



County-based demographics, patterns of treatment seeking, and disease burden for malignant tumor patients in China

Wenhua Mao¹, Xinrong Feng², Yongming Wang², Benjiao Zeng², Yihang Zhang², Kaifu Luo¹

¹Admin Office, Yun County People's Hospital, Lincang, China; ²Department of Oncology, Yun County People's Hospital, Lincang, China

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Correspondence to: Kaifu Luo. Admin Office, Yun County People's Hospital, Lincang, China. Email: yxrmmy160@163.com.

Background: The mortality of malignant tumors in rural areas of China in 2015 was significantly higher than that in city areas (213.6 per 100,000 *vs.* 191.5 per 100,000), bringing huge economic pressure to individuals and the local community. The comprehensive reform of county-level public hospitals in Yun County has helped patients with critical disease receive appropriate treatment. Therefore, an analysis focused on the epidemiology and disease burden of malignant tumors in Yun County could provide guidance for administrators and health practitioners in other counties.

Methods: This retrospective database study extracted data from the Yun County medical community (including two higher level hospitals: Yun County People's Hospital and Yun County Chinese Medicine Hospital, and 13 township central hospitals) from 1st Jul 2017 to 30th Aug 2020. Patients diagnosed as having a malignant tumor were enrolled and those with abnormal key baseline information were excluded. The epidemiology and disease burden for malignant tumor patients were assessed.

Results: A total of 3,792 patients were enrolled, and the most prevalent cancer in 2018 was thyroid (35.4 patients/100,000) and in 2019 this was lung cancer (30.6 patients/100,000). The mean outpatient visits per person for all-cause and tumor-specific visits were 9.99 and 3.94 visits across 2018 and 2019, respectively, and the mean inpatient visits per person in both years were the same at 2.56 visits. Total costs were 14.471 and 20.29 million in 2018 and 2019, respectively, and 71.7% and 73.0% of the total cost were covered by medical insurance over the 2 years.

Conclusions: The medical environment has improved since medical system reform commenced in 2019 in Yun County, and medical insurance has decreased the disease burden for patients and their families significantly.

Keywords: Malignant tumor; treatment seeking; disease burden; China county

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Introduction

World Health Organization (WHO) estimates suggest there were 18.1 million new cases of cancer and 9.6 million deaths worldwide in 2018 (1). In 2015, 4.3 million new cancer cases were reported in China, ranking this country first in the world (2), and more than 2.8 million people died of malignant tumors, accounting for 32% of the total cancer deaths worldwide (3). The 5 leading causes of cancer

death among both men and women are cancers of the lung and bronchus, stomach, liver, esophagus, and colorectum, accounting for about three-quarters of all cancer deaths (2). From 2000 to 2015, the age-standardized incidence rate for esophageal cancer, gastric cancer and liver cancer decreased significantly, while the age-standardized incidence rate for colorectal cancer in whole population and for lung cancer, breast cancer, cervix cancer, uterus cancer and thyroid

cancer in females increased significantly (4). The incidence rate in rural areas of China in 2015 was significantly higher than that in city areas (213.6 per 100,000 *vs.* 191.5 per 100,000), and the standardized mortality rate of malignant tumors in rural areas was higher than urban areas (149.0 per 100,000 *vs.* 109.5 per 100,000).

This regional difference may be caused by many factors, in which the higher smoking rate of rural populations in comparison to their urban counterparts likely to play a leading role (5,6). Smoking is highest in the southwest of China, which also has a standardized incidence rate of malignant tumors of (226.7 per 100,000) and mortality rate of (170.2 per 100,000), which is significantly higher than other parts of the country (7). The uneven distribution of medical resources in China, different degrees of access to and quality of cancer diagnosis and treatment, and the fact that most patients in rural and underdeveloped areas are in the middle and late stage of cancer when they are diagnosed, also contribute to the higher rate in these areas. This high prevalence creates a significant burden on patients, their families and the community at large. With the aging of the Chinese population and the increase of unhealthy behaviors and lifestyles related to cancer, the prevention and treatment of malignant tumors requires an increase in government health resources, especially in county and rural areas.

