

# Utilization of hospital services for cancer care in Mexico

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## Abstract

**Objective.** To analyze the utilization of hospital services for cancer care by location, sex, age group and care institution in Mexico from 2004-2013. **Materials and methods.** Time series study from 2004-2013, based on administrative records of hospital discharges for cancer in the health sector, including the private sector. **Results.** The utilization rate increased significantly from 290 to 360 per 100 000 inhabitants. A total of 62% of hospital discharges related to malignant tumors were concentrated in eight types of cancer. Leukemia, breast and colorectal cancers almost doubled in the period. While lung cancer showed a decline among men, it increased among women. A total of 63.1% of cancer patients were women, and 81% of cases occurred in the public sector. From 2011, the Ministry of Health was the main provider of hospital services for cancer care. **Conclusions.** Increases in utilization were mainly found in the Ministry of Health, quite possibly as a result of the implementation of universal insurance.

Keywords: neoplasm; utilization; health services; patient discharge; Mexico

## Resumen

**Objetivo.** Analizar la utilización de servicios hospitalarios para la atención del cáncer según localización, sexo, grupo de edad e institución de atención en México de 2004 a 2013. **Material y métodos.** Estudio de serie de tiempo de 2004-2013, de registros administrativos de egresos hospitalarios por cáncer del sector salud, incluyendo el sector privado. **Resultados.** La tasa de utilización incrementó significativamente de 290 a 360 por 100 000 habitantes. El 62% de egresos hospitalarios por tumores malignos se concentró en ocho tipos. La leucemia, cáncer de mama y de colon y recto casi se duplicaron en el periodo. El cáncer de pulmón muestra un descenso en hombres mientras que en las mujeres sigue aumentando; 63.1% fueron mujeres. El 81% ocurrió en el sector público. A partir de 2011 la Secretaría de Salud fue el principal productor de servicios hospitalarios para la atención del cáncer. **Conclusiones.** El aumento en la utilización se dio principalmente en la Secretaría de Salud muy posiblemente como resultado de la implementación del Seguro Popular.

Palabras clave: neoplasia; utilización; servicios hospitalarios; egreso hospitalario; México

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The use of hospital discharge records to measure the utilization of health services has proven useful in other countries.<sup>1,2</sup> In Mexico, there have been some studies on the costs of cancer care using hospital discharge records,<sup>3</sup> along with studies to assess hospital performance.<sup>4,6</sup>

Given the absence of a national cancer registry in Mexico and limited information on the use of hospital services for the care of this disease in the Mexican health system, a study of the sources of information available in the country is needed in order to develop indicators to assess the trend of services utilization in the Mexican population. The aim of this paper is to analyze the use of hospital services for cancer care in Mexico by tumor location, sex, age and care institution in the period 2004 to 2013 through hospital discharge administrative records in the health sector.

## Materials and methods

A time series study over the period 2004-2013 was performed to analyze the use of hospital services in Mexico. This analysis was achieved through the use of databases with information on hospital discharges by cancer location, sex, age group and care institution that have been generated by the Mexican health sector, including the private sector.

According to the Official Mexican Standard 035-SSA3-2012, hospital discharge is defined as "the event wherein the patient is released from in-patient services involving the vacation of a hospital bed. It includes discharges for cure, improvement, transfer to another hospital unit, death, voluntary discharge or flight and excludes movements between different services within the hospital."<sup>7</sup> It is important to consider that while hospital discharge records compile data for each event, a person can be admitted to the hospital on different occasions for the same cause or for various reasons in the same period.

### Source of information

*Hospital discharges in the public sector.* Public sector discharge records were obtained from a standard-format database of hospital discharges in the health sector (2004-2013), which is available on the website of the National Health Information System (*Sistema Nacional de Información en Salud - SINAIS*) of the Directorate General of Health Information (*Dirección General de Información en Salud - DGIS*).<sup>8</sup> This database included more than 51 million hospital discharge records during the evaluated

period and provided basic information such as year of care, sex, age of patient, and main condition. The records are coded according to the International Classification of Diseases ICD-10,<sup>9</sup> length of stay, reason for discharge and hospital discharges from the care institution produced by the Ministry of Health, the Mexican Social Security Institute (*Instituto Mexicano del Seguro Social - IMSS*), *Oportunidades* IMSS, the Institute for Social Security and Services for State Workers (*Instituto de Seguridad Social y Servicios para Trabajadores del Estado - ISSSTE*), Pemex and the Mexican Navy.

*Private sector hospital discharges.* Private sector discharge records were obtained by dynamic queries of health statistics from private establishments on the website of the National Institute of Statistics and Geography (*Instituto Nacional de Estadística y Geografía - INEGI*) for the period 2004 to 2013. The hospital discharge variables recorded consisted of the principal discharge diagnosis, sex, days of stay and deaths and were disaggregated nationally, by state and by group of causes.<sup>10</sup>

### Selection of causes of hospital discharge associated with cancer

Hospital discharges for cancer were selected according to the variable main condition, coded as malignant tumors C00-C97, based on the ICD-10. The discharges were grouped according to the 2004 Global Burden of Disease classification system.<sup>11,12</sup> On the basis of this classification, the causes were analyzed as follows: 1. Leukemia (C91-C95), 2. Breast (C50), 3. Lymphomas and Multiple Myeloma (C81-C85, C88, C90), 4. Cervix (C53), 5. Colorectal (C18-C21), 6. Ovary (C56), 7. Trachea, Bronchus and Lung (C33 and C34), 8. Prostate (C61), and 9. Other malignant tumors.

