



# Economic Burden of Colorectal Cancer: A Case of Fars, Iran

Abdosaleh Jafari<sup>1</sup>, Peyman Mehdi Alamdarloo<sup>2</sup>, Mehdi Dehghani<sup>3</sup>,  
Peivand Bastani<sup>1</sup>, and Ramin Ravangard<sup>1</sup> 

## Abstract

Among cancers, colorectal cancer is the third most common cancer in the world and the fourth leading cause of cancer deaths worldwide. Some studies have shown that the incidence of colorectal cancer is increasing in Iran and in Fars province. The present study aimed to determine the economic burden of colorectal cancer in patients referred to the referral centers affiliated to Iran, Shiraz University of Medical Sciences in 2019 from the patients' perspective. This is a partial economic evaluation and a cost-of-illness study conducted cross-sectionally in 2019. All the patients with colorectal cancer who had been referred to the referral centers affiliated to Iran, Shiraz University of Medical Sciences, and had medical records were studied through the census method (N = 96). A researcher-made data collection form was used to collect the cost data. The prevalence-based and bottom-up approaches were also used in this study. The human capital approach was applied to calculate indirect costs. The mean annual cost per patient with colorectal cancer in the present study was \$10930.98 purchasing power parity (PPP) (equivalent to 5745.29 USD), the main part of which was the medical direct costs (74.86%). Also, among the medical direct costs per patient, the highest were those of surgeries (41.7%). In addition, the mean annual cost per patient with colorectal cancer in the country was \$116917762 PPP (equivalent to 61451621.84 USD) in 2019. Regarding the considerable economic burden of colorectal cancer and in order to reduce the costs, these suggestions can be made: increasing the number of specialized beds through the cooperation of health donors, establishing free or low-cost accommodation centers for patients and their companions near the medical centers, using the Internet and cyberspace technologies to follow up the treatment of patients, and increasing insurance coverage and government drug subsidies on drug purchase.

## Keywords

colorectal cancer, cost of illness, economic burden, direct costs, indirect costs

Received September 8, 2020. Received revised March 14, 2021. Accepted for publication March 25, 2021.

## Introduction

Cancers make a wide range of chronic diseases that are currently one of the leading causes of death in many countries and account for a large part of their health budgets.<sup>1,2</sup> According to the world cancer statistics and the International Agency for Research on Cancer (IARC), 19.3 million new cases of cancer and 10 million deaths from cancer had been reported worldwide in 2020.<sup>3</sup> Also, 1,806,590 new cases of cancer and 606,520 deaths from the disease had been projected to occur in the United States in 2020.<sup>4</sup>

In Iran, the cancer growth rate is expected to increase to more than twice as much as the status quo in the next 20 years and become an important challenge of the health system, the

<sup>1</sup> Health Human Resources Research Center, School of Management and Medical Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>2</sup> Student Research Committee, School of Management and Medical Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>3</sup> Department of Hematology and Medical Oncology, Hematology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

### Corresponding Author:

Ramin Ravangard, Department of Health Services Management, School of Management and Medical Information Sciences, Shiraz University of Medical Sciences, Shiraz 0098, Iran.

Email: ra\_ravangard@yahoo.com



reasons for which are the increased life expectancy, the relatively increased number of the elderly, and the rapid change in the factors influencing the exacerbation of cancers.<sup>5</sup> Colorectal cancer, which is the colon and rectal (parts of the large intestine) cancer and is caused by the abnormal growth of cancer cells in the walls of the colon and rectum,<sup>6</sup> is also increasing, and according to global cancer statistics in 2018, colorectal cancer was the third most common cancers diagnosed in the world, accounting for 10.2% of all cancers.<sup>7</sup> Within that year, over 1.8 million new cases and about 861,663 deaths from colorectal cancer were reported. However, the incidence of the disease is constantly increasing around the world, especially in developing countries.<sup>7</sup> In 2018, colorectal cancer accounted for 9864 new cases (in both men and women) out of 110115 new cases of all cancers (9%) in Iran, which was the third most common cancer after breast cancer (12.5%) and gastric cancer (10.6%).<sup>8,9</sup> According to the National Cancer Registry of Iran in 2015, colorectal cancer was the fourth most common cancers in the entire population of men and women in Fars province, located in Iran's southwest and its capital is Shiraz, with 561 new cases.<sup>10</sup>