Yun County in Yunnan is in the southwest of China and has a permanent population of 460,000 and total population of 700,000 (8,9). In April 2014, the county was selected to be part of a trial of a comprehensive reform of county-level public hospitals, and a new medical health system focusing on an integral combination of medical treatment and health services started in June of that year. The new hospital system included two higher level hospitals, 13 township central hospitals, a center for disease control, and a maternity and child health hospital, and was designed to provide full coverage for health services and promote the implementation of hierarchical medical treatment. In 2019, the new insurance reform, diagnosis related groups (DRG), was initiated (10), and in 2020, to promote the development of the system, accelerate the construction of hierarchical treatment, and enhance the prevention for the critical diseases such as malignant tumors, a strategy of early screening and early treatment was implemented.

This study aimed to investigate the demographics, treatment pattern, and disease burden of patients with malignant tumors, and explore changes which occurred after the introduction of the new medical system. The results may provide evidence for the further construction

of prevention and early treatment resources for cancer patients. We present the following article in accordance with the STROBE reporting checklist (available at <https://dx.doi.org/10.21037/apm-21-2075>).

Methods

Study design

A retrospective analysis was performed to extract data from the records of patients with malignant tumors who presented to Yun County medical health care units including two higher level hospitals (Yun County People's Hospital and Yun County Chinese Medicine Hospital), and 13 township central hospitals, from 1st Jul 2017 to 30th Aug 2020. Patients with incomplete medical records and those under 18 years of age were excluded. All medical records including outpatient, inpatient, and emergency visits were extracted for the analysis. This study was approved by the ethics committee of Yun County People's Hospital (approval number: 2021-02). All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). Individual consent for this retrospective analysis was waived.

Demographic information including gender, age, ethnicity, marriage status, and medical insurance status were analyzed, as were the tumor types and treatment. Referral rates and patterns between higher level hospitals and county health centers were investigated, as was the disease burden for patients including health resource consumption and treatment costs. Moreover, all-cause visits and malignant tumor-specific visits were assessed separately.

Statistical analysis

Continuous variables were presented as minimum, maximum, mean, standard deviation (SD), median, and interquartile range (IQR) per group, while categorical variables were expressed as frequency and percentages. Analyses were conducted with the R statistical package v.2.13.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Demographics

A total of 3,912 patients with malignant tumors were enrolled. Two patients were excluded due to missing key

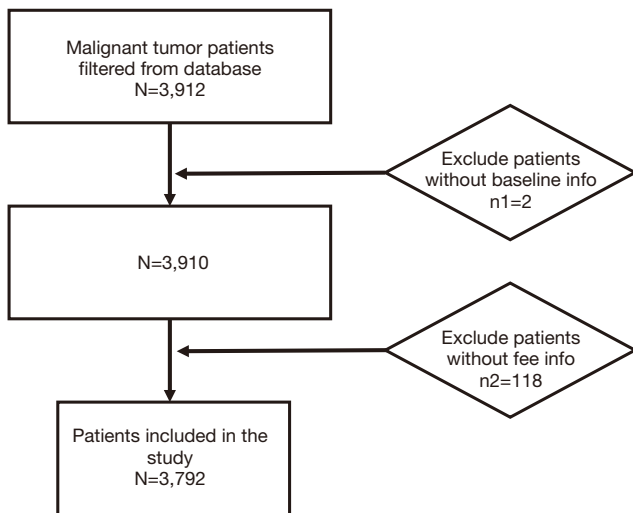


Figure 1 Scheme of population screening.

baseline information, and a further 118 were excluded because of missing cost information, resulting in 3,792 patient records used for further analysis (*Figure 1*).

Based on the results shown in *Table 1*, the mean age of patients was 56.4 (14.5) years old and male patients numbered slightly more than females. Most patients were Han ethnics. About 80% of patients were married, and over 85% had medical insurance coverage. The most common tumors, in order, were thyroid, lung, liver, and stomach, and were each found in over 10% of patients. Once diagnosed, 16.5% of patients received chemotherapy, 4.6% patients had surgery, and only 0.1% and 1.4% patients received radiation and target or immunization therapy, respectively.

Tumor prevalence

We also calculated the tumor prevalence in different target lesions in 2018 and 2019. The statistical results (*Table 2*) show that tumors occurring in the thyroid, lung, liver, stomach, and rectum were the most common. The prevalence of thyroid cancer was 35.4 patients per 100,000 persons, for lung 33.6% and for liver cancer 32.6%. However, in 2019, the prevalence of lung tumors was highest (30.6 patients/100,000), followed by thyroid and stomach tumors (27.0 and 28.7 patients/100,000, respectively).