Hospital discharges were analyzed by cancer location, year of occurrence, sex, age groups (under 15 years, 15 to 64 years and 65 years and over) and service provider institution (SSa / Sesa IMSS *Oportunidades*, IMSS, ISSSTE, Pemex and the Mexican Navy). For the private sector, it was only possible to perform an analysis of the location of the cancer because the data available were aggregated and data inconsistencies were detected in the breakdown by sex and age.

Indicators of utilization of services were calculated as follows:

*Total hospital discharges.* The total discharge number was the sum of hospital discharges by tumor location, sex, age and institution that occurred in each year of the study period.

Proportion of discharges:

$$\text{Proportion of discharges}_{j,k} = \frac{\sum \text{discharge by group}_{j,k}}{\sum \text{discharges}_j}$$

where j represents each of the studied variables: tumor location, sex, age group and institution; k represents their respective categories.

*Days of Stay.* The days of stay were defined as the 'number of days elapsed from patients' admittance to in-patient services up to discharge.' This number is obtained by subtracting the date of discharge from admittance. When the patient is admitted and is discharged on the same day, occupying a hospital bed, it counts as a day stay. A zero-day stay is recorded when the patient is seen exclusively on short stay services because these services have not used a hospital bed.

*Total days of stay.* The total days of stay represents the sum of days of stay by tumor location, sex, age and institution occurring in each year of the study period.

*Average days of stay:*

$$\text{Average days of stay}_{j,k} = \frac{\text{Total days of stay}_{j,k}}{\text{discharges}_{j,k}}$$

where j represents each of the variables studied: tumor location, sex, age group and institution; k represents their respective categories.

*Intrahospital mortality.* This number represents the total discharges due to death from cancer among total hospital discharges by cancer type.

*Overall rate of the utilization of hospital services.* The rate of utilization is calculated from the total hospital discharges from each institution, including the private sector, as the numerator, divided by the total population per year during the study period (according to estimates by the Consejo Nacional de Población - Conapo)<sup>13</sup> as the denominator. To make a comparison with statistics generated by the Organization for Cooperation and Economic Development (OECD),<sup>14</sup> all of the discharges in relation to cancer care were included in the numerator, i.e., malignant neoplasms (C00-C97), tumors in situ (D00-D09), benign tumors (D10-D36) and tumors of uncertain or unknown behavior (D37-D49), although the results are presented for one hundred thousand inhabitants.

To analyze trends in the overall rate of hospital services utilization and the rate based on the location of the eight most important tumors, regression models with time series cross-sectional data were employed using marginal linear models (time series cross-sectional data analysis).<sup>15</sup> The utilization rate was converted using the natural logarithm.

Given that it was not possible to define the affiliated population or users of each institution properly in the health sector and that users transition dynamically between different institutions in terms of eligibility and also turn to private services, the analysis presented in this document refers to the comparison of the absolute numbers and proportions observed by institution, age and sex for each tumor type.

An analysis was completed to determine the quality of data sources used that included the calculation of the percentage of causes coded as "ill defined", along with the percentage of missing values in the variables of interest. Finally, the percentage of records coded as tumors of uncertain or unknown behavior was calculated.

The databases were manipulated in the MS-SQL Server,\* and statistical calculations in Tableau 9.0.†

## Results

The hospital services utilization rate for cancer in Mexico showed an annual increase of 2.19% ( $p < 0.001$ , 95% confidence interval [CI] [1.88-2.49]), from 318 237 discharges in 2004 to 428 913 discharges in 2013, with an overall hospital services utilization rate of 300 discharges per one hundred thousand inhabitants in 2004 to 360 in 2013 (figure 1).

In 2013, 62% of the hospital care of malignant tumors focused on eight types of cancers: leukemia, breast, lymphoma and multiple myeloma, cervix, colorectal, ovary, trachea, bronchus and lung and prostate. During the 2004-2013 period, the annual utilization rates for these eight tumors increased significantly for all but cervical, prostate and trachea, bronchus and lung cancers. The latter decreased significantly by 1.8% ( $p \leq 0.001$ , 95% CI [-2.4, -1.2]), and its utilization rate in 2013 was 5.7 per one hundred thousand inhabitants. In the same year, the colorectal cancer rate ranged between 8.0 and 14.4 discharges per one hundred thousand inhabitants and showed an annual percentage increase of 7.2% ( $p \leq 0.001$ , 95% CI [6.4-8.1]); the breast cancer rate ranged between 36.0 and 61.8 per one hundred thousand women, with an increase of 7.0% ( $p \leq 0.001$ , 95% CI [5.9]); leukemia increased from 18.1 to 29.1 per one hundred thousand inhabitants in increments of 5.3% ( $p \leq 0.001$ , 95% CI [4.2-6.5]); lymphomas and multiple myeloma increased from 12.0 to 16.3 in increments of 3.2% ( $p \leq 0.001$ , 95% CI [2.6-3.7]); ovarian cancer increased from 13.3 to 14.3 in increments of 1.7% ( $p \leq 0.001$ , 95% CI [1-2.5]); and prostate cancer increased from 15.3 to 15.5, in increments of 0.3% ( $p \leq 0.3$ , CI 95% [-0.2-0.7]). The utiliza-

\* Microsoft. SQL Server 2012. Available from: <http://www.microsoft.com/es-es/server-cloud/products/sql-server/>.

† Tableau Software. Tableau Desktop 9.0. 2014.

