Increasing hospital admission rates and economic burden for colorectal cancer in Brazil, 1996–2008

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ABSTRACT

Objective.   *To determine the trends in hospital admission rates for colorectal cancer (CRC) in the Brazilian Public Health System from 1996 to 2008 and to assess the economic costs.*

Methods.   *Data from the Hospital Information Systems database of the Brazilian Unified Health System were used for analysis of all admissions with a primary diagnosis of CRC between 1996 and 2008.*

Results.   *There were 297 108 CRC admissions over the study period, with an annual increase from 12 821 in 1996 to 35 040 in 2008. Age-standardized admission rates increased from 8.7 to 23.56 per 100 000 for a percentage increase of 171%. The average length of stay decreased from 11.6 days in 1996 to 7.5 days in 2008. The average hospital mortality declined from 10.4% to 8.5%. Overall costs in United States dollars (US$) of CRC hospitalizations rose from US$ 16.5 million in 1996 to US$ 33.5 million in 2008; the average cost of each admission, however, decreased from US$ 1 283 to US$ 954.*

Conclusions.   *Hospitalization rates for CRC in Brazil significantly increased during a 13-year period, incurring a considerable rise in the inflation-adjusted economic burden; national in-hospital mortality rates have remained relatively high.*

Key words   Colorectal neoplasms; hospitalization; length of stay; hospital mortality; hospital costs; Brazil.

Colorectal cancer (CRC) is the third most common malignancy in the world in both men and women and it is the fourth leading cause of cancer-related death. Incidence rates of CRC worldwide are remarkably variable. The highest rates are found in developed countries, including the United States, Canada, Australia, and the countries of northwestern Europe. A comparatively low rate is observed in Asian, African, and South America countries, although incidence rates are increasing in countries that were previously considered low incidence (1).

The International Agency for Research on Cancer estimated that CRC was the fourth most common form of cancer in men and third in women for the year 2008 in Latin America (1); CRC was also the fourth most frequent cause of cancer-related death in men and fifth in women (1). In Brazil, for 2008, CRC was the fourth most frequent malignancy, with approximately 13 000 new cases estimated in males and 14 500 in females (2, 3).

Unfortunately, there are few studies on the epidemiology of CRC in Latin America and, specifically, in Brazil. Nevertheless, current data indicate that the incidence of CRC and its related mortality has increased in the country in recent decades, especially in the more developed and industrialized regions (4–6). An average annual growth of 3.5% in CRC deaths was reported between 1979 and 2000, from 2.44 to 4.12 per 100 000 males and from 2.8 to 4.29 per 100 000 females (4).

In spite of progress in the medical and scientific fields, CRC concomitantly presents a significant economic burden

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worldwide. The economic impact of CRC in the United States was estimated to range between 5.5 billion and 6.5 billion United States dollars (US$) in 2000, with inpatient costs representing 80% of total direct costs (7).

Although a progressive incidence of CRC has been demonstrated in Brazil, it is unknown how the current strategy of population screening for an early diagnosis and the availability of new and more effective chemotherapeutic agents affect nationwide hospitalization patterns for CRC. In addition, there are no studies on inpatient direct costs related to this disease in the Brazilian Public Health System. It is essential to measure these costs in order to estimate the CRC economic burden at a national level. Therefore, the objectives of this study were to determine rates and recent trends of hospital admissions for CRC in the Brazilian Public Health System between 1996 and 2008 and to assess the direct economic costs resulting from these admissions.

MATERIALS AND METHODS

Data sources

All data were extracted from the Hospital Information Systems of the Brazilian Unified Health System (SIH-SUS), which is maintained by DATASUS, the national agency for health statistics. SIH-SUS is a public nationwide database that comprises almost 80% of all hospital admissions in Brazil (8); it is the only public nationwide source of information on hospital morbidity and mortality. SUS is a subsystem of the National Health Care System, which consists of all health care centers financed by public providers. Thus, data from the other subsystem (the supplementary medical system, which consists of health plans and private patients) were not computed.

Collected data

All hospital admissions between 1996 and 2008 with a primary diagnosis of CRC were included. The CRC cases were identified by International Classification of Diseases (ICD) codes from the ninth and tenth revisions. The SIH-SUS database used the ICD-9 coding system until 1997; then the ICD-10 codes were adopted. Colon cancer (C18–C19) included cancers of the rectosigmoid junction; rectum cancer (C20–C21) included cancers of the rec-

tum and the anal canal, excluding those originating in the skin of the anal region.

