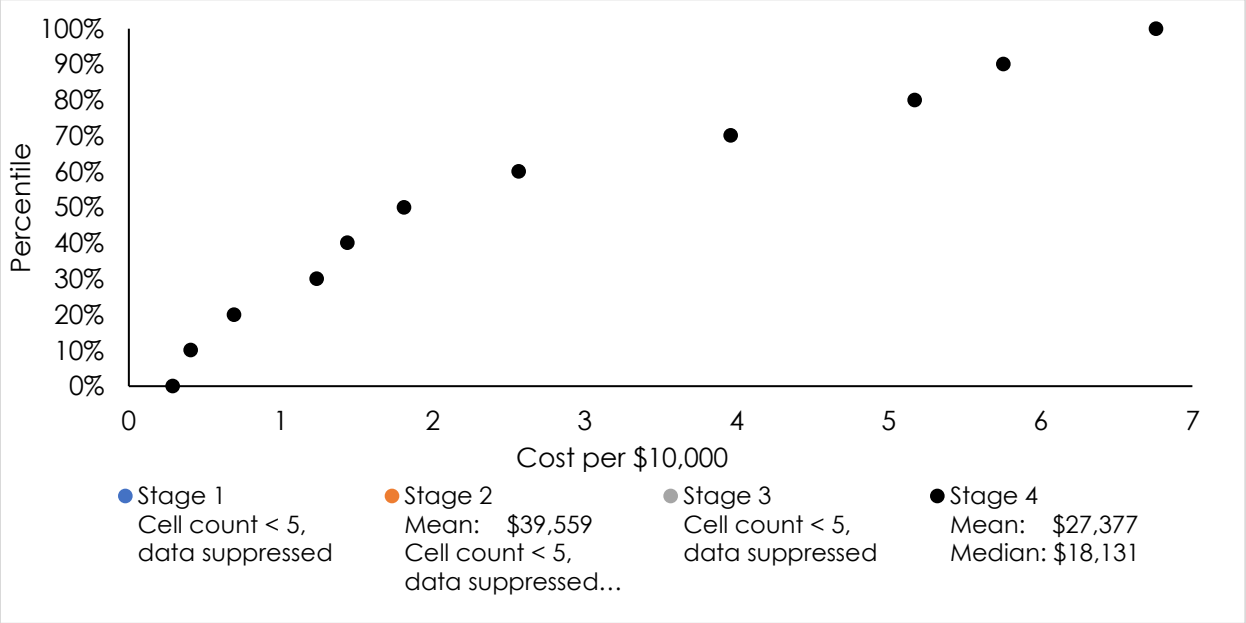


Figure 211: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with prostate cancer (2013 dollars)

