



Comparative Analysis of the Trends in Medical Utilization of Cancer Inpatients in Korea

Hyun-Ju Lee^a, Sung-Soo Kim^b

^aDepartment of Health Administration, Jungwon University, Goesan, Korea

^bDepartment of Healthcare Management, Cheongju University, Cheongju, Korea

Objectives: Cancer has attracted worldwide attention. The incidence and prevalence are increasing, and it is the main cause of death. The purpose of this study was to identify the characteristics of hospitalized cancer patients.

Methods: This study is a secondary data study using the Korean National Hospital Discharge In-depth Injury Survey Data conducted annually by the Korea Centers for Disease Control and Prevention. Using these data, we extracted inpatients whose principal diagnosis is cancer for nine years from 2005 to 2013.

Results: According to the analysis, the annual trend of cancer inpatients is steadily increasing. In 2025, it is expected to increase to about 670,000 inpatients. A cancer diagnosis created a change in medical utilization depending on the characteristics of patients and hospital. Men are more at risk of cancer than women. The number of hospital beds and hospital days were inversely proportional to cancer inpatients. There was also a difference in the equity of medical utilization by region. Other cancer management policies should be based on sex.

Conclusion: Populations between the ages of 45 and 64 years should be a priority in cancer policy. Because of the long-term hospitalization of patients with death as the outcome, a terminal cancer patient care facility is needed. These conclusions can provide a basis for various health policies.

Key Words: cancer, inpatients, mortality, length of stay, trends

Corresponding author: Sung-Soo Kim
E-mail: sungskim@cju.ac.kr

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INTRODUCTION

Worldwide, cancer is a disease with high incidence, morbidity, and mortality rates. In 2012, the global cancer incidence rate was 14 million people, and it is expected to increase to 19.3 million in 2025 [1]. In the United States, cancer is the second cause of death, and about 1.5 million people have diagnosed with cancer annually and 11 million persons living with cancer [2]. According to 2015 statistics on the causes of death in South Korea, cancer is the leading cause of death in both men and women; the mortality rate is 150.8/100,000 people. This statistic is about three times higher than that of heart or cerebrovascular diseases [3]. To date, studies of cancer have been based on clinical aspects such as causes and diagnosis, preventive measures for early detection, and the increase of treatment effectiveness [4,5]. With these efforts, early diagnosis and therapeutic outcomes improve, survival rates increase, and changes in patients' medical utilization are expected [6,7]. Additionally, the aging population may affect medical utilization. Changes in medical utilization also affect medical expenses, and since cancer is registered as a major serious disease, the patients' sharing of medical costs has decreased. It is predicted that this will have a significant impact on the increase of national medical expenses [8].



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In South Korea, the Korea Central Cancer Registry has announced the results of epidemiological analysis. These include the yearly incidence and mortality rates based on the cancer registration data of medical institutions. Cancer treatment methods vary according to the diagnosis. Furthermore, because of cancer's characteristics and prolonged recovery period there is higher hospitalization-centered medical utilization after the diagnosis as compared to other diseases. Therefore, it is necessary to conduct a study of the characteristics of medical utilization based on the hospitalization-centered data generated by treatment in the medical institutions. The World Health Organization (WHO) is concerned that treatment is not the method to prevent the cancer crisis; however, there are still insufficient studies to explain the characteristics of diseases based on state-level systematic health data or improve the changing demands for health care for the more vulnerable classes [1]. Thus, we investigated the characteristics of cancer patients based on the multi-year accumulated data of hospitalized patients. Accordingly, in this study we aimed to analyze how the length of stay (LOS), surgery, and mortality rates affected medical utilization, according to the characteristics of the patients, the results of treatment, and the characteristics of the hospitals. Based on this analysis, this study drew health and forensic implications that could be utilized as basic data for future cancer management policy.