Although the SIH-SUS database includes data since 1984, more accurate parameters for diagnosis registration were not introduced in hospital admission systems until 1995 (9); hence, only data registered after 1996 are included in this study. The following variables were evaluated: gender, age, overall costs, costs per episode of hospital admission, mean length of stay per admission, and number of in-hospital deaths.

The age-stratified hospitalization rates were calculated by dividing the number of hospital admissions due to CRC for each year and age group by the size of the corresponding Brazilian population in each age group, obtained from the 2000 Brazilian census of The Brazilian Institute of Geography and Statistics (10); the resulting rates were multiplied by 100 000 to obtain data expressed per 100 000 persons per year. Age-standardized hospitalization rates calculated by the direct method using the world standard population (modified by Doll et al. [11]).

The direct economic costs related to CRC hospital admissions reported in this study are based on the amount that SUS pays for each hospitalization, including all the specific costs of a hospital stay, such as complementary examinations, interventions and surgical procedures, medications (e.g., chemotherapy), and professional fees. These values were adjusted monthly for inflation according to Brazil's official inflation index from January 1996 until December 2008. These data were then converted from national currency (Brazilian real, BRL) to US$ using the 2007 purchasing power parity (PPP) conversion factor to the official exchange rate ratio from the United Nations Statistics Division (12), which was the most recent available at the time of this writing. We assumed that the 2008 PPP conversion factor remained stable with respect to 2007 (1 PPP US$ = 1.6 BRL). Comparisons based on market exchange rates can lead to misinterpreted results because these rates are more susceptible to short-term variations and influences that often do not represent real long-term trends. PPP conversions, on the other hand, enable large equivalent economic comparisons across distinct countries (13).

Statistical analysis

All data were analyzed with SPSS 15 software (SPSS Inc., Chicago, United

States of America). Data used for this study comprise all CRC admissions in the Brazilian Public Health System. Therefore, descriptive rather than inferential statistics were used in the analysis. Increasing or decreasing trends of admission rates over time were assessed by the absolute change in percentage of the studied variables.

Ethical aspects

This study was approved by the local Institutional Ethics Committee and was done in accordance with the Declaration of Helsinki of the World Medical Association.
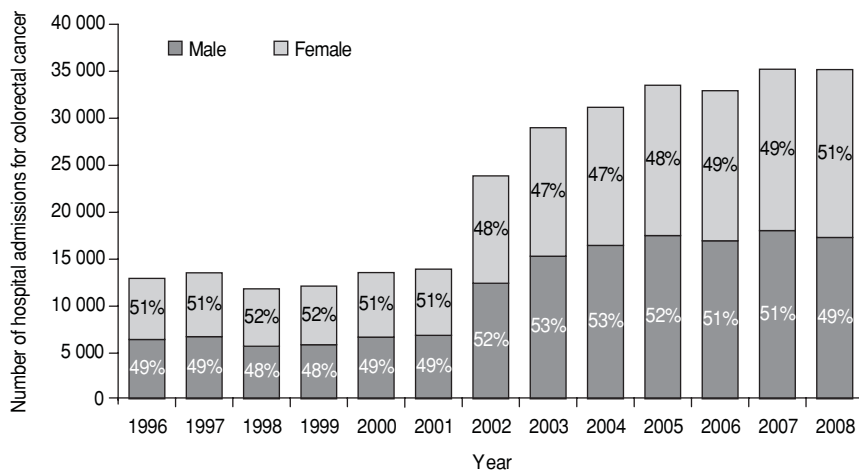
RESULTS

The SIH-SUS database identified 297 108 hospital admissions for CRC between 1996 and 2008. The total hospital admissions increased 173% in the study period, from 12 821 admissions in 1996 to 35 040 in 2008 (Figure 1). Gender distribution revealed a relatively stable male/female ratio for the 1996–2001 period, with a slight female predominance (male/female ratio = 0.95:1.0); from 2002 onward, a slight male predominance was noted until 2008 (1.06:1.0), when a female predominance was again observed (0.96:1.0) (Figure 1).

Hospitalization rates stratified by age demonstrated increasing trends for all age groups during the period (Figure 2). The highest rates were observed in the 70- to 79-year age range (ranging from 47.9 per 100 000 in 1996 to 117.4 per 100 000 in 2008 for a 145% increase); for the 60- to 69- and > 80-year age groups, the hospitalization rates rose from 37.0 and 41.4 per 100 000 to 90.7 and 101.3 per 100 000, respectively. The highest percent increase occurred in the < 40- and 50- to 59-year age groups, from 2.1 and 18.0 to 6.7 and 57.2 per 100 000 for 210% and 217% increases, respectively.

