RESEARCH ARTICLE

Analyzing the variation in treatment costs for colorectal cancer (CRC): A retrospective study to assess an underlying threat among the Vietnamese

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Abstract

Objective: Colorectal cancer (CRC) is the third most common, and the second deadliest, cancer documented in recent years, and numerous studies have addressed this issue. Nevertheless, little attention has been given to the CRC burden in Vietnam. Our study aims to analyze variations in cost for CRC treatments using the cost of illness (COI) method.

Methods: Utilizing medical records spanning from 2014 to 2017 supplied by a primary healthcare facility in Ho Chi Minh City, a population of 9,126 patients, diagnosed with and treated for CRC, was analyzed in terms of demographic detail and individual treatment cost.

Results: Among the 9,126 patients hospitalized with CRC, 3,699 patients were between the ages of 50 and 65. Colon cancer accounted for 56.4% and 60.4% of the total patients in Inpatient Department (IPD) and Outpatient Department (OPD). The total direct medical cost was calculated to be over ten million USD for IPD patients and over three million USD for OPD patients over a four year span of data. The per-patient cost was $2,741.00 (IPD) and $588.80 (OPD), with chemotherapy drugs being 53% (IPD) and 73% (OPD) of the overall treatment cost. Patients going through both treatment regimens incurred a mean cost of $4,271.20 (IPD) and $1,779.80 (OPD).

Conclusion: There is a similarity in the costs of CRC treatment in developing countries in Asia. Despite many limitations, we are certain this study will be useful for future studies regarding the CRC burden in Asia in general, as well as in developing countries like Vietnam.

Keywords: Colorectal cancer cost-of-illness, Direct medical cost, Retrospective, Vietnam. (JPMA 69: S-34 (Suppl. 2); 2019)

Introduction

One of the world's most lethal diseases, cancer, which represents a group of non-communicable diseases related to tissue malformation and overgrowth, was responsible for the death of approximately 8.8 million people in 2015.[1] Globally, cancer has the second highest mortality rate — being responsible for one out of six cases of mortality.[1] Among them, colorectal cancer (CRC), a type of cancer that begins as polyps on the inner lining of the colon or rectum, caused the deaths of 774,000 people in 2015, and the overall lifetime risk of developing colorectal cancer is about 4% in both genders.[2] According to the World Health Organization's (WHO) 2012 cancer database, CRC is the third most common cancer in both morbidity and mortality, after lung cancer and prostate cancer, with an estimated nearly 1.4 million new cases diagnosed each year, 55% of which come from developing countries where healthcare systems still require much improvement.[3]

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In the United States (US), although there has been a steady decline in incidence and mortality rate due to lifestyle changes, it is projected that there will be 97,220 new cases of colon cancer and 43,030 new cases of rectal cancer in the near future.[2,4] Additionally, even though other studies, which target European countries, show a relative decrease in mortality, the burden of colorectal cancer is still higher in Europe than in any other areas of the world, especially in Central Europe, where colorectal cancer is most prominent.[3,5,6] In Asia, on the other hand, the impact of colorectal cancer is not as significant, as there were 592,563 cases ofcolorectal cancer in 2012, most of which came from developed countries, with the highest standardized incidence recorded in Korea (45 per 100,000). However, the incidence of colorectal cancer has been increasing in many countries belonging to the Association of Southeast Asian Nations (ASEAN). For example, the incidence rate might be as high as 16% in unselected Indonesian colonoscopy patients,[7] while the crude rate of colorectal cancer in Thai people is about 8 per 100,000.[8]

Though advances in cancer screening and treatment over the past few decades have steadily reduced the prevalence, as well as the mortality rate, through early detection and prevention, as a collateral result, the

economic burden brought by cancer treatments has significantly risen. On a global scale, it is estimated that long-term costs for colorectal cancer are up to $50,175 USD per patient, making it the second most economically impactful cancer ($99 billion in expenditure globally in 2008).[9,10] In the US, the incidence of CRC is decreasing as the survival rate improves, but the cost of treatment is also increasing. The overall cost of care is projected to rise to $14.02 billion USD by 2020.[11] Another study has also pointed out that 25% of CRC patients struggle financially due to healthcare expenditures.[12] As for Asian countries, where most CRC cases have already reached late stage by the time they are diagnosed, people are more vulnerable to healthcare-related financial burdens.[13,14] In China, a study conducted in 2017 showed that the overall direct expenditure for a patient diagnosed with CRC was $10,987.50 USD, while the average household income was only $8,887.56 USD per year.[15] In addition, the mean total cost of managing CRC for one year after diagnosis was $2,595.90 USD, with the highest cost being recorded in the later stages of the disease (Stages III and IV).[13]