Several studies have been conducted on the costs of colorectal cancer worldwide. For example, Tran et al (2021) conducted a study in Vietnam in 2018, the result of which showed that the total economic cost of colorectal cancer was 132.9 million USD, of which indirect costs were 83.58% of the total cost.<sup>11</sup> The findings of the study by Azzani et al (2016) in Malaysia on patients with colorectal cancer indicated that the total 1-year (2013) patient cost was 2595.9 USD, and the highest median costs were related to direct medical costs, in which the surgery and chemotherapy costs had the highest ones, respectively.<sup>12</sup> In their study in Korea, Byun et al (2014) estimated the economic burden of colorectal cancer in 2010 to be about 3 billion and 100 million USD, of which the highest costs were related to indirect costs.<sup>13</sup>

Similar studies have also been conducted in Iran. For instance, Vahdatimanesh et al (2017)<sup>14</sup> carried out a study in 2012 and found out that the economic burden of colorectal cancer was 298148718 USD, a big percentage of which (58%) was the mortality cost, and direct medical costs accounted for 32.14% of the total costs. In the study by Davari et al (2012),<sup>15</sup> only direct medical costs were examined, and it was reported that the mean direct medical costs per patient were 16143.18 USD, of which the cost of drug treatment was the highest medical services cost.

Considering that the researchers found few comprehensive studies on the economic burden and total costs (direct and indirect) of colorectal cancer in Iran, and most of the studies had only examined direct medical costs, and due to the fact that determining the economic burden of the disease was necessary for proper allocation of financial resources and future policies, the present study aimed to determine the economic burden of colorectal cancer in patients who had been referred to the referral centers affiliated to Iran, Shiraz University of Medical Sciences in 2019.

## Materials and Methods

This is a partial economic evaluation and a cost-of-illness study conducted cross-sectionally in 2019. The study population consisted of all the patients with colorectal cancer who had been referred to the referral centers affiliated to Iran, Shiraz University of Medical Sciences, and had medical records there. According to the statistics by the referral centers in Shiraz, the total number of colorectal cancer patients was 96 in 2019 who were examined through the census method. Shiraz is the fifth-most-populous city of Iran and the capital of Fars Province.

To collect the required data, a data collection form was developed using the opinions of Oncology, Health Services Management, and Health Economics experts. It is noteworthy that the prevalence-based and bottom-up approaches were respectively used to prepare the cost data and to calculate the costs and economic burden from the patients' perspective. The bottom-up approach is used when the detailed data on resource use, including the patient-level data, are available.<sup>16</sup> Also, the prevalence-based study is used when the costs of a disease over a period of usually 1 year as well as all the costs of medical care for the study year are measured.<sup>17</sup>

The costs were determined based on both the purchasing power parity (PPP) dollar, which was equal to 22075 Rials for 1 US dollar according to the World Bank website,<sup>18</sup> and the current US dollar (USD), which was equal to 42000 Rials in Iran in the study year (2019) for 1 US dollar according to the Central Bank of Iran (CBI) website.<sup>19,20</sup>

In this study, the data collection form consisted of the following 4 sections was used to collect the required data:

Patients' demographic characteristics, including age, sex, marital status, education level, employment status, type of basic health insurance coverage, having supplementary health insurance coverage, and place of residence.

Direct medical costs including the costs of laboratory tests, radiography and ultrasound, MRI, CT scan, endoscopy, outpatient visits, chemotherapy, surgeries, heart tests, medical consumables, and port insertion, which were collected using the data in the patients' medical records and their insurance bills. The costs of the drugs used by the patients were determined according to their types and doses, and the price of the drugs was also obtained from the Deputy of Food and Drug, Shiraz University of Medical Sciences, and was then calculated at the market price.

Direct non-medical costs including transportation of the patients and their companions to the medical centers, and the costs of the patients' and their companions' accommodation and food, purchase of assistive devices such as wheelchairs, walkers, canes, abdominal supports, etc. babysitters and kindergartens, telephone and internet contacts with families, the cost of changes in the environment and living space for the patients' adaptation (such as baths, toilets, elevators, cars, furniture, etc.), and formal and informal care by nurses, family and friends were determined by asking the patients or their companions.