MATERIALS AND METHODS

1. Study population

This study investigated the characteristics of Korean patients hospitalized with cancer as their principal diagnosis. This study used the Korean National Hospital Discharge In-depth Injury Survey of discharged patients administered since 2004 by the Center for Disease Control and Prevention. Each year the Korean National Hospital Discharge In-depth Injury Survey extracts a sample of patients from about 170 sample hospitals nationwide and conducts an analysis, applying the weighted value to estimate the number of discharged patients on the national scale [9,10]. This study, also, analyzed hospitalized cancer patients, applying this weighted value. In February 2017, to acquire of the data for this research, the researchers went through the procedure for consent, including the application form for the use of raw materials and the pledge of information security through the Injury Monitoring Business Homepage of Center for Disease Control and Prevention. The data gathered were the extracted records of patients with cancer as their principal diagnosis from the 1.8 million data points from the Korean National Hospital Discharge In-depth Injury Survey accumulated for nine years

from 2005 through 2013, using the database program, Microsoft Access (Microsoft, Redmond, WA, USA). The study criteria were patients with the principle diagnosis of C00-C97 code classified as malignant neoplasm in the Korean Standard Classification of Disease (KCD).

2. Measurement

The variables were divided into three parts. First, variables for the characteristics of patients: sex, age, insurance type, and hospitalization route were selected. Second, for characteristics of patients' discharge the results of treatment and location after discharge were selected. Third, the location and number of beds in the treatment hospital were selected. Additionally, for an analysis of progress by year, the year of hospitalization was used. Lastly, the LOS, surgery, and death were defined as variables of medical utilization.

3. Research model

To investigate the relationships of the characteristics of cancer patients, the discharge, and the hospitals with the variables of medical utilization, LOS, surgery and death, the following research model was set (Figure 1).

4. Data analysis

Data from the Korean National Hospital Discharge In-depth Injury Survey was loaded into the Microsoft Access database, and the variables were merged in rows. The cancer patients were extracted, using Structured Query Language under the condition of the KCD. IBM SPSS Statistics ver. 20.0 (IBM Co., Armonk, NY, USA) was used for statistical analysis. For a comparison of the average LOS according to the characteristics of the patients, the discharge, and the hospitals, independent sample *t*-test and one-way analysis of variance (ANOVA) were conducted. Additionally, the progressive increase in the number of cancer patients by year was analyzed, using a linear regression model; to analyze the characteristics of surgery and death distribution, a chi-square test was conducted. The sample design of this Korean National Hospital Discharge In-depth Injury Survey is a composite sampling design, which recommends the application of the weighted value

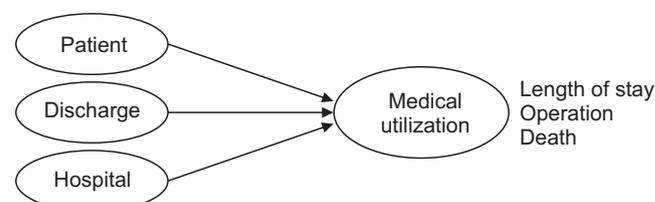


Figure 1. Research model.