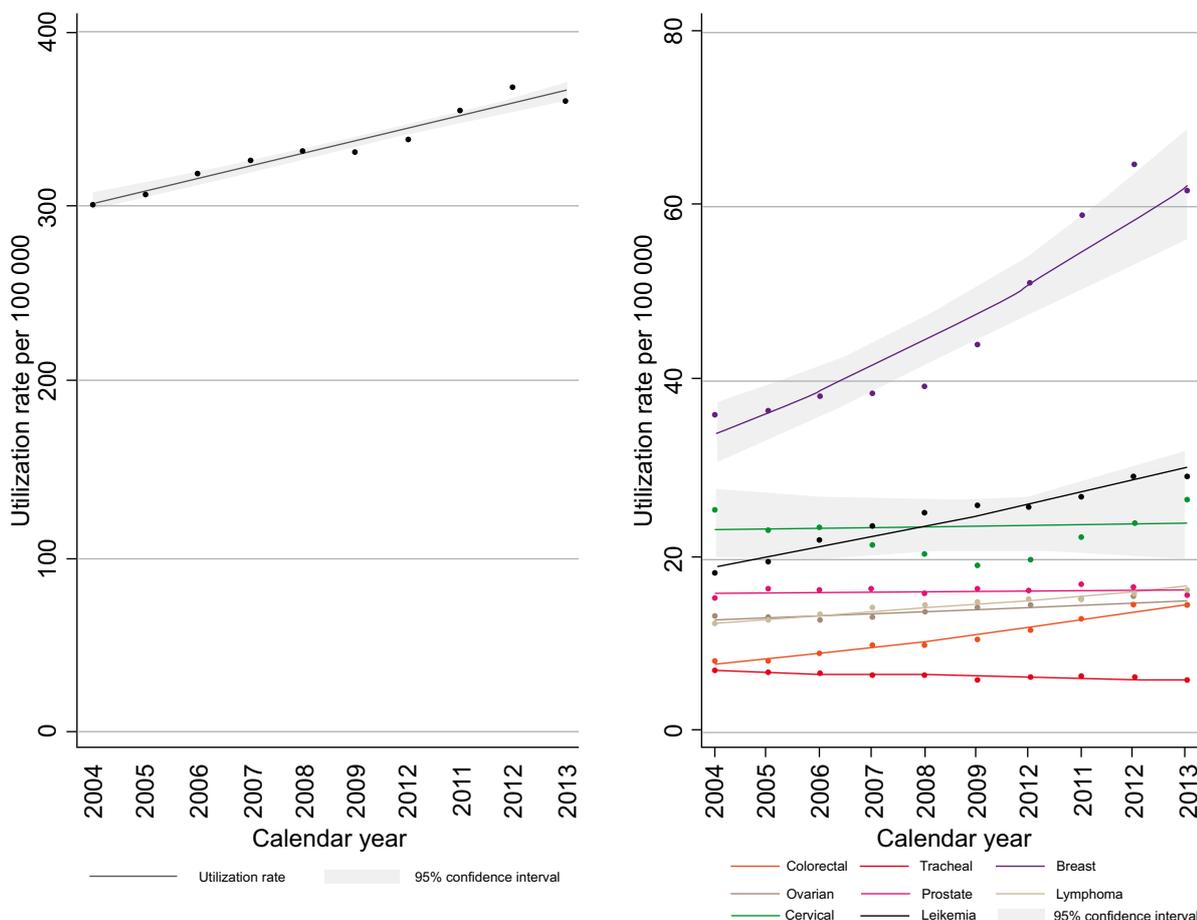
tion rate for cervical cancer varied between 25.3 and 26.4 per one hundred thousand women, with a non-significant increase of 0.3% ( $p < 0.8$ , 95% CI [-2.7-3.5]). However, our results show that the rate had been declining until 2009, after which it began an upward trend (figure 1).

The results by sex, age group and institution are exclusively represented by the public sector, with absolute increases and proportions, because of difficulties in defining the user population.

In the last ten years, it has been observed that hospital services utilization for cancer care in the public sector was higher among women, with an approximate ratio of two women per man, a rate that was maintained throughout the evaluation period, resulting in 65.4% of discharges among the female population in 2013 (figure 2).