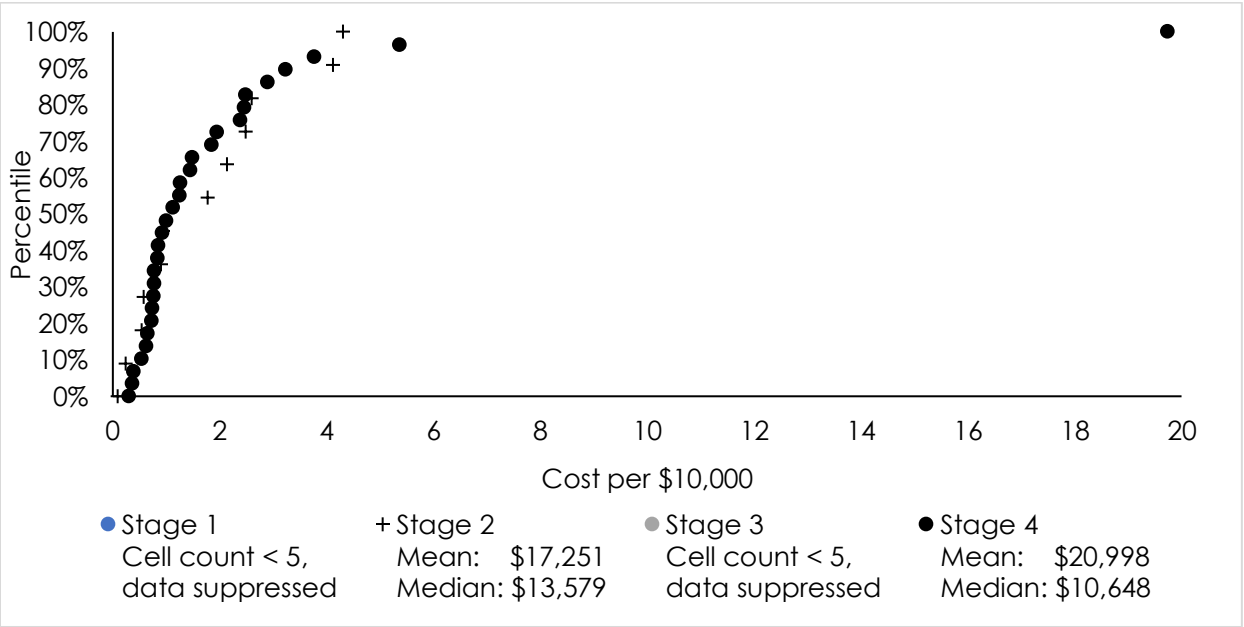
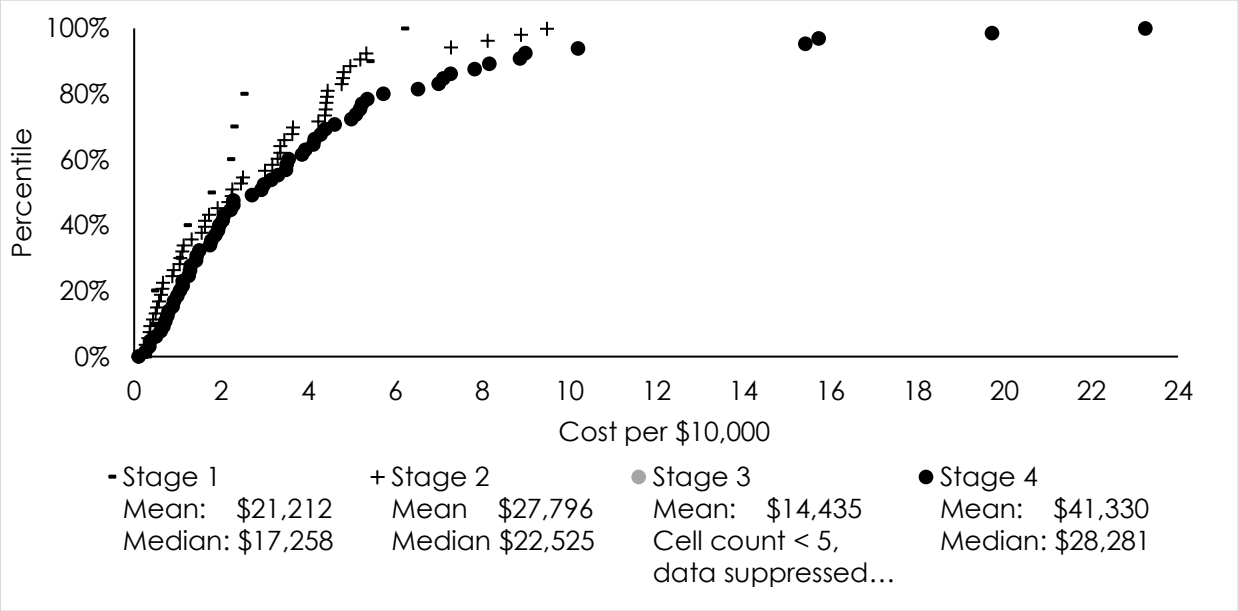


Figure 212: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with prostate cancer (2013 dollars)



Rectal cancer

Figure 213: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with rectal cancer (2013 dollars)