Table 1. Mean comparison of length of stay (LOS) by general characteristics

Variable	Subject	LOS (day)	t or F	p-value
Sex	Male	2,184,622 (55.49)	12.38 ± 16.75	26.070 < 0.001
	Female	1,752,579 (44.51)	11.91 ± 19.12	
Age (y)	≤ 18	74,489 (1.89)	12.38 ± 20.09	1,236.094 < 0.001
	19–44	502,732 (12.77)	10.87 ± 24.94	
	45–64	1,726,882 (43.86)	11.99 ± 16.62	
	65–74	1,045,095 (26.54)	12.56 ± 16.38	
	≥ 75	588,003 (14.93)	13.10 ± 16.06	
Insurance	National Health Insurance	3,547,295 (90.10)	11.69 ± 15.80	8,838.533 < 0.001
	Type-1 Medicaid ^a	338,949 (8.61)	16.75 ± 31.60	
	Type-2 Medicaid ^a	23,379 (0.59)	15.94 ± 20.33	
	Others	27,578 (0.70)	14.28 ± 20.47	
Admission route	Emergency	856,972 (21.77)	16.14 ± 20.93	27,920.817 < 0.001
	Outpatient	3,070,684 (77.99)	11.09 ± 16.73	
	Others	9,546 (0.24)	14.00 ± 20.87	
Treatment outcome	Improved	3,288,385 (83.52)	11.09 ± 13.68	66,826.383 < 0.001
	Not improved	284,206 (7.22)	9.10 ± 15.70	
	Death	344,288 (8.74)	24.64 ± 38.04	
	Others	20,321 (0.52)	18.22 ± 21.19	
Disposition	Return-home	3,399,643 (86.35)	10.85 ± 13.51	65,702.037 < 0.001
	Other hospital	181,694 (4.61)	13.42 ± 19.94	
	Death	344,288 (8.74)	24.64 ± 38.04	
	Others	11,576 (0.29)	11.30 ± 13.95	
Hospital location	Seoul, Gyeonggi, Incheon	2,052,080 (52.12)	11.45 ± 15.76	2,616.644 < 0.001
	Chungcheong	344,317 (8.75)	12.85 ± 17.62	
	Jeolla	378,038 (9.60)	12.16 ± 15.12	
	Gyeongsang	933,180 (23.70)	13.65 ± 22.89	
	Gangwon, Jeju	229,586 (5.83)	11.59 ± 15.93	
Number of beds	100–299	503,394 (12.79)	13.79 ± 19.29	6,301.467 < 0.001
	300–499	554,192 (14.08)	12.73 ± 16.63	
	500–999	1,849,587 (46.98)	12.67 ± 19.44	
	≥ 1,000	1,030,028 (26.16)	10.19 ± 14.21	
Total	3,937,201 (100.00)	12.17 ± 17.84		

Values are presented as number (%) or mean ± standard deviation.

^aKorea is eligible for medical assistance if the beneficiary (including foreign nationals) as defined in the National Basic Living Security Act. Type 1 is fully exempted at the time of admission and Type 2 is responsible for 10% of the cost of care.

for the accurate estimation of patients [10]. This study conducted an analysis, applying the weighted value to all analysis methods.

RESULTS

1. Comparison of general characteristics and LOS

A comparison of the general characteristics of the subjects and the average LOS accordingly were as follows (Table 1). From 2005

through 2013, the estimated number of discharged patients with cancer as the principal diagnosis nationwide was almost four million. Men were 55.49%, about 10% more than women (44.51%). By age divided based on life-cycle, those between 45 and 64 years had the most distribution (43.86%), followed by those between 65 and 74 years (26.54%), those over 75 years (14.93%), those between 19 and 44 years (12.77%), and those under 18 years (1.89%). For insurance type, those covered by National Health Insurance and those covered by Medical Care Assistance were over 90% and about 9%, respectively. For hospitalization route, emergency admission was 21.77%, and outpatient was 77.99%. For the results of treatment, 83.52% of the patients improved, but 8.74% died, and unimproved patients were 7.22%. For location after discharge, 86.35% of the patients went home, but 4.61% were transferred to other hospitals or sent back to the referring hospitals. As for the locations of hospitals in which patients were admitted, the proportion of Seoul, Gyeonggi-do, and Incheon was the highest at 52.12%, followed by Gyeongsang-do (23.70%), Jeolla-do (9.60%), Chungcheong-do (8.75%), Gangwon-do and Jeju-do (5.83%). For the number of beds in the hospitals, most had 500 to 999 beds (46.98%), and there was also a high rate of those with more than 1,000 beds (26.16%). Hospitals with 300 to

499 beds accounted for 14.08%, and those with 100 to 299 beds were 12.79%. The end result was that over 70% of the cancer patients received treatment at hospitals with over 500 beds.

An analysis of a comparison of the average LOS according to general characteristics, demonstrated statistically significant differences in all subjects. To examine the main results, there were somewhat more men than women, and by age, the average LOS was highest in 75-year-old patients at 13.10 ± 16.06 days, those aged 65 to 74 years (12.56 ± 16.38 days), those under 18 years (12.38 ± 20.09 days), those aged 45 to 64 years (11.99 ± 16.62 days), and those aged 19 to 44 years (10.87 ± 24.94 days). By insurance type, Medical Care Assistance Type 1 patients were the highest (16.75 ± 31.60 days), followed by Medical Care Assistance Type 2 (15.94 ± 20.33 days), other (14.28 ± 20.47 days), and National Health Insurance (11.69 ± 15.80 days). For hospitalization route, the LOS was much longer in those admitted through emergency at 16.14 ± 20.93 days than outpatient at 11.09 ± 16.73 days. In the results of treatment, patients who died were at 24.64 ± 38.04 days, more than two times higher LOS than the average. By the locations of hospitals, the LOS was the lowest in hospitals located in Seoul, Gyeonggi-do, and Incheon at 11.45 ± 15.76 days, while it was highest in those located in Gyeongsang-do at