**Table 1.** Demographic Characteristics of the Studied Colorectal Cancer Patients (N = 96).

Characteristics		Number of patients	%	Characteristics		Number of patients	%	
Sex	Male	44	45.8	Place of residence	Shiraz	40	41.6	
	Female	52	54.2		Fars province cities except Shiraz	33	34.4	
Age (years)	24-46	26	27.1		Provinces other than Fars	23	24	
	46-57	32	33.3	Types of basic health insurance coverage	Social Security	50	52.1	
	≤57	38	39.6		Armed forces	3	3.1	
Marital status	Single	4	4.2		Iran Health Insurance	36	37.5	
	Married	92	95.8		Imam Khomeini Relief Foundation	1	1.1	
Education level	Illiterate	16	16.7	Oil Company	3	3.1		
	Lower than diploma	27	28.1	No insurance	3	3.1		
	Diploma	24	25	Having supplementary health insurance coverage	Yes	48	50	
	Academic degrees	29	30.2		No	48	50	
Employment status	Employee	17	17.7		Types of basic health insurance coverage	Social Security	50	52.1
	Worker	4	4.2			Armed forces	3	3.1
	Self-employed	21	21.9			Iran Health Insurance	36	37.5
	Retiree	17	17.7			Imam Khomeini Relief Foundation	1	1.1
	Unemployed	2	2.1	Oil Company		3	3.1	
	Housewife	35	36.4	No insurance		3	3.1	

Finally, indirect costs included absenteeism and potential productivity lost due to the disease or patient care, and the cost of premature death from the disease were obtained using the data collection form and asking the patients and their companions directly. Indirect costs related to productivity lost were calculated using the human capital approach, and the individuals' wages were considered the minimum wage in 2019 as approved by the Ministry of Labor, Welfare and Social Security; i.e. the minimum wage in 2019 was determined \$22.90 PPP per day (equivalent to 12.03 USD per day), and every 8 working hours was equivalent to 1 working day.<sup>18</sup>

The Excel 2016 software was used to analyze the collected data.

## Results

As shown in Table 1, of the 96 cases studied, most of the patients diagnosed with colorectal cancer were female (54.2%), over the age of 57 years (39.6%), married (95.8%), with academic degrees (30.2%), housewives (36.4%), under the coverage of Social Security Insurance (52.1%), and living in Shiraz (41.6). Also, half of the cases had supplementary health insurance coverage.

The results of calculating the direct medical, direct non-medical, and indirect costs per colorectal cancer patient are shown in Table 2. As the table shows, the highest mean direct medical, direct non-medical, and indirect costs per patient were related to those of surgeries (1792.53 USD equivalent to \$ 3410.47 PPP), accommodation of the patients and their companions (299.17 USD equivalent to \$ 569.21 PPP), and patient companions' absenteeism due to patient care (264.73 USD equivalent to \$ 503.67 PPP), respectively.

The results also showed that the highest mean costs per patient were the direct medical costs (4300.95 USD equivalent to \$ 8183 PPP) (Table 2).

Assuming that the incidence rates of colorectal cancer in Iran were equal in 2018 and 2019, the following formula was used to calculate the prevalence rate of colorectal cancer in Iran in 2019:<sup>21</sup>

Prevalence rate = incidence rate of colorectal cancer (estimated at 12.9 per 100,000 in 2018)<sup>9</sup> \* average duration of colorectal cancer (estimation of 1 year).<sup>22</sup>

Considering the population of the country in 2019 (82,913,906 people),<sup>23</sup> the number of colorectal cancer patients was obtained 10696, and the costs calculated in the present study (including direct medical, direct non-medical, and indirect costs) were multiplied by it. As a result, the mean annual cost of colorectal cancer patients in Iran was \$ 116917762 PPP (equivalent to 61451621.84 USD) in 2019, and the mean direct medical costs were a major part of the total economic burden of colorectal cancer in the country (\$ 87525368 PPP equivalent to 46002961.2 USD) (Figure 1).