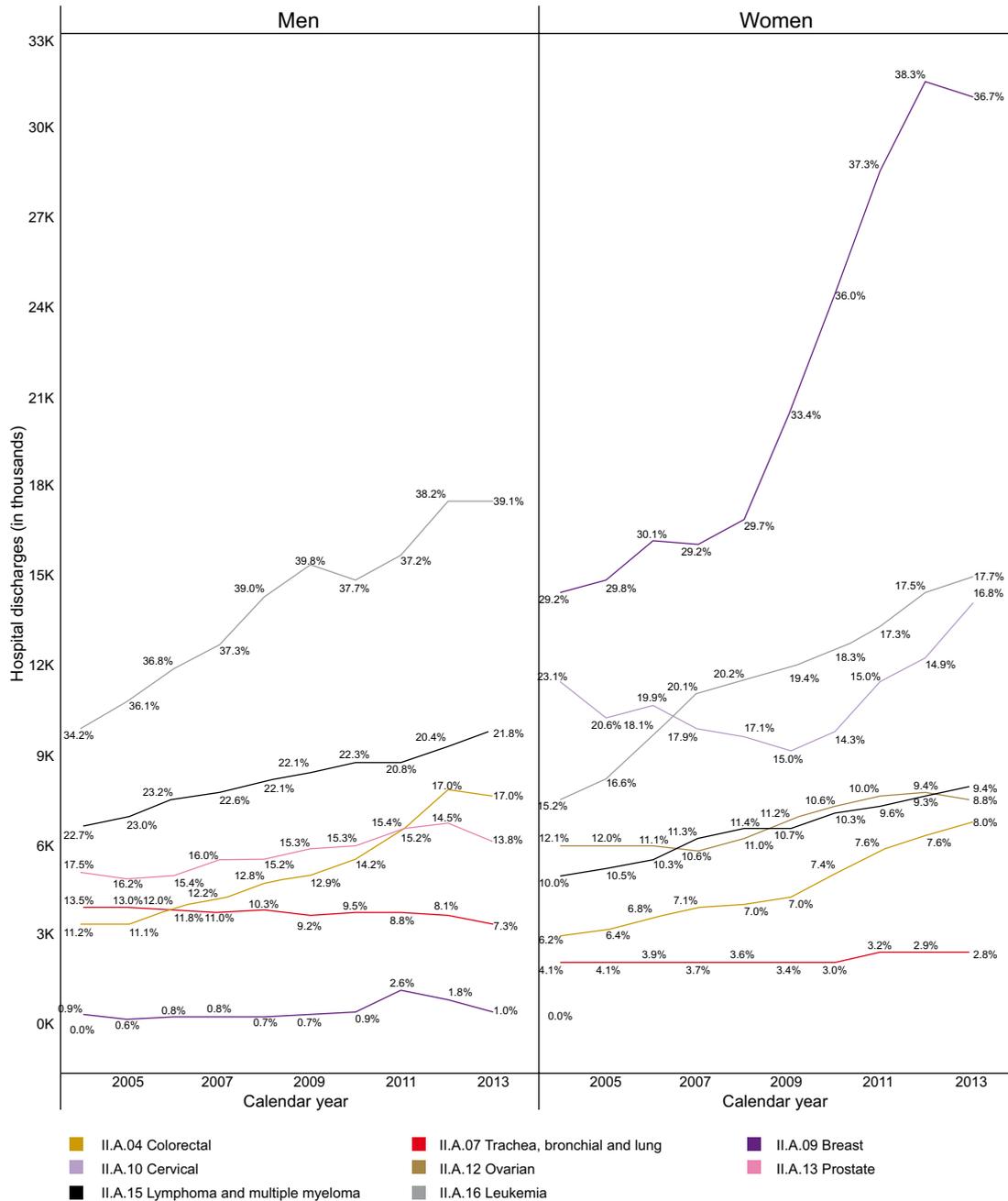
The utilization of breast cancer services was highest among women and showed an increase of 114.9% over the period studied. Furthermore, in 2013, this category

accounted for 36.7% of total discharges for the eight main types of cancer. Figure 2 shows that the highest increases occurred between 2009 and 2012. The use of colorectal cancer care services increased 121.3% in the period, representing the tumor with the highest percentage among women; in 2013, 8% of discharges were related to colorectal cancer. The utilization of services for leukemia among women almost doubled in the period (98.9%) and was the most frequent reason for hospital service utilization among men, causing an increase of 75.9% in the period. This condition accounted for 17.6% of discharges among women and 39.1% among men. However, just as among women, for men, the largest percentage increase in utilization was due to colorectal cancer care, with an average growth of 134.2% with respect to its value in 2004; in 2013, the utilization for this type of tumor accounted for 17.0% of discharges and became the third most common category. The



Source: calculations are based on hospital discharges in the public health sector, DGIS / SSA 2004-2013,<sup>8</sup> and discharges from the hospitals in the private sector, INEGI, 2004-2013<sup>10</sup>