Table 2. Regional distribution of cancer inpatient

Region	Year									Total
	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Seoul	82,378	58,823	64,750	68,436	74,823	76,373	89,738	90,480	85,805	691,606
Busan	45,895	40,513	29,137	27,854	28,966	22,992	24,096	25,055	22,759	267,267
Daegu	22,796	16,338	16,241	15,779	17,181	19,373	15,508	14,738	14,819	152,773
Incheon	21,877	18,819	15,681	22,995	25,048	30,213	35,975	30,738	33,470	234,816
Gwangju	7,978	6,319	11,352	10,240	11,695	13,225	13,436	13,789	14,797	102,831
Daejeon	10,296	10,389	11,320	15,629	11,399	11,024	11,686	13,373	11,227	106,343
Ulsan	14,625	10,138	10,591	11,347	12,378	11,332	10,287	10,953	11,860	103,511
Gyeonggi	75,738	57,274	57,843	64,715	69,748	82,754	84,388	87,850	90,023	670,333
Gangwon	12,582	9,945	9,819	13,234	17,357	22,962	26,006	27,637	26,273	165,815
Chungbuk	11,276	10,021	12,103	20,840	19,910	22,876	26,463	26,037	28,167	177,693
Chungnam	19,634	16,454	16,222	18,960	18,352	21,984	21,568	25,803	26,942	185,919
Chonbuk	18,577	17,034	16,261	18,718	17,876	17,902	18,615	18,214	17,879	161,076
Chonnam	21,185	17,373	23,122	24,429	23,795	23,527	26,487	28,164	26,619	214,701
Gyeongbuk	31,989	25,235	25,582	26,317	26,567	30,529	27,690	29,113	26,388	249,410
Gyeongnam	51,015	40,840	36,540	35,947	36,059	33,637	33,086	38,143	35,331	340,598
Jeju	6,629	4,128	5,975	16,005	12,568	13,140	14,167	16,878	15,917	105,407
Unknown	1,443	518	381	466	148	560	830	937	1,819	7,102
Total	455,913	360,161	362,920	411,911	423,870	454,403	480,026	497,902	490,093	3,937,201

13.65 ± 22.89 days. By the number of beds, the LOS in hospitals with 100 to 299 sickbeds was the highest at 13.79 ± 19.29 days, and in those with 1,000 beds was at 10.19 ± 14.21 days, about two days shorter than 12.17 days, the overall average.

2. Progressive increase of cancer patients by year

The results of the progressive increase in cancer patients by year according to the region are in Table 2. The number of discharged patients in 2005 was excessively estimated. Excluding this, there was an increase in the number by more than 300,000 persons in 2013 as compared to that in 2006. To examine the number by region, it was noted that the number of cancer patients in hospitals located in Busan and Daegu decreased, but in all other regions increased.

To show this progress of increase visually, a straight linear regression equation was drawn (Figure 2). The drawn regression equation was as following Equation 1. x representing the period was on a monthly basis. R^2 representing the explanatory power of the regression equation was 0.4524 (Equation 2). That is, the explanation power of the regression model to predict the number of discharged cancer patients with the period as an independent variable was 45.24%, which was at a high level, and the regression coefficient of the period x was 97.309, so the progress of increase turned out to be significant.