In the Vietnamese context, there have, until now, been few studies assessing the cost of diagnostic healthcare services for CRC, though CRC is one of the most socioeconomically concerning illnesses, given the underlying nature of the disease and the limited number of reliable treatment facilities.[3,16] To make future decisions on insurance policy, healthcare budgets, and the eventual modification of the National Guideline for Colorectal Cancer Treatment, it is important to identify and estimate the relevant costs of illness regarding various aspects relating to the disease.[17] Using the dataset provided by a primary government-owned hospital specializing in cancer treatment, our study aims to estimate and assess the unequal economic burdens between inpatient and outpatient CRC groups and to analyze the relationship between direct medical costs and individual demographic characteristics, variants in diagnosis, and comorbidities. Information on the economic burden of CRC in Vietnam will prove useful as a basis for future policies relating to colorectal management.

Patients and Methods

Utilizing Binh Dan Hospital's electronic medical records database, a retrospective Cost-Of-Illness (COI) analysis was conducted with the aim of calculating the direct medical cost for CRC cases from 2014 to 2017. This COI study targeted healthcare receiver's expenditures.

Binh Dan Hospital was chosen as the study site. Situated in the heart of Ho Chi Minh City-one of the ten most dynamic cities in the world and the city with the most developed healthcare system in the region-Binh Dan Hospital was an ideal choice for this research. The survey population was made up of hospitalized patients diagnosed with colon or rectal cancer via the International Statistical Classification of Disease and Related Health Problems, tenth edition (ICD-10). Codes C18 and C20 from ICD-10 were used in patient selection. An anonymized dataset of all confirmed CRC patients from January 2015 to December 2017 was obtained from the hospital's electronic databases. A population of 5,458 outpatients and 3,668 inpatients was selected, all of whom were Vietnamese citizens diagnosed with the disease.

Statistical Analysis

Each entry of the case data contains the explanatory variables of healthcare utilization described in the case ID: patient age, gender, region of occupation, diagnostic types, and insurance code (which was calculated into discount percentages to obtain the total cost of treatment for patients with insurance). For the inpatient group, the explanatory variables also include length of stay during treatment and additional information relating to individual treatment plans-i.e., surgery, chemotherapy (prescribing and administering chemotherapeutic agents listed in the Binh Dan guideline for CRC treatment), utilizing both treatment regimens (administering chemotherapeutic agents following initial surgery sessions to enhance treatment outcome), and check-ups (including patients who only signed up for cancer screening, treatment monitoring, or early cancer detection).[18] Simple descriptive methods-like percentage, mean, median, and standard deviation-were used for analyzing continuous and categorical variables summarizing data on demographic characteristics, clinical status, and cost components.

Direct medical cost (DMC) is the medical cost directly related to the disease (i.e., HCC). It is usually associated with medical care expenditures for diagnosis, treatment, and all specialist and general practitioner care, including emergency care, rehabilitation, physiotherapy, etc.[19,20] The DMC in this survey comprised two parts: costs for inpatients (CI) and costs for outpatients (CO).

All costs, which were from previous years, were converted to the 2018 US dollar currency using the Consumer Price Index (CPI)[21] and were categorized into major cost components. The skewed database relating to cost in both patient groups was bootstrapped and interpreted as total cost and per patient expenditure (95% Confidence Interval). In addition, the influences of the demographic

factors were analyzed as mean differences and were calculated by bootstrap. The result was interpreted using $P < 0.05$ (95% Confidence Interval).