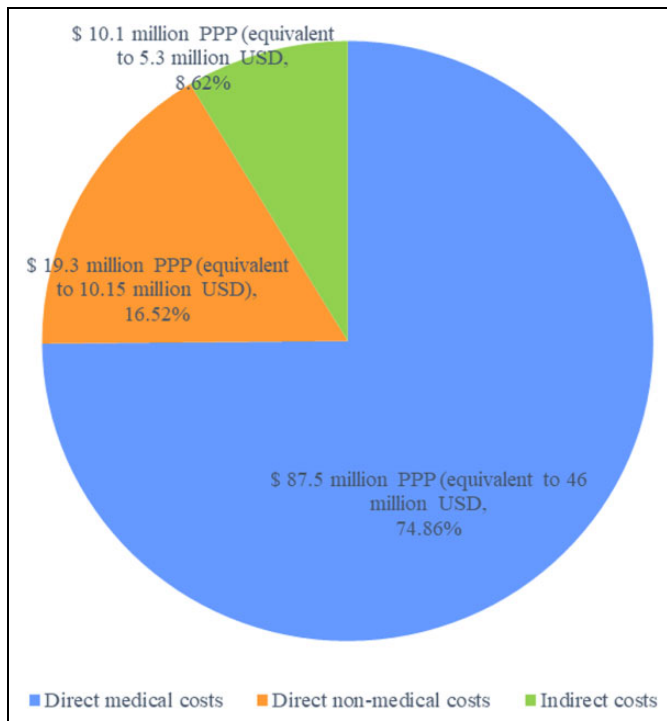
## Discussion

The ever-increasing costs of health systems around the world, especially in low- and middle-income countries such as Iran, has become a major concern of health managers and policy-makers, the main reason for which is the growing number of non-communicable, chronic, and incurable diseases such as cancer.<sup>24</sup> The significant advancement of diagnostic and therapeutic technologies has made the cost of colorectal cancer treatment to be remarkably high.<sup>25</sup> The aim of the present study was to determine the economic burden of colorectal cancer in patients who had been referred to the referral centers affiliated to Iran, Shiraz University of Medical Sciences in 2019.

The results of this study showed that most of the patients were female, over the age of 57, married, with academic degrees, housewives, covered by Social Security Insurance, and residents of Shiraz. The results of Izadi et al's (2015) study on patients

**Table 2.** Mean Annual Direct Medical, Direct Non-Medical, and Indirect Costs per Colorectal Cancer Patient in 2019 (\$ PPP and USD).

Type of costs		Mean (USD)	Mean (PPP)	%	% of total costs
Direct medical costs	Surgeries	1792.53	3410.47	41.7	74.86
	Chemotherapy	1353.03	2574.27	31.5	
	Medications and drugs	607.25	1155.36	14.1	
	Laboratory tests	113.81	216.53	2.6	
	Medical consumables	91.79	174.65	2.13	
	Colonoscopy	84.72	161.19	2	
	CT	84.50	160.77	1.96	
	Port insertion	63.41	120.64	1.43	
	Ultrasound	42.09	80.07	1	
	Physicians and oncologists visits	34.42	65.48	0.80	
	MRI	10.29	19.58	0.24	
	Endoscopy	8.68	16.52	0.20	
	Radiology	8.46	16.10	0.20	
Heart tests	5.97	11.37	0.14		
Total	4300.95	8183	100		
Direct non-medical costs	Accommodation	299.17	569.21	31.52	16.52
	Transportation of patients and their companions	286.72	545.51	30.22	
	Patients' and their companions' food	141.83	269.84	14.95	
	Special diet	124.07	236.06	13.07	
	Changes in the home environment to adapt to the disease	40.67	77.38	4.29	
	Phone and internet calls with family	29.92	56.92	3.15	
	Babysitter and kindergarten	22	41.86	2.32	
	Purchasing assistive devices	4.53	8.61	0.48	
	Total	948.91	1805.39	100	
Indirect costs	Patient companions' absenteeism due to patient care	264.73	503.67	53.43	8.62
	Absence from work due to the disease	230.70	438.93	46.57	
	Total	495.43	942.59	100	
Total costs		5745.29	10930.98	100	100