$$y = 97.309x + 31,152 + \varepsilon \quad (1)$$

$$R^2 = 0.4524 \quad (2)$$

3. Characteristics of operation and death

Surgery and death are treated as the results of medical utilization in the treatment of diseases. This study analyzed them, dividing them as the variables of medical utilization in order to reflect these characteristics of diagnosed cancer patients. First, to analyze the characteristics of the surgery of patients who were hospitalized with cancer, a chi-square test was conducted according to demographic characteristics (Table 3). In all patients, the proportion of patients for surgery was 33.63%. The rate of surgery in women was much higher than in men. It was 41.36% in women while it was 27.42% in men. By age, half of the patients aged 19 to 44 years and 20.84% of elderly patients over 75 years had surgery. However, only 15.68% of patients under 18 years had surgery. For insurance type, most of them were National Health Insurance patients (35.02%), while Medical Care Assistance Type 1 patients were 19.69%. For hospitalization route, outpatient was 39.63%, which was higher than emergency (11.95%). It turned out that 39.31% of patients who improved as a result of treatment had surgery, while only 5.82% of those that died did.

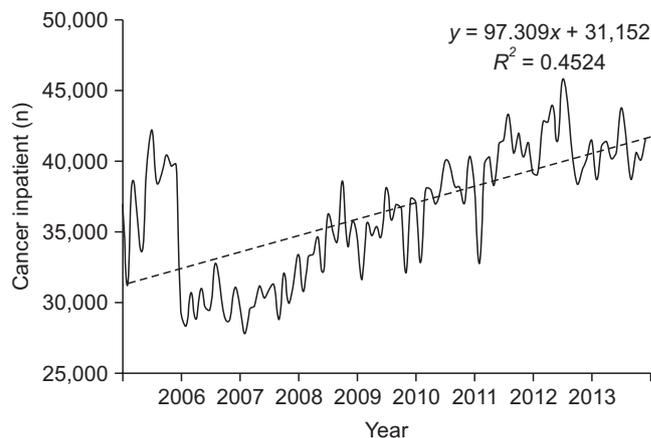


Figure 2. Trend analysis of cancer inpatient.

By the location of the hospital, 38.79% of the patients in hospitals located in Seoul, Gyeonggi-do, and Incheon had surgery, while only 20.06% of those in Gangwon-do and Jeju-do did. By the number of beds, 43.34% of patients who had treatment in hospitals with more than 1,000 beds had surgery, while only 13.11% of those in hospitals with 100 to 299 beds did, thus, the larger the number of beds, the higher the rate of surgery. All of the above results were statistically significant ($p < 0.001$).

The results of an analysis of the characteristics of the death of hospitalized cancer patients are in Table 4. Differences in demographic characteristics and death distribution were statistically significant ($p < 0.001$); 7.27% of the women and 9.93% of men died. Further, mortality rates increased with increasing age. In those aged > 75 years, the mortality rate was 14.39%, while in those aged < 18 years, it was 3.32%. By insurance type, the mortality rate of Medical Care Assistance Type 1 patients was 12.43%, while that of National Health Insurance patients was 8.37%. By the location of the hospital, the mortality rate was 6.94% for patients in hospitals located in Seoul, Gyeonggi-do and Incheon, while that of patients in Gyeongsang-do was 11.45%. By the number of beds, the mortality rate was 3.76% in hospitals with 1,000 sickbeds, which was very low, and the mortality increased with the decrease in the number of beds; the mortality rate of patients in hospitals with 100 to 299 beds was 18.88%.

DISCUSSION

This study was conducted to clarify the characteristics of medical utilization in cancer patients and to facilitate data-based health policy suggestions, independent of clinical and preventive medical aspects of cancer. The Korean National Hospital Discharge In-depth Injury Survey by the Center for Disease Control