Ethical Considerations

The Medical Ethics Council at the Binh Dan Hospital approved the research protocol. The study was conducted under the supervision of the Pharmacy Department of the University of Medicine and Pharmacy in Ho Chi Minh City. Because the data was collected through the hospital's records and contained personal information, it is anonymized to protect the patients' privacy. The collected data is confidential and used exclusively for research purposes.

Results

Out of a total of 9,126 patients in this study, three-fifths were OPD patients with CRC. IPD patients were hospitalized for an average 16.0±13.1 days (Q1-Q3: 6-22 days). Over 40.0% of participants with CRC were in the 50-65-year-old group, making the average age of initial CRC diagnosis around 58.7±14.2 years old. The percentage of study subjects living in urban areas was 70.4% for IPD and 62.2% for OPD. 60.4% of OPD patients and 56.4% of IPD patients were diagnosed with C18. Male patients made up the majority of the study population, as 61% of IPD patients were male. More than half of IPD patients had 100% insurance coverage, while, for OPD patients, "80% insurance coverage" and "self-paid" accounted for the largest percentages (42.3% and 42.1% respectively). Over half of IPD patients were treated with both surgery and chemotherapy, and only 3.2% of the patients were prescribed chemotherapy drugs. For OPD patients, the most common treatment regimen was check-ups (46.4%), followed by chemotherapy treatment (23.2%) (Table-1).

Detailed Costs for CRC

The results obtained by our analysis show that the mean per-patient costs were $2,741.00 USD (95% CI: $2,611.90 - $2,873.30) and $588.80 USD (95%CI:$563.20 -$614.80) in IPD and OPD, respectively. In terms of these medical institutions, the cost due to chemotherapy drugs was the largest contributor towards direct medical costs (53% for IPD and 73% for OPD), as shown in Figure-1. The total cost burden for IPD patients was $10,055,271.20 USD, while OPD patients had a total economic burden of only one-third of that number ($3,214,503.70 USD) [Table-2].

Table-1: Demographical characteristics of patients with CRC in Binh Dan hospital over a 2014-2017 period.

		IPD (N=3,668)		OPD (N=5,458)	
Numeric Variables		Mean (SD)	Median (Q1-Q3)	Mean (SD)	Median (Q1-Q3)
Age		58.7 (14.2)	59 (50-68)	58.2 (14.6)	59 (49-68)
Number of visits		4.5 (4.9)	2 (1-8)	5.8 (7.1)	2 (1-9)
Length of stay (days)		16.0 (13.1)	15 (6-22)	-	-
Nominal variables			N (%)		N (%)
Age groups	<50		902 (24.6)		1422 (26.1)
	50-65		1503 (41)		2196 (40.2)
	65-75		728 (19.8)		1068 (19.6)
	>75		535 (14.6)		772 (14.1)
Region	Urban		2582 (70.4)		3393 (62.2)
	Rural		1086 (29.6)		2065 (37.8)
ICD-10 code	C18		2070 (56.4)		3298 (60.4)
	C20		1598 (43.6)		2160 (39.6)
Sex	Male		2238 (61)		3128 (57.3)
	Female		1430 (39)		2330 (42.7)
Insurance coverage (%)	100		2045 (55.8)		549 (10.1)
	95		289 (7.9)		300 (5.5)
	80		559 (15.2)		2310 (42.3)
	Self-paid		775 (21.1)		2299 (42.1)
Treatment regimen	Surgery		1308 (35.7)		980 (18)
	Chemo		119 (3.2)		1269 (23.2)
	Both		1977 (53.9)		678 (12.4)
	Check-up		264 (7.2)		2531 (46.4)

CRC: Colorectal cancer; IPD: Inpatient Department; OPD: Outpatient Department.

Table-2: Per case and total direct medical costs attributable to CRC (USD).