**FIGURE 1. OVERALL RATE OF HOSPITAL SERVICE UTILIZATION AND THE EIGHT MOST IMPORTANT TUMORS**

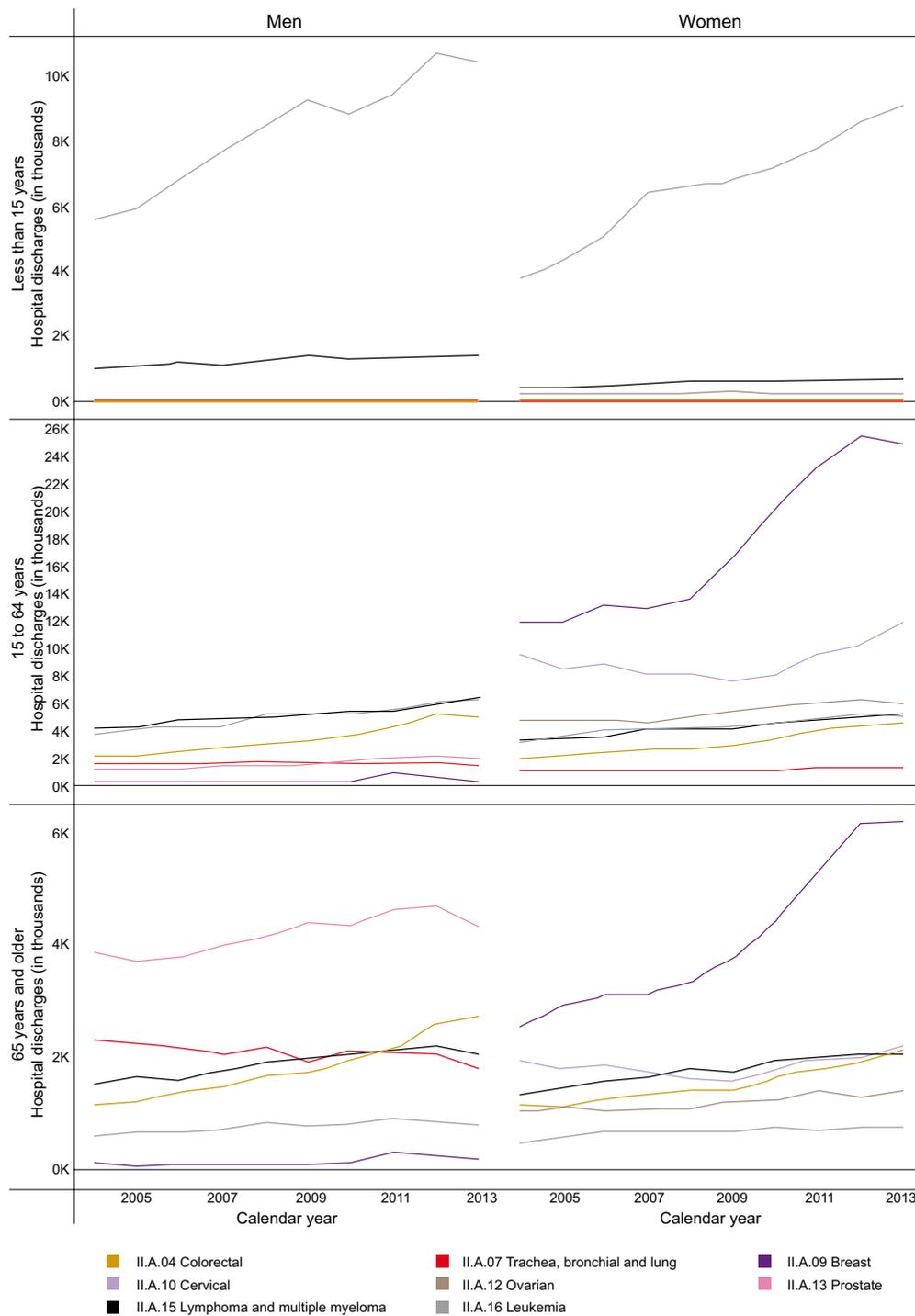


Source: based on hospital discharges in the public health sector, DGIS / SSA, 2004-2013<sup>8</sup>

**FIGURE 2. TOTAL AND ANNUAL PROPORTIONS OF HOSPITAL DISCHARGES BY SEX FOR THE EIGHT MOST IMPORTANT CANCERS**

service utilization rates for lymphomas and multiple myeloma and prostate cancer rose by 47.7% and 21.4%, respectively, while care for malignant tumors of the trachea, bronchus and lung in men decreased by 17.2%, in contrast to what was observed in women, for whom care increased by 15.2% (figure 2).

Childhood cancer care (under 15 years) accounted for 16.8% of all hospital discharges of care for the eight main cancers in the public sector during the study period. Care for the 15- to 65-year-old population category accounted for 60.6%, and care for the elderly (65 years and older) accounted for 22.6% of total discharges (figure 3).



Source: based on hospital discharges in the public health sector, DGIS / SSA, 2004-2013<sup>8</sup>

**FIGURE 3. TOTAL AND ANNUAL PROPORTIONS OF HOSPITAL DISCHARGES BY SEX AND AGE GROUP FOR THE EIGHT MAIN TYPES OF CANCER**

Utilization of inpatient care for leukemia accounted for 87.6% of all discharges among patients under 15 years old, while lymphoma and multiple myeloma accounted

for 10.4%. Discharges for leukemia doubled in this age group (107.4%), and those for lymphomas increased by 50.0% in the past decade (figure 3).

The utilization of hospital services among women 15 to 64 years of age was primarily due to care for breast cancer (31.1%), cervical cancer (20.4%) ovarian cancer (11.9%), leukemia (9.6%), lymphoma and multiple myeloma (9.5%), and colorectal cancer (6.9%). Among men 15 to 64 years of age, the main causes for hospital utilization were lymphoma and multiple myeloma (30.1%), leukemia (29.6%), colorectal malignant tumor (19.9%), cancers of the trachea, bronchus and lung (9.5%) and prostate cancer (9.1%). For both sexes in this age group, the main increases were for colon cancer (130.6%) followed by breast cancer (105.7%), leukemia (59.5%), lymphoma and multiple myeloma (53.3%), prostate cancer (50.7%), and cervical cancer (24.0%), while utilization for malignant tumors of the trachea, bronchus and lung decreased (1.6%). The utilization of hospital services by these types of cancer in men decreased by 12.9% in 2013 compared to 2004, whereas in women, an increase of 15.7% (figure 3) was observed.

The most common causes of cancer care in patients over 65 years of age were breast cancer (18.4%), prostate cancer (18.3%), lymphomas and multiple myeloma (15.9%), colorectal cancer (14.4%), and cancers of the trachea, bronchi and lung (13.6%) (figure 3). In patients over 65 years of age, the fastest growing use of hospital services was for breast cancer, with an increase of 142.7%, followed by colorectal cancer (91.4%), leukemia (66.4%) and lymphoma and multiple myeloma (53.1%), while use of services for cancers of the trachea, bronchus and lung decreased by 12.4% (figure 3). In men in this age group, utilization decreased by 22.2%, while it increased by 10.6% in women (figure 3).

Our results, by care institution, show that during the 2004-2013 period, 81% of discharges occurred in public sector institutions and that 19% occurred in the private sector. Cancer care in the public sector was the origin of almost 6% of all discharges, ranking third in importance, while in the private sector, cancer care was ranked seventh in importance, based on number of discharges and patient days, respectively.