Table 3. Operation rate of cancer inpatient

Variable	Operation		χ^2 (<i>p</i>)	
	Yes	No		
Sex	Male	599,057 (27.42)	1,585,565 (72.58)	84,663.673 (< 0.001)
	Female	724,889 (41.36)	1,027,691 (58.64)	
Age (y)	≤ 18	11,681 (15.68)	62,808 (84.32)	137,325.162 (< 0.001)
	19–44	252,880 (50.30)	249,853 (49.70)	
	45–64	638,673 (36.98)	1,088,209 (63.02)	
	65–74	298,164 (28.53)	746,930 (71.47)	
	≥ 75	122,548 (20.84)	465,455 (79.16)	
Insurance	National Health Insurance	1242,314 (35.02)	2,304,981 (64.98)	33,191.483 (< 0.001)
	Type-1 Medicaid ^a	66,735 (19.69)	272,214 (80.31)	
	Type-2 Medicaid ^a	7,501 (32.08)	15,878 (67.92)	
	Others	7,396 (26.82)	20,182 (73.18)	
Admission route	Emergency	102,444 (11.95)	754,528 (88.05)	230,475.332 (< 0.001)
	Outpatient	1,217,024 (39.63)	1,853,660 (60.37)	
	Others	4,478 (46.91)	5,068 (53.09)	
Treatment outcome	Improved	1,292,748 (39.31)	1,995,638 (60.69)	289,492.347 (< 0.001)
	Not improved	9,763 (3.44)	274,443 (96.56)	
	Death	20,036 (5.82)	324,253 (94.18)	
	Others	1,399 (6.89)	18,922 (93.11)	
Disposition	Return-home	1,291,218 (37.98)	2,108,424 (62.02)	211,570.745 (< 0.001)
	Other hospital	11,831 (6.51)	169,863 (93.49)	
	Death	20,036 (5.82)	324,253 (94.18)	
	Others	860 (7.43)	10,716 (92.57)	
Hospital location	Seoul, Gyeonggi, Incheon	796,089 (38.79)	1,255,991 (61.21)	62,973.989 (< 0.001)
	Chungcheong	96,338 (27.98)	247,979 (72.02)	
	Jeolla	126,762 (33.53)	251,276 (66.47)	
	Gyeongsang	258,692 (27.72)	674,489 (72.28)	
	Gangwon, Jeju	46,065 (20.06)	183,521 (79.94)	
Number of beds	100–299	65,967 (13.10)	43,7427 (86.90)	154,992.835 (< 0.001)
	300–499	147,578 (26.63)	406,614 (73.37)	
	500–999	663,952 (35.90)	1,185,635 (64.10)	
	≥ 1,000	446,449 (43.34)	583,579 (56.66)	
Total		1,323,946 (33.63)	2,613,255 (66.37)	

Values are presented as number (%).

^aKorea is eligible for medical assistance if the beneficiary (including foreign nationals) as defined in the National Basic Living Security Act. Type 1 is fully exempted at the time of admission and Type 2 is responsible for 10% of the cost of care.

and Prevention was data accumulated since 2005 based on the yearly summaries of the discharge of hospitalized patients. Using this data, this study analyzed the characteristics of hospitalized

patients with cancer as the principal diagnosis in hospitals with more than 100 beds. Cancer is a disease with high worldwide mortality and morbidity rate, and as the number of surviving

Table 4. Mortality of cancer inpatient

Variable	Mortality		χ^2 (<i>p</i>)	
	Yes	No		
Sex	Male	216,830 (9.93)	1,967,792 (90.07)	8,575.234 (< 0.001)
	Female	127,458 (7.27)	1,625,121 (92.73)	
Age (y)	≤ 18	2,469 (3.32)	72,019 (96.68)	38,114.345 (< 0.001)
	19–44	25,366 (5.05)	477,366 (94.95)	
	45–64	132,513 (7.67)	1,594,369 (92.33)	
	65–74	99,310 (9.5)	945,785 (90.5)	
	≥ 75	84,630 (14.39)	503,373 (85.61)	
Insurance	National Health Insurance	296,936 (8.37)	3,250,359 (91.63)	6,639.601 (< 0.001)
	Type-1 Medicaid ^a	42,129 (12.43)	296,820 (87.57)	
	Type-2 Medicaid ^a	2,068 (8.85)	21,311 (91.15)	
	Others	3,155 (11.44)	24,423 (88.56)	
Admission route	Emergency	200,659 (23.41)	656,312 (76.59)	295,435.605 (< 0.001)
	Outpatient	143,196 (4.66)	2,927,488 (95.34)	
	Others	433 (4.54)	9,113 (95.46)	
Treatment outcome	Improved	-	3,288,385 (100)	NA
	Not improved	-	284,206 (100)	
	Death	344,288 (100)	-	
	Others	-	20,321 (100)	
Disposition	Return-home	-	3,399,643 (100)	NA
	Other hospital	-	181,694 (100)	
	Death	344,288 (100)	-	
	Others	-	11,576 (100)	
Hospital location	Seoul, Gyeonggi, Incheon	142,514 (6.94)	1,909,567 (93.06)	19,504.613 (< 0.001)
	Chungcheong	36,910 (10.72)	307,407 (89.28)	
	Jeolla	33,833 (8.95)	344,205 (91.05)	
	Gyeongsang	106,813 (11.45)	826,368 (88.55)	
	Gangwon, Jeju	24,220 (10.55)	205,367 (89.45)	
Number of beds	100–299	95,053 (18.88)	408,341 (81.12)	113,499.359 (< 0.001)
	300–499	72,310 (13.05)	481,882 (86.95)	
	500–999	138,174 (7.47)	1,711,413 (92.53)	
	≥ 1,000	38,752 (3.76)	991,276 (96.24)	
Total		344,288 (8.74)	3,592,913 (91.26)	