The age-standardized hospitalization rates increased from 8.7 per 100 000 in 1996 to 23.56 per 100 000 in 2008, representing a striking rise of 171%. The largest increase occurred between 2001 and 2002, from 9.4 to 15.31 per 100 000 (a 63% increase).

The average length of hospital stay for CRC patients has decreased from 11.6 days in 1996 to 7.5 days in 2008. The average hospital mortality for CRC de-

FIGURE 1. Number of hospital admissions for colorectal cancer and percentage distribution by gender, Hospital Information Systems of the Brazilian Unified Health System, Brazil, 1996–2008

elevated and increasing incidence rates, probably due to "westernization" of the lifestyle in these countries (14).

In Brazil, the incidence of CRC varies remarkably among distinct geographic areas as a function of differences in socioeconomic patterns, risk factor exposure profiles, and availability of medical and economic resources (6). Likewise, mortality from CRC has been rising in Latin America (14, 16), although the mortality rates remained below 10 per 100 000 in most countries of the region until 2000 (16). Trends in CRC mortality are unfavorable in Brazil, mainly due to modifications in national dietary and lifestyle habits; the prevalence of obesity, for example, has increased significantly over the last 20 years in three nationwide surveys (17).

In contrast, in the United States, deaths due to CRC have declined almost 9% over a 15-year period (18, 19). Screening strategies, early detection, advances in prevention, and improved treatment with new chemotherapeutic regimens have resulted in an overall 5-year survival rate of 65.2% in that country. In Brazil, overall 5-year relative survival rates of 33.1% in men and 32.7% in women with CRC were found according to a worldwide population-based study (20).

To the best of our knowledge, this is the first study to show an increase in hospitalization rates for CRC in the Brazilian Public Health System. On the other hand, according to data from the US Agency for Healthcare Research and Quality, there were almost 571 700 hospitalizations in 2006 related to CRC in the United States (191.4 per 100 000 persons), of which about one-quarter (151 900) had a principal diagnosis of CRC (50.8 per 100 000 persons) (21). In addition, the rate of hospital admissions for CRC decreased almost 15% between 1995 and 2006 in that country (21). Although these numbers cannot be compared in absolute terms because of the different methodologies used in each study, they provide important parameters to illustrate different trends in hospital admissions for these countries.

creased from 10.4% in 1996 to 8.5% in 2008; when stratified by age, however, in-hospital mortality rates remained relatively stable for all age groups except for the < 40-year age group (6.6% in 1996 and 2.9% in 2008 for a 56% relative decrease). As would be expected, the higher mortality rates were observed in the patients older than 80 years (22.9% in 1996 and 22.1% in 2008) (Figure 3).

With respect to economic burden, the inflation-adjusted total charges attributable to CRC hospitalizations have grown 103%, from US$ 16.5 million in 1996 to US$ 33.5 million in 2008 (Figure 4). When the average hospital charge per CRC admission was analyzed, however, a decreasing trend was observed over

the period, declining from US$ 1 283 in 1996 to US$ 954 in 2008 (Figure 4).

DISCUSSION

Colorectal cancer remains a major clinical and public health issue on a global scale. Currently, the highest incidence rates of CRC are observed in Europe, North America, and Oceania; the lowest rates are reported in Asia, Africa, and South America (14). In the United States, the incidence of CRC among men declined by 2.8% per year from 1998 to 2005 and among women it declined by 2.2% per year in the same period (15). By contrast, newly developed countries, such as the Czech Republic, have been presenting

The temporal trends in CRC hospitalizations reported in this study can be partly explained by nationwide increases in the incidence of CRC. Increasing incidence trends can also reflect better screening policies. Although Brazil still needs to consolidate a nationwide integrated cancer-screening program for