Cost components	Direct medical cost					
		IPD			OPD	
	Total	Per patient	95% CI	Total	Per patient	95% CI
Diagnosis	490,394.9	133.7	(128.8-138.6)	518,549.1	95.0	(91.1 - 99.0)
Physician	2,077.2	<0.1	(0.5-0.6)	1,072.9	<0.1	<0.1
Laboratory tests	337,607.3	92.1	(89.3-94.9)	193,508.9	35.5	(34.4-36.5)
Chemo drugs	5,343,862.3	1,456.5	(1,347.9-1,569.6)	2,330,025.6	426.8	(404.7-449.6)
Surgeries	1,161,019.4	316.4	(296.9-336.9)	98,127.1	18.0	(16.8-19.2)
Additional pharmaceuticals	839,753.5	228.9	(218.3-239.6)	73,000.3	13.4	(12.4-14.4)
Medical supplies	946,171.2	258.0	(244.9-271.6)	167.8	<0.1	<0.1
Facility utilization	57,066.6	15.6	(14.6-16.5)	-	-	-
Ambulance	218.7	<0.1	<0.1	-	-	-
Hospital bed	796,129.7	217.0	(209.7-224.4)	-	-	-
Others	80,970.5	22.1	(19.8-24.5)	51.1	<0.1	<0.1
Total cost	10,055,271.2	2,741.0	(2,611.9-2,873.3)	3,214,503.7	588.8	(563.2-614.8)

CRC: Colorectal cancer; IPD: Inpatient Department; OPD: Outpatient Department.

Table-3: Costs of CRC with demographic categories (USD).

Characteristics		IPD		OPD	
		Mean	95% CI	Mean	Min
Age	<50	2,724.8	2,483.1-2,990.7	557.8	510.2-608.5
	50-65	2,860.0	2,658.5-3,072.3	636.4	596.0-678.1
	65-75	2,897.6	2,604.8-3,227.5	588.6	533.7-648.6
	>75	2,201.2	1,921.1-2,508.5	509.0	446.7-578.5
Region	Urban	2,805.6	2,652.4-2,971.7	572.6	541.5-605.2
	Rural	2,577.7	2,379.3-2,796.3	614.6	571.4-658.1
ICD-10 code	C18	2,580.4	2,411.5-2,758.7	565.4	533.6-597.2
	C20	2,947.9	2,753.2-3,158.7	624.5	584.0-667.0
Sex	Male	2,797.5	2,631.1-2,978.4	626.7	592.3
	Female	2,650.5	2,458.2-2,852.8	537.5	502.3
Treatment type	Surgery	1,140.7	1,090.9-1,192.7	171.6	162.2-181.2
	Chemo	657.5	483.8-914.2	1,314.3	1,250.9-1,380.0
	Both	4,271.2	4,061.4-4,497.6	1,779.8	1,696.8-1,864.9
	Check-up	139.6	121.9-160.5	67.8	64.3-71.3

CRC: Colorectal cancer; IPD: Inpatient Department; OPD: Outpatient Department.

Table-4: Comparison of recent studies which scoped on treatment cost of CRC.

Recent studies relating to CRC in different regions	Number of patients	Participants' Age	Tumor site (Colon)	Individual mean cost (USD)	
	N	Mean	%	IPD	OPD
Our study	9,126	58.7±14.2	58.8	2,741.0 (2,611.85-2,873.26)*	588.8 (563.2-614.79)*
Meram Azzani's study (Malaysia)[13]	138	-	-	2,595.9***	
Niilo Farkklila's study (Finland)[22]	509	68.6*	56.6	12,339 (9,127-15,550)*	12,339 (9,127-15,550)*
Xue Song's Study (USA)[23]	6,675	64.1*	69.7	15,179±49,095	
Huang's study (China)[15]	2,356	57.4*	-	9,973.1***	

Abbreviations: CRC: Colorectal cancer; IPD: Inpatient Department; OPD: Outpatient Department
Note: *: mean (95% CI); **: mean (SD); ***: mean [neither SD nor 95% CI were available.