The IMSS was the largest provider of inpatient services, with 38.2% of hospital discharges constituting care for eight major cancers, followed by the SSA and the Sesa, which provided 35.7% in the period. However, in the Ministry of Health, the annual provision of hospital services increased from 25 837 discharges in 2004 to 65 551 in 2013 (26.8 and 44.1% of the total annual provision, respectively). With an average annual growth of 18.4% from 2011, the SSA and the Sesa combined represent institutions in the health sector with greater discharge outputs for cancer in Mexico. In 2013, this statistic was reflected by an increase of 153.7% over 2004. In the IMSS and the private sector, the annual increases

in the number of discharges were only 2.1 and 0.5%, respectively (figure 4).

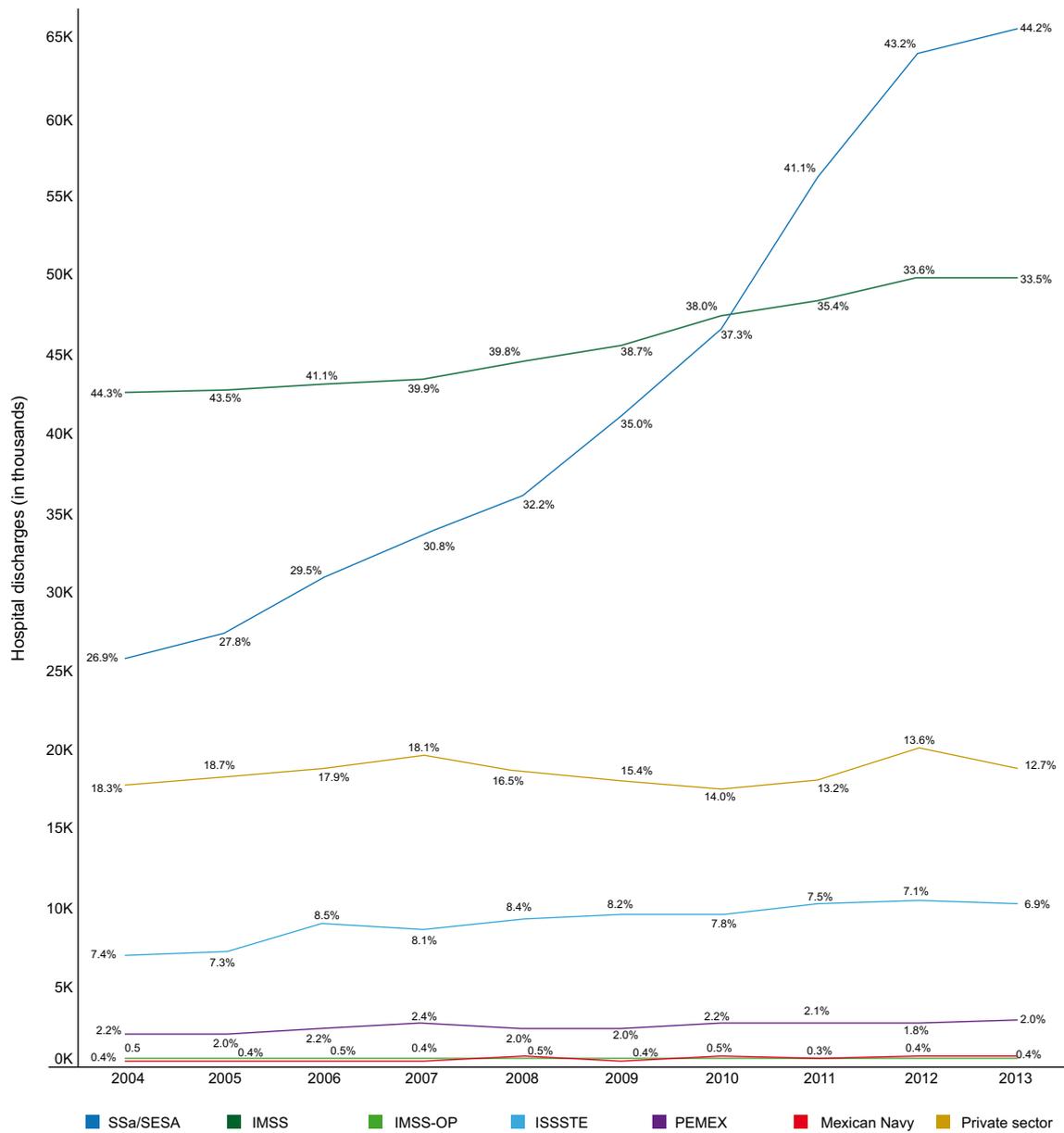
In the ISSSTE, an increase of 45.5% was observed in 2004, with discharges rising from 7 086 in that year to 10 307 in 2013. The participation of the private sector in the care of the eight main cancers has been reduced by one-third, decreasing from 18.3 in 2004 to 12.8 in 2013 (figure 4).

Regarding the motives for discharge, 83.5% of hospital discharges for the care of the eight main cancers involved discharging the patient because of improvement, 4.9% for healing, 5.3% for bereavement and 5.9% for other reasons. The causes that increased intrahospital mortality as determined by the study were leukemia (24.3%), malignant tumors of the trachea, bronchus and lung (17.1%), lymphomas and multiple myeloma (15.3%), breast cancer (12.2%), and colorectal cancer (10.3%). The intrahospital mortality among patients with trachea, bronchus and lung cancer was 15.5%, three times greater than what was observed for prostate cancer, leukemia, and lymphoma and multiple myeloma and five times greater compared to women discharged for breast cancer.