FIGURE 2. Age-stratified hospital admission rates (per 100 000 persons) for colorectal cancer, Hospital Information Systems of the Brazilian Unified Health System, Brazil, 1996–2008
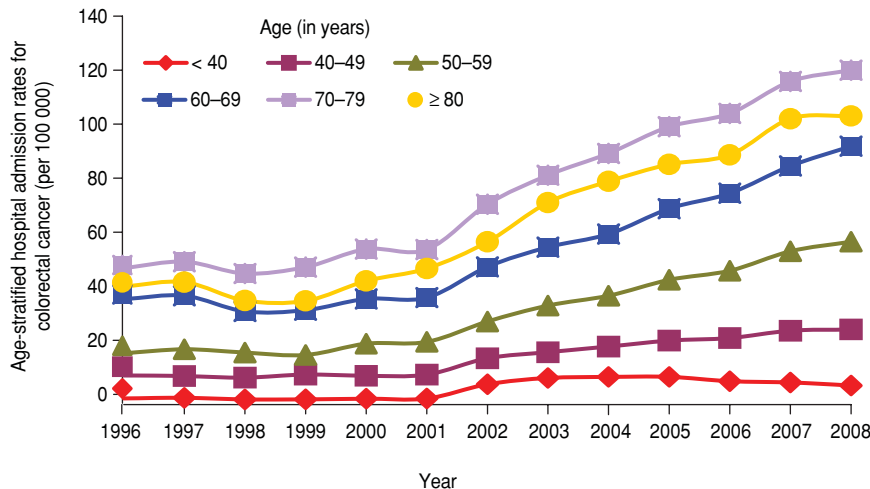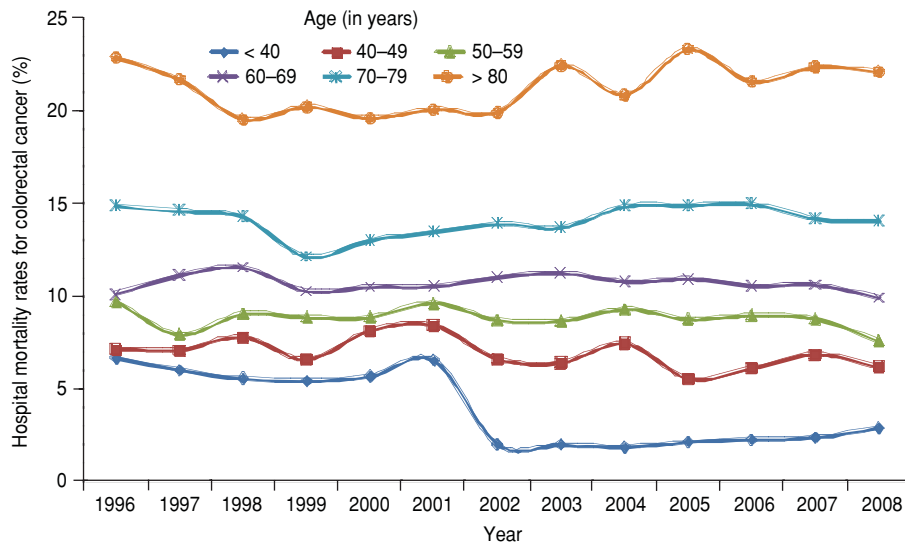
FIGURE 3. Hospital mortality rates (percent) for colorectal cancer stratified by age groups, Hospital Information Systems of the Brazilian Unified Health System, Brazil, 1996–2008


CRC, diagnostic tests have gradually become more widely available in the Public Health System (6).

Regarding age, the highest age-stratified hospitalization rates were observed in patients older than 60 years; in absolute percent terms, however, only 41% of the hospital admissions occurred in this age group between 1996 and 2008; in contrast, most hospitalizations principally for CRC in the United States in 2006 occurred in patients older than 65 years (62.3%) (21). Given that CRC is predominantly a disease of older individuals, the aging of Brazil's population probably will be accompanied by an in-creased incidence of CRC cases. By the year 2030, the population age 65 or older will account for about 13.3% of the Brazilian population. Currently, this age group represents 6.9% of the total population (22). Furthermore, population aging probably has an important role in the economic and epidemiologic impacts of CRC screening (23).

Despite the significant increase in the total charges for CRC admissions between 1996 and 2008, the number of total admissions has increased in the same manner, which might have contributed to the decreasing trends observed in the mean hospital charge per admission.
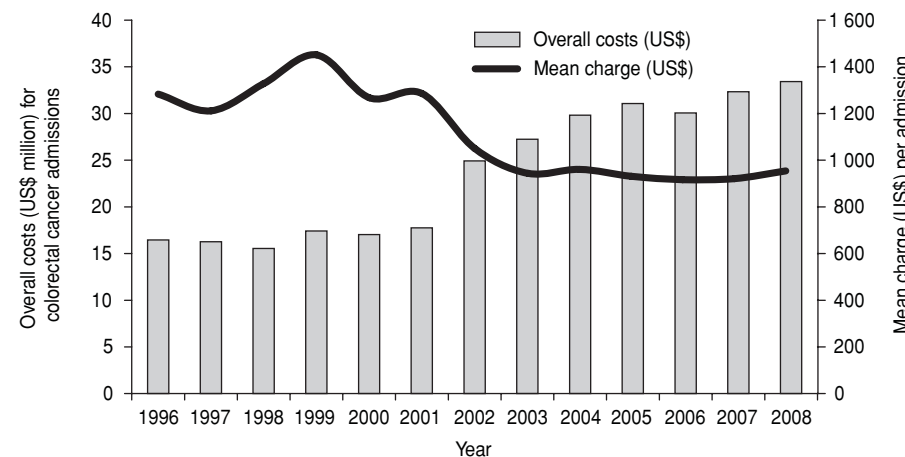
This trend may denote that financial resources allocated for CRC hospitalizations are insufficient to support the growing admission rates. On the other hand, a decreasing mean hospital charge per admission could be partially explained by the decreased mean length of stay.