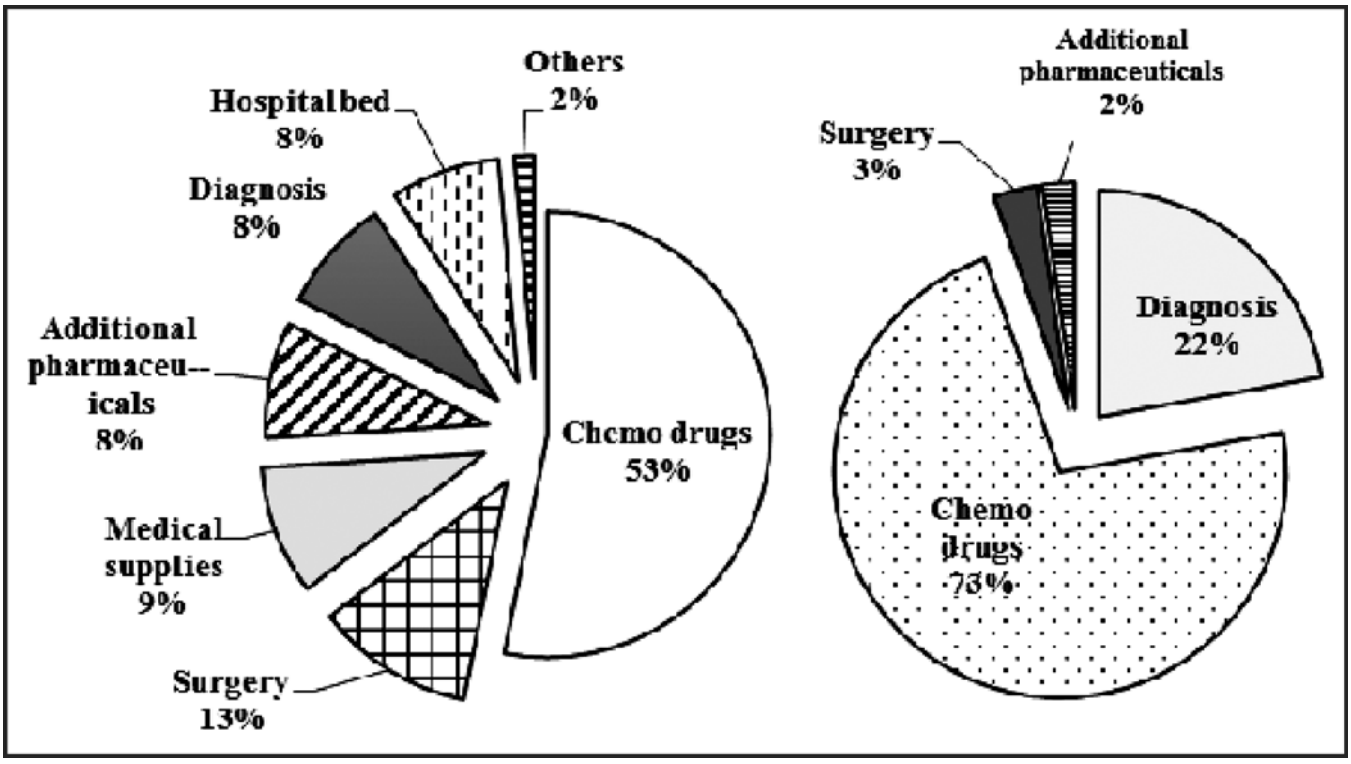

Figure-1: The percentage of cost components in both IPD and OPD sectors.

Costs for CRC with Demographical Factors

With costs broken down by demographical factors, IPD patients, with ages spanning from 65 to 75 years, had the highest expenditure compared with other age groups. The highest expenditure for OPD patients was in the 50-to-65-years-old group. Urban IPD patients had higher costs than rural IPD patients, whereas the reverse trend was illustrated for OPD patients. It is also worth mentioning that patients diagnosed with C20 tended to have higher expenditures than C18 patients. Concerning gender, male patients seemed to spend more on CRC treatment because, in both groups, the costs for male patients were slightly higher than for their female counterparts. Patients treated with both chemotherapy and surgery had the highest expenditures among treatment regimens (over $4,000 USD for IPD and over $1,500 USD for OPD). Check-ups only made up a total of $139.60 and $67.80 USD among IPD and OPD patients, respectively [Table-3].

Discussion

It is seen by the severity of the disease that CRC creates a heavy burden on society, both epidemiologically and economically. It is among the most impactful cancers in modern Vietnam, as the Vietnamese population is increasingly under the influence of the Western lifestyle. Therefore, our study focused on direct medical expenditures and the financial burden caused by CRC.