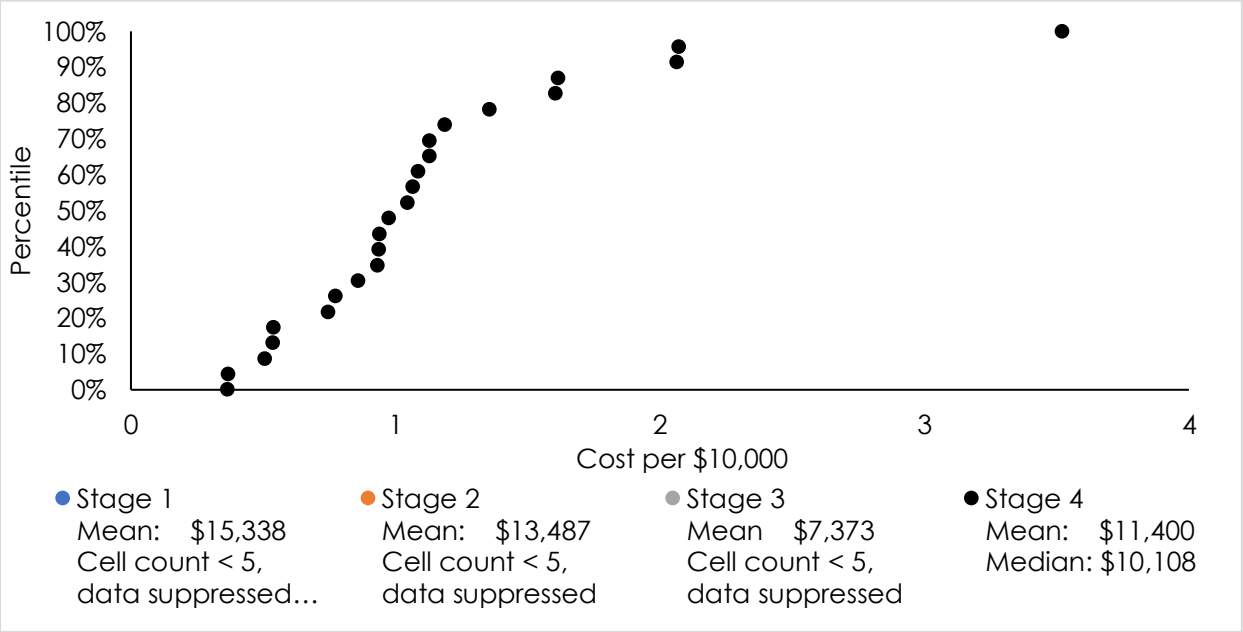


Figure 214: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with rectal cancer (2013 dollars)

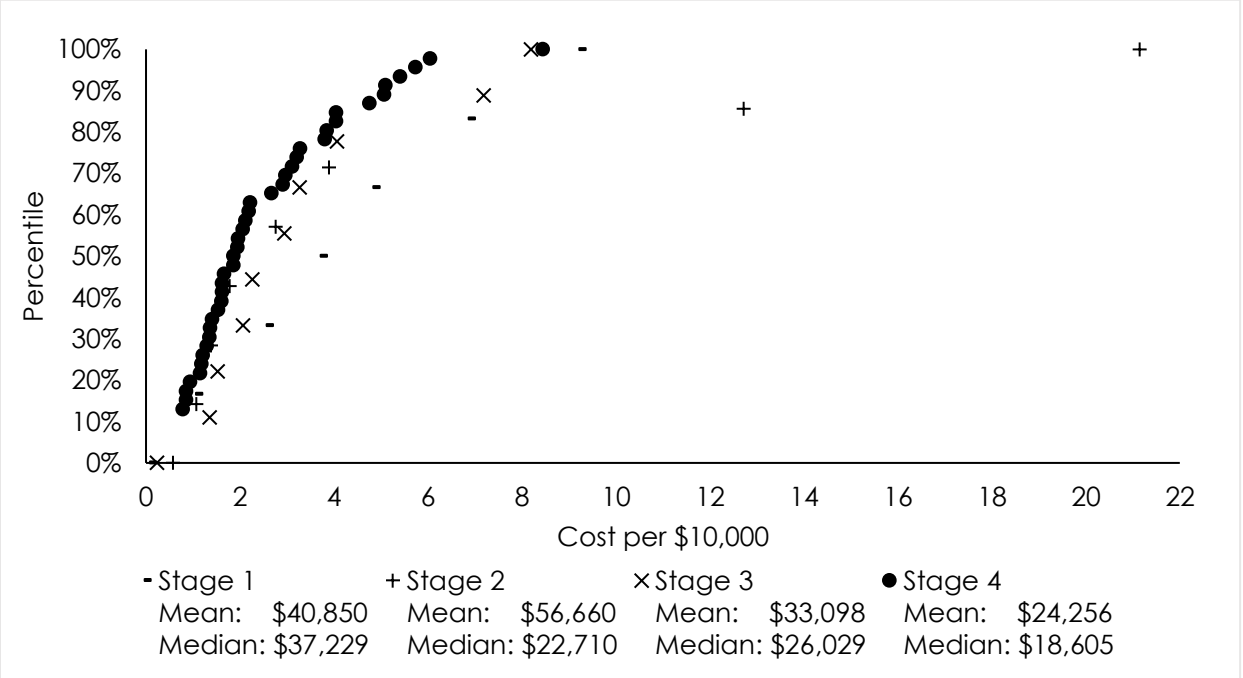


Figure 215: Estimated distribution of the total cost (conservative estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with rectal cancer (2013 dollars)