**Figure 1.** Estimation of total annual costs of colorectal cancer patients in Iran in 2019 (\$ PPP and USD).

with gastric cancer showed that most of the patients were female with a mean age of 65 years.<sup>26</sup> In their study, Shen et al (2020)<sup>27</sup> examined the patients with metastatic colorectal cancer the mean age of whom was 55 years and 62% of them were male. In addition, Eghdami et al (2019) carried out a study on gastric cancer patients and stated that most of them were male, in the age group of 55 to 65 years, farmers, married, illiterate or with primary education level, and covered by rural health insurance.<sup>28</sup>

The results of the present study indicated that colorectal cancer has a significant economic burden on the health system and the community. In this study, the mean total cost including direct medical, direct non-medical, and indirect costs per patient studied was \$ 10930.98 PPP (equivalent to 5745.29 USD), of which the highest was direct medical costs (\$ 8183 PPP equivalent to 4300.95 USD, 74.86%).

It was found out in the current study that the highest mean direct medical costs per patient were those of surgeries (41.7%). The main reason for the high cost of surgeries could be that the surgery for removing the affected organ (i.e. colon) was one of the main requirements for starting the treatment process and was usually done before chemotherapy in order to prevent metastasis and progression of the disease to other tissues such as the liver and lungs. But since the surgery department in the studied centers was not active to perform surgeries on colorectal cancer patients and there were long waiting lists

for surgeries in public centers, and also due to the patients and their families' concerns about the progression of cancer and in order to accelerate the treatment process and increase life expectancy, the patients had been referred to private medical centers for surgeries. This in turn increased the mean direct medical cost of surgeries compared to other direct medical costs. In the studies by Azzani et al (2016) in Malaysia on patients with colorectal cancer,<sup>12</sup> Izadi et al (2015) on gastric cancer patients in Kerman<sup>26</sup> and Sheerin et al (2015) on colorectal cancer patients in New Zealand,<sup>29</sup> surgeries had accounted for the highest costs, which is consistent with the results of the present study, but Vahdatimanesh et al (2017)<sup>14</sup> and Davari et al (2012) concluded in their studies that the highest direct medical costs were those of chemotherapy drugs,<sup>15</sup> the reason for which was the high price of chemotherapy drugs in Vahdatimanesh et al's research. Davari et al (2012)<sup>15</sup> also stated that the reason for this was the lack of necessary facilities in the health centers studied and as most surgeries were performed outside the centers. Consequently, the cost of surgeries on colorectal cancer patients was reported much less than the actual costs (due to the extraction of the data only from the patients' medical records in the centers studied and the lack of recording the costs of surgeries). Thus, the results of the 2 studies mentioned are not consistent with those of the present research.

Regarding the results of the present study, among the direct non-medical costs per patient, the highest were those of accommodation. One of the main reasons for the high cost of the patients and their companions' accommodation was that almost more than half of the patients (58.7%) did not live in Shiraz and had come from other cities of Fars or other provinces such as Bushehr, Hormozgan, Sistan and Baluchestan, etc. (from a long distance), and sometimes their hospitalization time for chemotherapy was delayed because there was no unoccupied and available bed. They also needed to rent a house or stay in a hotel, inn, etc. because most cancer patients had to visit and consult with other physicians, including internal or surgical specialists, due to the side effects of chemotherapy such as nausea, vomiting, lethargy, etc. and this caused their accommodation costs to increase significantly. The results of this study are inconsistent with those of Vahdatimanesh et al (2017)<sup>14</sup> and Eghdami et al (2019)<sup>28</sup> who stated that the highest direct non-medical costs were those of transportation and travel.

On the other hand, the highest costs per patient among the indirect costs (8.62%) were those of the patient companions' absenteeism due to patient care. The main reason for this result could be that each patient was usually accompanied by more than one person when being referred to the hospitals and healthcare centers, who worked for organizations and, therefore, had absences from work. Consequently, the cost of patient companions' absenteeism due to accompanying patients as well as patient care was high. The results of the present study are inconsistent with those of the studies by Tran et al (2021),<sup>11</sup> Vahdatimanesh et al (2017),<sup>14</sup> and Byun et al (2014),<sup>13</sup> in which it had been reported that mean indirect costs were the highest ones. The difference can be because of the

several premature deaths due to colorectal cancer and their related costs in these 3 studies.