The eight main cancers produced 5 911 225 days of stay and more than a third of the total discharges for cancer. In total, 34.0% were due to leukemia, 17.0% to lymphoma and multiple myeloma, 11.9% to breast cancer, 11.4% to malignant colorectal tumor, 8.2% to cervical cancer, 7.2% to cancers of the trachea, bronchus and lung, 5.5% to malignant ovarian tumors, and 4.9% to malignant tumors of the prostate.

The average length of stay because of leukemia was 7.9 days; 50% of discharges recorded lasted between 1 and 9 days (interquartile range), and 25% were 9 or more days (75th percentile). A total of 5% of discharges had durations of 30 or more days (95th percentile). The average length of care for malignant tumors of the trachea, bronchus and lung was 7.3 days. However, the interquartile range (2-9) had a higher lower limit than that of leukemia, as reflected in the micrographs accompanying table I. Overall, the average length of stay for the care of the eight major cancers was 5.9 days, and the 95th percentile was 21 days (table I).

Based on proportions of hospital discharges, care for malignant tumors mainly occurred in the Federal District (27.3%), Jalisco (8.7%), Veracruz (6.6%), Michoacán (6.5%) and Nuevo León (5.5%). Between 2009 and 2013, 1263 hospitals reported at least one discharge in the public sector related to malignant tumors; however, 70% of these discharges occurred in 84 hospitals. The ten main hospitals that produced 30% of the discharges were the State Center for Cancer Care in Morelia SSA / Sesa, Michoacan, with 53 500 discharges in the period, followed by the Jalisco Institute of



Source: calculations are based on hospital discharges in the public health sector, DGIS / SSA 2004-2013,<sup>8</sup> and discharges from the hospitals in the private sector, INEGI, 2004-2013<sup>10</sup>

**FIGURE 4. TOTAL AND ANNUAL PERCENTAGES OF HOSPITAL DISCHARGES BY INSTITUTION PROVIDING THE SERVICES. MEXICO, 2004-2013**

Oncology SSa / Sesa (37 753), the Oncology Hospital of the Siglo XXI National Medical Center IMSS in Mexico City (36 557), the National Cancer Institute SSa / Sesa in the Federal District (33 055), the Specialties Hospital IMSS HES25 in Nuevo León, Monterrey (28 777), the General Hospital of Mexico of the SSa / Sesa in the Federal District (28 639), the Specialties Hospital HES of IMSS (23 301), the Children’s General Hospital Eva Samano Lopez Mateos in Morelia, Michoacan (18 196),

the “20 of November” hospital, ISSSTE in Mexico City (17 125) and the Centenario Hospital Miguel Hidalgo from the Ministry of Health in Aguascalientes (16 004).

Regarding the quality of information, 1.4% of all hospital discharges were coded as ill-defined, and less than 1% of the records had unspecified values in key analysis variables: sex, age, insurance eligibility and motive of discharge. Likewise, hospital discharges in which the main condition was coded within the group

**Table I**  
**DISCHARGES AND DURATION OF STAY BY MAIN TYPES OF CANCER. MEXICO, 2004-2013**

	Discharges	Patient days	% Patient days	Mean	P 25	Median	P 75	P 95
II.A.16.x. Leukemia	255 821	2 010 118	34.0%	7.9	1	4	9	30
II.A.09.x. Breast	219 041	700 593	11.9%	3.2	1	2	3	10
II.A.15.x. Lymphoma and multiple myeloma	146 882	1 002 390	17.0%	6.8	2	4	8	22
II.A.10.x. Cervical	108 789	483 680	8.2%	4.5	1	3	5	14
II.A.04.x. Colorectal	97 683	671 009	11.4%	6.9	2	4	9	21
II.A.12.x. Ovarian	67 003	327 955	5.5%	4.9	2	3	6	15
II.A.07.x. Tracheal, bronchial and lung	58 783	426 725	7.2%	7.3	2	5	9	23
II.A.13.x. Prostate	57 203	288 755	4.9%	5.1	2	3	6	15
<b>Total</b>	<b>1 011 205</b>	<b>5 911 225</b>	<b>100.0%</b>	<b>5.9</b>	<b>1</b>	<b>3</b>	<b>7</b>	<b>21</b>

of cancers as uncertain or unknown behavior accounted for 11.4% of total discharges resulting from cancer care in the public sector.

### Discussion

Our results indicate that there has been a significant increase in the use of hospital services for cancer care in Mexico in the last ten years, with a hospitalization rate for cancer of 360 discharges per one hundred thousand inhabitants in 2013. This rate is higher than the value reported by the OECD of 300,<sup>14,16</sup> as the information reported by this agency does not consider hospitalizations in the private sector.<sup>14</sup> According to the World Health Organization (WHO)<sup>17</sup> and the OECD,<sup>14</sup> Mexico is among the countries

with the lowest cancer incidence in the region and with the lowest hospitalization rate from the member countries of the OECD, followed by the United States.<sup>16</sup>

More than sixty percent of hospital discharges for malignant tumors in Mexico were related to the care of eight types of cancer: breast malignancy; leukemia; lymphoma and multiple myeloma; colorectal, cervical, ovarian, and prostate cancers; and malignant tumor of the trachea, bronchi and lungs, the majority of which were included in the catastrophic expenses funds CAUSES 2014.<sup>18</sup> The most significant increases in the rate of utilization were for colorectal cancer, breast cancer and leukemia, which nearly doubled the number of discharges in the period studied. These diseases are among the cancers with the highest mortality rates in Mexico.