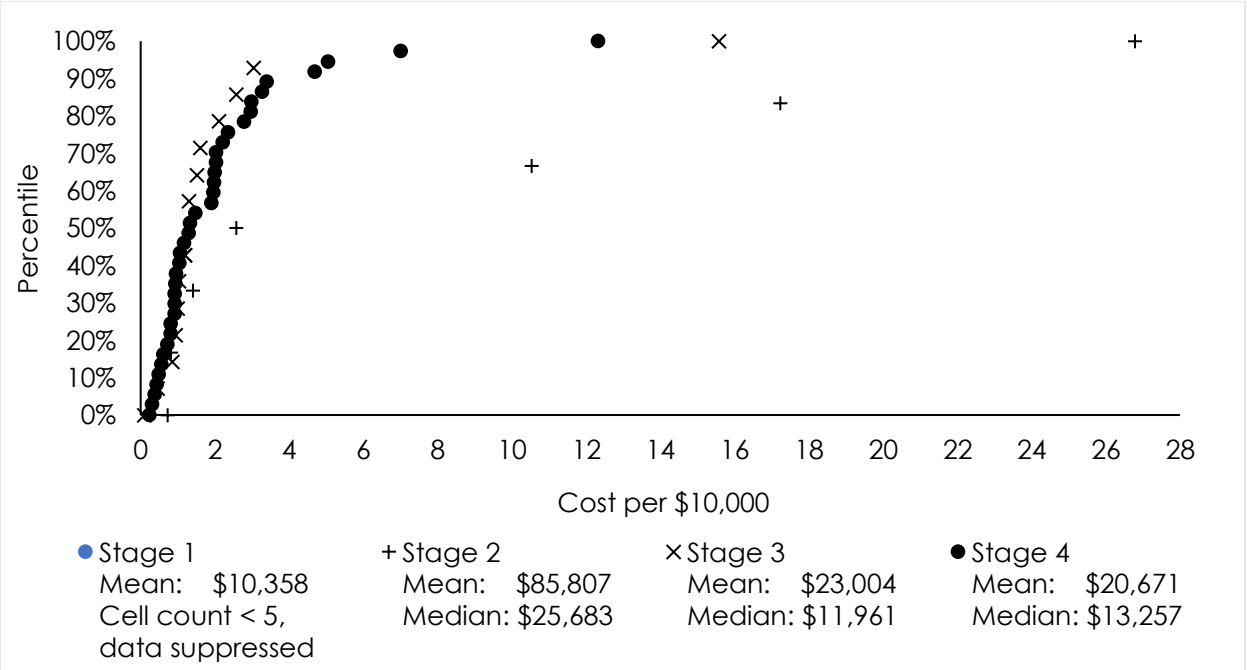
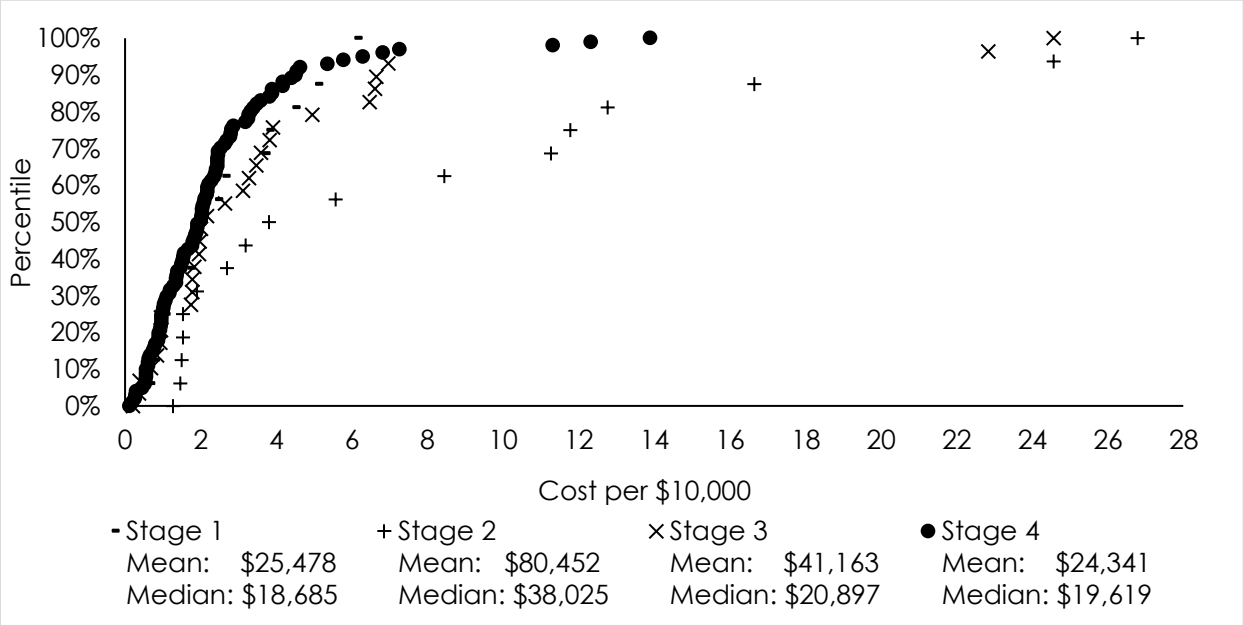