Some limitations of the present study could be the self-report of the patients or their companions about direct non-medical costs and indirect costs, and as a result, forgetting or approximately mentioning some costs (recall bias). The small sample of patients although all the patients with colorectal cancer who had been referred to the referral centers affiliated to Shiraz University of Medical Sciences have been studied, incomplete data in some of the patients' medical records, lack of calculation of costs paid by the government and insurance organizations due to lack of access to data, and lack of cooperation of some patients with the researchers in providing accurate cost data could also be mentioned.

## Conclusion

The present study showed that colorectal cancer imposed a great economic burden on society and the health system. According to the findings, the highest costs of colorectal cancer patients were direct-medical costs (with the highest share related to the cost of surgery).

In this regard, in order to reduce the costs and economic burden of colorectal cancer, the following suggestions are presented: increasing the number of specialized beds, especially colorectal cancer surgical beds, through the cooperation of health donors and attracting their financial resources; establishing free or low-cost accommodation centers for the patients and their companions near the medical centers; providing specialized healthcare services for cancers, including colorectal cancer, in the cities of the province; using the Internet and cyberspace technologies including WhatsApp to follow up the treatment of patients in cases where in-person referrals are not needed in order to reduce patients' face-to-face visits, especially their visits to large cities and provincial centers to receive the services, and subsequently reducing indirect and direct non-medical costs; providing free screening programs and tests with the subsidy of the Ministry of Health and Medical Education for faster detection and diagnosis of the affected cases and those prone or at risk of the disease; and increasing insurance coverage and government drug subsidies on drug purchase.

## Authors' Note

This study was approved by the Shiraz University of Medical Sciences Ethics Committee (Code: IR.SUMS.REC.1397.232). To participate in this study, all the patients or their companions were taken written informed consent, and all were assured of the confidentiality of their responses.

## Acknowledgments

The present article was extracted from the thesis written by Peyman Mehdi Alamdarloo and was financially supported by Shiraz University of Medical Sciences grant No. 1396-01-07-16633. The researchers would like to thank the studied patients and their companions for their kind cooperation with the researchers in collecting and analyzing the data.


## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## ORCID iD

Ramin Ravangard  <https://orcid.org/0000-0001-7115-9850>

## References

1. Siegel R, Miller K, Jemal A. Cancer statistics 2016. *CA Cancer J Clin.* 2016;66(1):7-30.
2. Longo CJ, Deber R, Fitch M, Williams A, D'Souza D. An examination of cancer patients' monthly 'out-of-pocket' costs in Ontario, Canada. *Eur J Cancer Care.* 2007;16(6):500-507.
3. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2021.
4. Siegel RL, Miller KD, Goding Sauer A, et al. Colorectal cancer statistics, 2020. *CA Cancer J Clin.* 2020;70(3):145-164.
5. Zendehelel K, Hasanlou Z, Sedighi Z, et al. Improving quality of cancer registration in Iran. Part2: suggesting new national cancer registration program in Iran, based on comparative study of 18 countries. *Hakim Res J.* 2010;12(4):50-57.
6. Safaee A, Moghimi-Dehkordi B, Fatem S, Pourhoseingholi M, Ghiasi S, Zali M. Colorectal cancer in Iran: an epidemiological study. *Asian Pac J Cancer Prev.* 2008;9(1):123-126.
7. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2018;68(6):394-424.
8. International Agency for Research on Cancer. Number of new cases in 2018, both sexes, all ages. Islamic Republic of Iran 2018. Accessed June 18, 2020. [www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj3hPb08q7rAhWV5OAKHc-jBRIQFjAAegQIAhAB&url=https%3A%2F%2Fgco.iarc.fr%2Ftoday%2Fdata%2Ffactsheets%2Fpopulations%2F364-iran-islamic-republic-of-fact-sheets.pdf&usg=AOvVaw1KJ-4RebPsayew84Ek1qVR](http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj3hPb08q7rAhWV5OAKHc-jBRIQFjAAegQIAhAB&url=https%3A%2F%2Fgco.iarc.fr%2Ftoday%2Fdata%2Ffactsheets%2Fpopulations%2F364-iran-islamic-republic-of-fact-sheets.pdf&usg=AOvVaw1KJ-4RebPsayew84Ek1qVR)
9. Zendehelel K. Cancer statistics in IR Iran in 2018. *Basic Clin Cancer Res.* 2019;11(1):1-4.
10. Roshandel G, Ganbari Motlagh A, Malekzadeh R. *Annual Report of Iranian National Population-Based Cancer Registry 2015.* 1 ed. Mirmah; 2018.
11. Tran BT, Choi KS, Nguyen TX, et al. The direct and indirect costs of colorectal cancer in Vietnam: an economic analysis from a social perspective. *Int J Environ Res Public Health.* 2021;18(1):12.
12. Azzani M, Roslani AC, Su TT. Financial burden of colorectal cancer treatment among patients and their families in a middle-income country. *Support Care Cancer.* 2016;24(10):4423-4432.
13. Byun J-Y, Yoon S-J, Oh I-H, Kim YA, Seo H-Y, Lee Y-H. Economic burden of colorectal cancer in Korea. *J Prev Med Public Health.* 2014;47(2):84-93.
14. Vahdatimanesh Z, Zendehelel K, Akbari Sari AA, et al. Economic burden of colorectal cancer in Iran in 2012. *Med J Islam Repub Iran.* 2017;31:115.
15. Davari M, Maracy M, Emami M, et al. The direct medical costs of colorectal cancer in Iran: analyzing the patient's level data from a cancer specific hospital in Isfahan. *Int J Prev Med.* 2012;3(12):887-892.
16. Mercier G, Naro G. Costing hospital surgery services: the method matters. *PLoS One.* 2014;9(5):e97290.
17. Byford S, Torgerson DJ, Raftery J. Economic note: cost of illness studies. *BMJ.* 2000;320(7245):1335.
18. Salary and benefit in 1398. 2019. Accessed June 18, 2020. <https://www.irantalent.com/blog/salary-and-benefits-in-1398/>
19. Exchange Rate. Central Bank of the Islamic Republic of Iran. Accessed June 18, 2020. [https://www.cbi.ir/default\\_en.aspx](https://www.cbi.ir/default_en.aspx)
20. Jo C. Cost-of-illness studies: concepts, scopes, and methods. *Clin Mol Hepatol.* 2014;20(4):327-337.
21. Tu HAT, Woerdenbag HJ, Riewpaiboon A, et al. Cost of illness of chronic hepatitis B infection in Vietnam. *Value Health Reg Issues.* 2012;1(1):23-28.
22. Ghahremani R, Yavari P, Khodakarim S, Etemad K, Khosravi A. The estimated survival rates for colorectal cancer and related factors in Iran from 1384 to1388 using the Aalen's Additive Risk Model. *Iran J Epidemiology.* 2016;11(4):20-29.
23. Iran Population Growth Rate 1950-2020. Accessed June 18, 2020. <https://www.macrotrends.net/countries/IRN/iran/population-growth-rate2019>
24. Davari M, Walley T, Haycox A. Health care challenges in Iran. *Iran J Public Health.* 2005;34(1):30-31.
25. Ghatak N, Trehan A, Bansal D. Financial burden of therapy in families with a child with acute lymphoblastic leukemia: report from north India. *Support Care Cancer.* 2016;24(1):103-108.
26. Izadi A, Jaffari Sirizi M, Esmaeelpour S, Barouni M. Evaluating direct costs of gastric cancer treatment in Iran-case study in Kerman city in 2015. *Asian Pac J Cancer Prev.* 2016;17(6):3007-3013.
27. Shen L, Li Q, Wang W, et al. Treatment patterns and direct medical costs of metastatic colorectal cancer patients: a retrospective study of electronic medical records from urban China. *J Med Econ.* 2020;23(5):456-463.
28. Eghdami A, Ostovar R, Jafari A, Palmer AJ, Bordbar N, Ravangard R. Economic burden of gastric cancer: a case of Iran. *Cancer Control.* 2019;26(1):1073274819837185.
29. Sheerin I, Green T, Sarfati D, Cox B. Projected costs of colorectal cancer treatment in New Zealand in the absence of population screening. *N Z Med J.* 2015;128(1408):72-85.