The increase in discharges for colorectal cancer coincides with increased mortality of the disease in adults and the elderly, in addition to the estimated increase in the proportion of deaths from this cancer worldwide, which increased from 0.47% in 1999 to 0.85% in 2010 in both sexes.<sup>19,20</sup> According to reports published by the Department of Epidemiology of the SSA, the incidence of breast cancer increased 289% between 2000 and 2013, surpassing 3.72 to reach 10.76 cases per 100 000.<sup>21</sup> The use of hospital services to care for tumors of the trachea, bronchus and lung showed differential changes. While a decrease was noted among men during the period, the incidence increased among women. Limitations with the data remained, and it was not possible to test the hypothesis of differences. However, the findings conformed to mortality data observed and could be a reflection of the different degrees of progress made in controlling the epidemic of smoking among men and women in Mexico.<sup>22</sup>

The use of hospital services for cancer care was the highest among women, especially for breast cancer, leukemia and cervical cancer. Women in the 15- to 64-year old age group accounted for almost half of all discharges produced by public sector institutions; this rate coincides with the various explanatory models on the increased use of health services for women.<sup>23</sup> Additionally, the rate was associated with the increased reporting of breast cancer among women; more than 80% of these cases are identified in advanced stages.<sup>24</sup> In men, the leading causes of hospital services utilization were leukemia, lymphomas and cancers of the colon and rectum and prostate.

The leading causes of hospitalization in children under 15 years were largely leukemia, distantly followed by lymphoma and multiple myeloma and liver cancer. This incidence coincides with what was reported by the Ministry of Health for the period 2005-2010, where the largest proportion of cancer cases in children under 20 years was leukemia, with the 10- to 14-year-old age group the most affected.<sup>25</sup> From 2005 and 2010, the Ministry of Health reported that leukemia contributed to almost half of all deaths by malignant tumors in this age group (49.7%).<sup>25</sup>

During the study period, the IMSS produced the majority of hospital discharges for the care of the eight major cancers. However, the provision of inpatient services in the SSA/Sesa increased beginning in 2011, which resulted in the SSA/Sesa becoming the institution with the highest production of hospital discharges in Mexico. This finding is most likely a result of expanded coverage and accessibility under the implementation of the System of Social Protection in Health, which is provided to the low-income population.<sup>26</sup> An increase in the utilization of hospital services for cancer care was also observed in the ISSSTE. With a relatively stable population, the observed increase may be a reflect of an ageing population.

While the available data are limited with respect to generating general statistics, absolute and proportional changes in the use of hospital services for cancer care, by institution in the public sector, may be due to changes in a) the affiliated/registered/user population sizes; b) geographic accessibility, sociocultural or economic; or c) the epidemiological profile of the population. Thus, while national health surveys do not reflect dramatic changes in the epidemiological profile, they do document changes in geographical and financial access to health services through the Seguro Popular. This possibility leads us to suggest that the observed increase in SSA/Sesa use is mainly due to changes in public policy that resulted from the implementation of universal insurance.

The length of stay by event and cancer type reflected great variability. Leukemia care represented the highest average number of patient days per event, the most extreme range of variation, greater increases in hospital discharges, and greater numbers of hospitalization days. This finding could be due to the occurrence of complications, such as infections, anemia and thrombocytopenia, that occur frequently during treatment and prolong a patient's hospital stay.<sup>27</sup>

The geographic distribution of cancer discharges is a reflection of the availability of cancer care infrastructure and is concentrated in states of Mexico City, Jalisco, Veracruz, Michoacan, and Nuevo Leon. These states have State Cancer Care Centers (CECs), which are classified as tertiary centers. They possess the capacity to perform oncological operations, apply chemotherapy, and perform histopathological diagnoses with radiotherapy units on hand. This result is particularly interesting for further investigation into issues of mortality and geographical location regarding cancer care infrastructure. Moorin and colleagues cite a large number of works that describe and support the inverse relationship between distance services and health conditions.<sup>28</sup>

Drawing on this experience, the utilization of hospital discharge records could be effective in monitoring the progress of health institutions' coverage such as the Health Social Protection System (*Seguro Popular*), and the level of utilization of services in the affiliated population. Furthermore, the results can be used as inputs for the development of indicators to measure the success of health care for different types of cancer and for subgroups by sex, age and care institution. It is also critical to advance the development of applications and algorithms to link data from different sources to estimate survival, medical procedures and therapeutic paths. Likewise, these analyses will be indispensable to the development of indicators of quality of care and their costs.

The main limitations of the study lie in the quality of the data and the definitions of the denominators. Gi-

ven that the administrative records of health institutions could not be assigned denominators, it was not possible to perform an analysis by age group, sex and institution, although the overall rate by location could have been calculated using the total population. In terms of quality, a high percentage of deaths are still classified as tumors of uncertain or unknown behavior, a number that should decrease. Private sector data are only available as statistical aggregates, which hindered their analysis and presented inconsistencies in their breakdown by sex and age. Even when the data were disaggregated at the patient level, sector information only provides a minimum of information and prevents analysis of comorbidities and medical procedures associated with hospital care. It would be highly desirable if institutions in the public and private sectors could provide more detailed information regarding hospital discharge records, incorporating the dates of admittance and discharges, comorbidities and medical procedures used, such as that published by the Ministry of Health and the State Health Services.

The most relevant themes concerning utilization of hospital services to address in future research entail the assessment of treatment capacity and quality of existing services based on the causes of hospital discharge.<sup>29</sup>

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