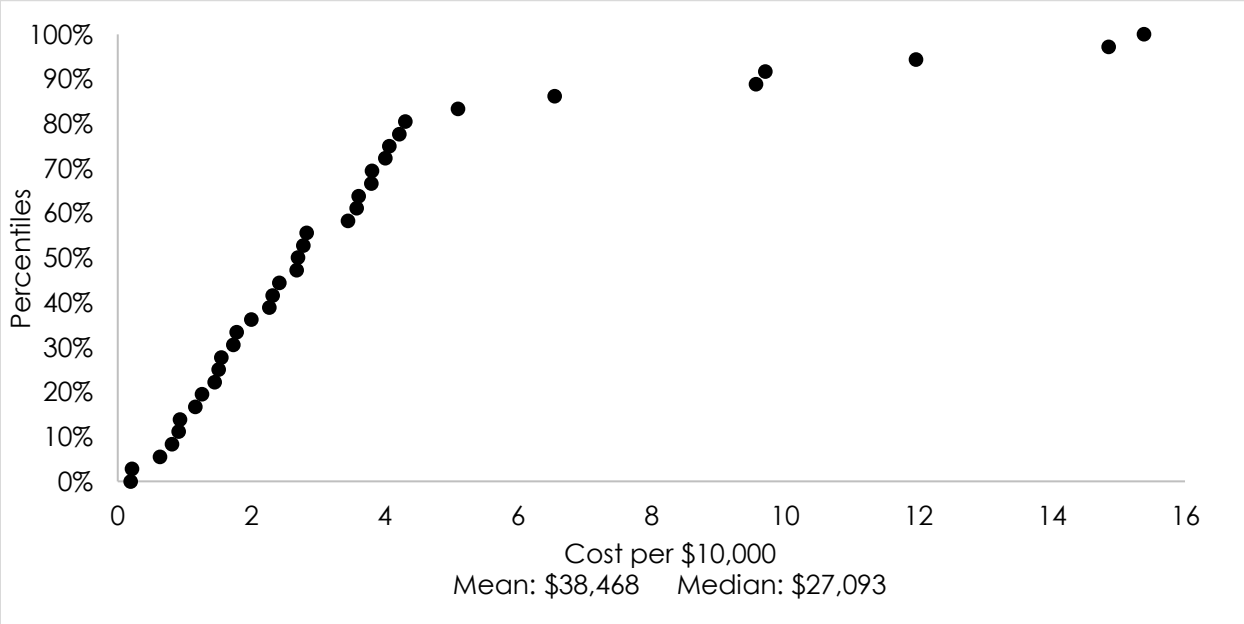
Figure 216: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with rectal cancer (2013 dollars)