Values are presented as number (%).

NA, not available.

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patients increases with the development of treatment methods, medical utilization will change greatly [11]. In addition, cancer may have a large impact on the increase in national medical ex-

penses and the burden of diseases for individuals; thus, a study to understand the characteristics of patients hospitalized with cancer, which is necessary for policy suggestions, is timely.

The main results and implications of the study are as follows. The risk of cancer was higher in men than in women in terms of incidence rate, and the medical utilization of hospital treatment was about 10% higher in men than in women. This could be explained by the higher incidence rate. In addition, men showed a relatively higher LOS than women. The surgery rate in women was 41.36%, much higher than the 27.42% in men. Furthermore, for the in-hospital mortality rate, that of men was 9.93%, which was higher than the 7.27% in women. The surgery rate was high because of the high probability of early cancer and great expectation of full recovery. In sum, it was noted that men were more vulnerable to cancer than women were [12]. Therefore, it would be necessary to implement an effective national cancer policy by sex in parallel with this finding. In other words, even for the same cancer, there must be differentiation between men and women in the cancer control policy. With early diagnosis, the ratio of hospitalized patients aged 45 to 64 years was the highest, and with the increase of age, it tended to decrease. However, the LOS was highest in patients over 75 years. In terms of prevention, like early diagnosis, it is judged that the state should develop a cancer control project with a middle-aged class aged 45 to 64 years, and this suggests that it is necessary for medical institutions to control the elderly patients' LOS. Of the hospitalized cancer patients 50.30% who had surgery were in aged 19 to 44 years, and surgery tended to decrease with the increase of age, but with the increase of age, the mortality rate also increased [13]. Additionally, the LOS was more than two times higher in patients who died than in those who did not, which supported the basis for the necessity of a policy for the care of terminally ill cancer patients such as hospice care [14,15]. By hospitalization route, in emergency patients, the LOS was longer, but the surgery rate was lower. On the other hand, mortality was higher in emergency patients. Since these major serious diseases directly lead to death because of complications, policy considerations of local hub special hospitals for cancer patients should proceed. Cancer patients' hospital treatment was concentrated in the capital region, according to the location of hospitals, and their LOS was low. In addition, the surgery rate was high, but the mortality rate was low in hospitals in the capital region. This is mainly because the medical institutions that effectively treat major diseases like tertiary general hospitals are concentrated in the capital region [16]. This suggests that it is necessary to promote the fairness of cancer treatment between regions. For the number of beds in the hospitals that treated hospitalized cancer patients, over 70% were large hospitals with more than 500 beds, and the LOS was low. The greater the number of hospital beds, the higher the surgery rate became, but the mortality rate sharply dropped, so

cancer patients' preference for large hospitals was confirmed. Treatment methods and early detection of cancer have been developed, but in terms of recognition, the phenomena in which patients are concentrated in large hospitals in the capital region remain because of anxiety about the results of treatment. Thus, it is necessary to tighten a medical quality management policy that can reduce the regional gap. In addition, it is necessary to implement a policy so that regional equity is secured in the allocation of medical resources. Further, we observed a steadily progressive increase in the number of hospitalized cancer patients. This is consistent with WHO that has predicted that the number of cancer patients would greatly increase to 19.3 million persons in 2025 [1]. As a result of an estimation of a nonlinear equation in a time-series analysis, it is expected that the number of hospitalized cancer patients, will increase by 37% from 490,000 in 2013 to 670,000 in 2025. It is necessary to get ready for the fiscal crisis because of changes in major diseases like cancer as well as the economic burden because of population changes.