Because the total economic impact for CRC has not been studied in Brazil, the percentage that hospitalization charges represent in CRC overall costs is unknown. Nevertheless, the economic costs of CRC admissions in Brazil are notably low when compared with those reported by more developed countries, even when adjusted for international economic variations using the PPP conversion factor; this observation probably can be extended to the CRC total economic costs.

Although the average mortality during hospitalization changed significantly over time, this effect seems to be attributable mainly to the decrease occurring in the age group below 40 years; age stratification did not disclose a significant decrease in CRC hospital mortality rates for the other age groups. In fact, the average hospital mortality rates for CRC remain substantially high in Brazil. In 2006, for example, hospital mortality for CRC in Brazil was 8.3%, while a 4.5% rate was reported in the United States (21).

Possible limitations of the study concern the accuracy of the SIH-SUS data, which may be affected by imprecise information registered on medical records and by the fact that the principal diagnosis may be selected based on the amount the Public Health System will pay for it (24, 25). Data obtained from large government databases are also limited because of the variability of information provided by each health care center, the lack of clinical information, and the heterogeneity in the quality of health care among distinct areas of the country. Moreover, as it is unknown how specifically the CRC admissions registered in the SIH-SUS databank represent overall CRC admissions in Brazil, another limitation of this study relates to representativeness of the data. It is known, however, that to some degree SUS partly finances high-complexity procedures for private patients (26), such as oncologic treatment; therefore, the SIH-SUS databank may also include data from private patients.

In conclusion, this study demonstrated that hospitalization rates for CRC

FIGURE 4. Overall costs and mean charge for colorectal cancer admission, Hospital Information Systems of the Brazilian Unified Health System, Brazil, 1996–2008

in the Brazilian Public Health System significantly increased between 1996 and 2008. Furthermore, these data provide an insight into the increasingly significant economic impact of colorectal cancer admissions to the health system.

Further studies are necessary to determine the epidemiology and the total economic costs of CRC in Brazil. A possible way to improve both the quantity and the quality of information nationally on the epidemiology of CRC could be to

create an independent database supported by multiple cancer care reference centers from all geographic regions of the country. This would enable a more accurate assessment of costs related to this disease in Brazil.

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RESUMEN

Aumento de las tasas de ingresos hospitalarios por cáncer colorrectal y su carga económica en Brasil, 1996–2008

Objetivo. Determinar las tendencias de las tasas de ingresos hospitalarios por cáncer colorrectal (CCR) en el sistema de salud pública brasileño de 1996 al 2008 y evaluar sus costos económicos.

Métodos. Se utilizó la información de la base de datos de los sistemas de información de los hospitales del Sistema Único de Salud brasileño con objeto de analizar todos los ingresos con diagnóstico primario de CCR entre 1996 y el 2008.

Resultados. Durante el período de estudio, se produjeron 297 108 ingresos por CCR, con un aumento anual de 12 821 en 1996 a 35 040 en el 2008. Las tasas de ingresos estandarizadas según la edad aumentaron de 8,7 a 23,56 por 100 000, con un aumento porcentual de 171%. La estancia hospitalaria media disminuyó de 11,6 días en 1996 a 7,5 días en el 2008. La mortalidad hospitalaria promedio descendió de 10,4% a 8,5%. Los costos de las hospitalizaciones por CCR aumentaron de US$16,5 millones en 1996 a US$33,5 millones en el 2008; el costo promedio de cada ingreso, sin embargo, disminuyó de US$1 283 a US$954.

Conclusiones. Las tasas de hospitalización por CCR en Brasil han aumentado significativamente a lo largo de un período de 13 años y han acarreado un considerable incremento de la carga económica ajustada según la inflación; las tasas nacionales de mortalidad hospitalaria se han mantenido relativamente elevadas.

Palabras clave   Neoplasias colorrectales; hospitalización; tiempo de internación; mortalidad hospitalaria; costos de hospital; Brasil.