Skin cancer

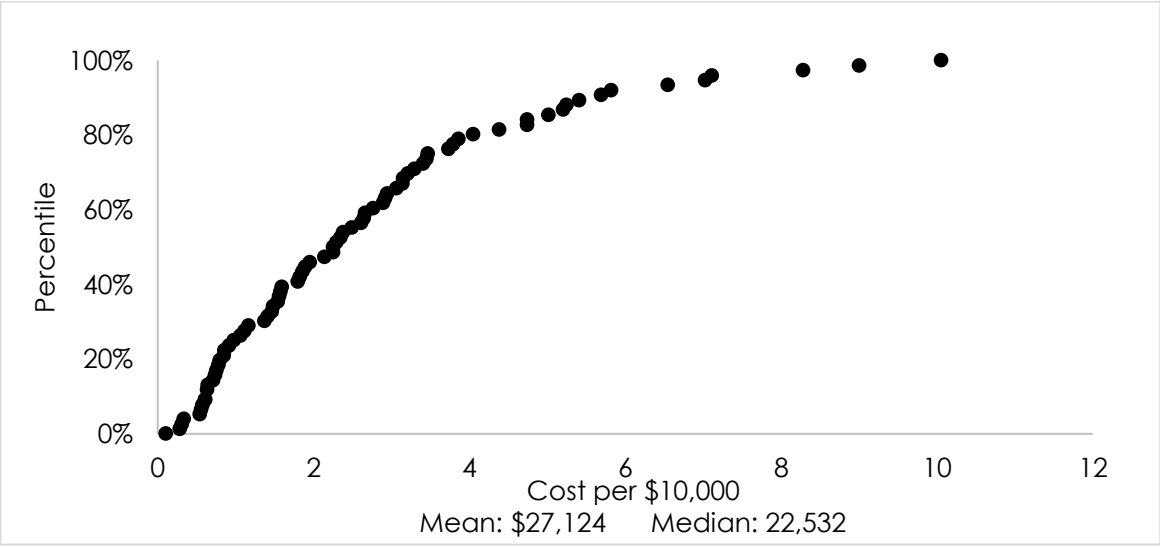
*Skin 12 months 18-64 conservative estimates suppressed. No mean available.

Figure 217: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 18 to 64 years with skin cancer (2013 dollars)



* Skin 12 months 65+ conservative estimate suppressed. **Mean: $16,144**

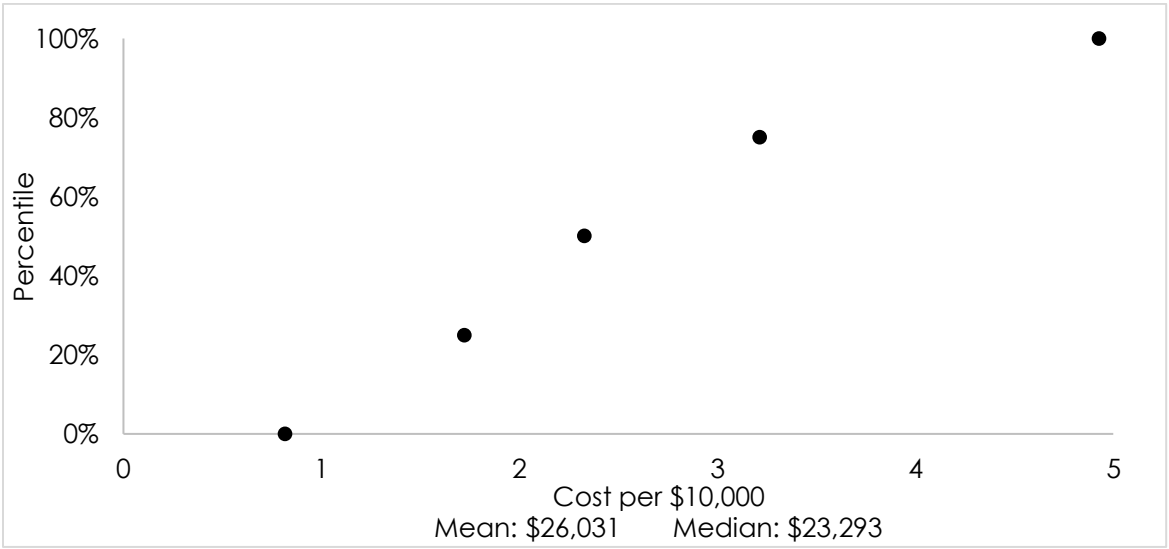
Figure 218: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with skin cancer (2013 dollars)



Testicular cancer

* Testicular 12 months 18-64 conservative estimates suppressed. **Mean: $138,254**
* Testicular 12 months 18-64 relaxed estimates suppressed. **Mean: $458,763**
*Testicular 12 months 65+ conservative estimates suppressed. No Mean available.

Figure 219: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with testicular cancer (2013 dollars)



Ureter cancer

*Ureter 12 months 18-64 conservative estimates suppressed. **No Mean available.**
* Ureter 12 months 18-64 relaxed estimates suppressed. **Mean: $36,814**
* Ureter 12 month 65+ conservative estimates suppressed. **No Mean available.**

Figure 220: Estimated distribution of the total cost (relaxed estimation) for inpatient hospitalizations during the last 12 months of life for patients aged 65 years and older with ureter cancer (2013 dollars)