A total of 9,126 patients recorded in the Binh Dan Hospital database were included in this study, giving our study one of largest sample populations.[13-15,18,23] The majority of these patients were diagnosed with cancers located in the colon. This study also includes an unusual age span of patients diagnosed with and treated for CRC, which was heavily concentrated between 50 and 65 years of age. Through cross-examination with Huang et al. (2017)[15] and Kikuchi et al. (2017),[24] whose study samples were also based in hospital records, we believe that the mean age trend of CRC incidence in Asian nations is identical to that recorded in the previous literature. Comparing studies based in Asia with those from other regions, we have concluded that the average age of initial CRC diagnosis in Asian communities is approximately ten years younger than in other regions [Table-4]

It has been decades since people first set scrutinizing eyes on the cost burden of CRC treatment. Since then, on the international scale, many studies, with different aims and methods, have shed light on this concept. CRC treatment can result in disastrous economic burdens, but they differ

markedly in many aspects. The total CRC burden is recorded to be a catastrophic $10,055, 271.20 USD for IPD patients, which is over three times higher than the OPD patient's overall cost burden. The total costs, as well as the direct costs, were highest within the first six months after diagnosis, as the initial treatment involves hospitalization and utilizes the most service.[18,19] (According to Binh Dan Hospital's guideline for CRC treatment, regular check-ups and disease monitoring are assigned every six months following initial diagnosis and treatment). On the other hand, we found that the mean costs for an individual patient in the IPD and OPD groups in Vietnam were $2,741.0 USD and $588.80 USD, respectively. Therefore, we conclude that the average expenditure among South East Asian nations' CRC patients are, to some extent, similar at around $3,000 USD, while those in developed countries, like the US or China (and even European countries like Finland), surge to over $10,000 USD.[13,15,23,24] Pharmaceuticals made up the majority of the total expenses for one patient, overtaking 60-75% of the total mean cost. Chemotherapy drugs and immunosuppressants contributed must towards this cataclysmic expense, which imposes a considerable economic burden on patients due to these types of drugs rarely being covered by insurance policies.

To our knowledge, our study is one of only three studies in Vietnam assessing CRC-related treatment costs and the overall burden of the disease in a prestigious health care facility. To give the most thorough view with the provided database, we divided the records into IPD and OPD groups and evaluated the patients' service utilization based on the cost components. These study results could also be used as a foundation for future study regarding CRC treatment effectiveness, as well as for finding the main drivers of CRC cost. Cost component analysis, in our opinion, could be used as a reference for policy makers and insurance companies so that they may fully aid people who are in great need of financial support during treatment.

Limitations

COI studies, such as this, have recently been subjected to criticism for their varied results. Another limitation, common to studies relying on administrative databases, is that such databases may easily include errors in cost categorization and may lack crucial information regarding patients' demographic details. The expenditure analysis may have also been affected by missing data relating to disease severity. This is one of the study's largest flaws, in our opinion, because that missing data prevented us from categorizing CRC cost into disease stages, though cost has been proven to vary distinctively across stages-especially the later stages. Moreover, overall CRC treatment required a long follow-up period; therefore, data covering four years of patients' treatment might be too short and, thus, insufficient for conducting a study regarding CRC cost. In any case, this fact would increase the cost of CRC treatment over time.

Obviously, much work remains to determine the accurate cost of treatment for CRC and provide the complete picture surrounding the disease. Nevertheless, in Vietnam, direct nonmedical expenditure, indirect expenditure, and intangible expenditure seem to be neglected due to the fact that Vietnamese people typically bear the disease with them in their daily lives. Those are the challenges that we need to face.

Conclusion

This study provides calculations of total costs of CRC care. It has found that the majority of CRC patients incur considerable economic burdens to treat their disease. Patients receiving chemotherapy treatments bear the most considerable economic burden, since chemotherapy drugs are often excluded from insurance policies. Comparing our work with other research sharing the same scope, we have concluded that there is an overall similarity between the cost of CRC treatment across developing Asian countries-somewhere in the proximity of $2,500 to $3,000 USD. Despite evident flaws in our study, we certainly think this research is a solid, beginning foundation for policy makers to draft more efficient insurance policies, and more cost-effective treatment plans, for patients. Future studies should view this work as a reference to help them aim for a broader scope: the overall cost of illness throughout Asian nations.

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