Suggestions and implications for health policy were discussed based on the results of the study. The Korean database for this study was based on the system for the survey with discharged patients in developed countries such as the United States and Australia. By the research characteristic of the use of secondary data, this study has a limitation that it is difficult to include the factors that can reflect the characteristics of cancer. However, as a result of a statistical analysis reflecting the weighted value based on a composite sampling design, it is possible to estimate the number of hospitalized patients on the national scale, so it has a value for its utilization in policy research on various diseases for the future. Subsequent studies should conduct in-depth analysis according to various factors of cancer and associated diseases.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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REFERENCES

1. Gulland A. Global cancer prevalence is growing at “alarming pace,” says WHO. *BMJ* 2014;348:g1338. <https://doi.org/10.1136/bmj.g1338>
2. Huang ME, Sliwa JA. Inpatient rehabilitation of patients with cancer: efficacy and treatment considerations. *PM R* 2011;3:746-57. <https://doi.org/10.1016/j.pmrj.2011.05.020>
3. Statistics Korea. 2015 annual report of causes of deaths. Daejeon: Statistics Korea; 2015.
4. Sadigh G, Carlos RC, Ward KC, et al. Breast cancer screening in patients with newly diagnosed lung and colorectal cancer: a population-based study of utilization. *J Am Coll Radiol* 2017;14:900-10. <https://doi.org/10.1016/j.jacr.2017.01.022>
5. Park JK, Park HA. Screening rates of major cancers after a cancer diagnosis in adults in Korea. *Korean J Health Promot* 2012;12:67-74.
6. Loud JT, Murphy J. Cancer screening and early detection in the 21st century. *Semin Oncol Nurs* 2017;33:121-8. <https://doi.org/10.1016/j.soncn.2017.02.002>
7. Clarke TC, Christ SL, Soler-Vila H, et al. Working with cancer: health and employment among cancer survivors. *Ann Epidemiol* 2015;25:832-8. <https://doi.org/10.1016/j.annepidem.2015.07.011>
8. Lee YJ. A study on the influences of changes to the co-payment of cancer patients of their uses of medical services. *J Korean Pub Policy* 2009;11:3-25.
9. Korea Centers for Disease Control and Prevention. Korean national hospital discharge in-depth injury survey. Osong: Korea Centers for Disease Control and Prevention; 2012.
10. Cha SK, Kim SS. The determinant of the length of stay in hospital for Schizophrenic patients: using data from the in-depth injury patient surveillance system. *J Digit Converg* 2013;11:351-9.
11. Haylock PJ. Advanced cancer: emergence of a new survivor population. *Semin Oncol Nurs* 2010;26:144-50. <https://doi.org/10.1016/j.soncn.2010.05.008>
12. Yang Y, Li T, Nielsen ME. Aging and cancer mortality: dynamics of change and sex differences. *Exp Gerontol* 2012;47:695-705. <https://doi.org/10.1016/j.exger.2012.06.009>
13. White MC, Holman DM, Boehm JE, et al. Age and cancer risk. *Am J Prev Med* 2014;46:S7-15. <https://doi.org/10.1016/j.amepre.2013.10.029>
14. Tjia J, Ellington L, Clayton MF, et al. Managing medications during home hospice cancer care: the needs of family caregivers. *J Pain Symptom Manage* 2015;50:630-41. <https://doi.org/10.1016/j.jpainsymman.2015.06.005>
15. Gomes B, Higginson IJ, Davies E. Hospice and palliative care. In: Quah SR, editor. *International encyclopedia of public health*. 2nd ed. Oxford: Academic Press; 2017. p. 69-76.
16. Kang AG. An analysis of the equity in health service utilization with the regional distribution of health care resources. *Korean Soc Secur Stud* 2007;23:189-219.