Pattern of treatment seeking

We investigated the treatment rate per year in thirteen

Table 1 Demographics and clinical characteristics of patients with malignant tumors

Characteristics	Result (n=3,792)
Age (years), mean \pm SD	56.4 \pm 14.5
Gender, n (%)	
Male	1,963 (51.8)
Female	1,829 (48.2)
Ethics, n (%)	
Han	3,252 (85.8)
Non-Han	345 (9.1)
Missing	195 (5.1)
Marriage status, n (%)	
Married	3,060 (80.7)
Single	88 (2.3)
Widowed	25 (0.7)
Divorced	2 (0.1)
Others	10 (0.3)
Unspecified	607 (16.0)
Medical insurance, n (%)	
Covered	3,333 (87.9)
Self-pay	459 (12.1)
Target lesion, n (%)	
Thyroid	419 (11.0)
Lung	416 (11.0)
Liver	392 (10.3)
Stomach	391 (10.3)
Rectum	297 (7.8)
Breast	293 (7.7)
Blood	238 (6.3)
Colon	209 (5.5)
Esophagus	189 (5.0)
Cervix	142 (3.7)
Bladder	114 (3.0)
Nasopharynx/throat	80 (2.1)
Ovarium	47 (1.2)
Prostate	35 (0.9)
Treatment pattern for primary tumor, n (%)	
Surgery	1,173 (4.6)
Chemo	6,624 (16.5)
Radiation	55 (0.1)
Targeted/immunization	552 (1.4)

SD, standard deviance.

township central hospitals (*Table 3*) and this showed 10,726 visits occurred in county health centers, with 29.9% of these all-cause visits, while tumor-specific visits were seen in 1,603 (23.2%) of patients visiting township central hospitals. The analysis result for all-cause visits showed a huge increase in treatment rates in township central hospitals, rising from 5.3% in the period between Jul 2017 and Dec 2017 to 34.1% in 2020. The treatment rate for tumor-specific visits in township central hospitals also showed a large increase from 2017 to 2020, while the rise was less across 2018, 2019, and 2020, with 25.2%, 23.8%, and 22.4%, respectively.

For the referral rate analysis, we investigated the

Table 2 Prevalence of tumors in different target lesions

Target lesion (patients/100,000)	2018 (n=466,700), n (%)	2019 (n=466,790), n (%)
Thyroid	165 (35.4)	126 (27.0)
Lung	157 (33.6)	143 (30.6)
Liver	152 (32.6)	91 (19.5)
Stomach	137 (29.4)	134 (28.7)
Rectum	128 (27.4)	72 (15.4)
Breast	110 (23.6)	90 (19.3)
Blood	94 (20.1)	64 (13.7)
Colon	77 (16.5)	61 (13.1)
Esophagus	72 (15.4)	56 (12.0)
Cervix	67 (14.4)	31 (6.6)
Bladder	39 (8.4)	34 (7.3)
Nasopharynx/throat	36 (7.7)	24 (5.1)
Ovary	25 (5.4)	24 (5.1)
Prostate	11 (2.4)	18 (3.9)

Table 3 Treatment rate per year in county health centers

Year	All-cause		Tumor-specific	
	Total visits	Visits in county health centers, n (%)	Total visits	Visits in county health centers, n (%)
Total	35,835	10,726 (29.9)	11,237	2,603 (23.2)
2017.7–2017.12	1,672	89 (5.3)	468	39 (8.3)
2018.1–2018.12	10,976	3,048 (27.8)	3,240	818 (25.2)
2019.1–2019.12	14,180	4,516 (31.8)	4,419	1,050 (23.8)
2020.1–2020.8	9,007	3,073 (34.1)	3,110	696 (22.4)

Total visits: total visits in Yun County medical health care units.

yearly rate from 2017 to 2020 in the Yun County medical community, and three referral patterns for all-cause and tumor-specific visits were assessed separately. We defined the two higher level hospitals as the top units and the 13 township central hospitals as down units. *Table 4* shows 1,154 and 294 patients were referred for all-cause visits and tumor-specific visits, respectively, while for or all-cause visits, 199 patients (17.2%) experienced “up-to-down” referral, 130 patients (11.3%) experienced “down-to-top” pattern, and 825 patients (71.5%) experienced bidirectional referral. For tumor-specific visits, 125 patients (42.5%) had “up-to-down” referral, 25 patients (8.5%) were referred “down-to-up”, and 144 patients (49.0%) received referral in both directions. In addition, in the yearly analysis result, “down-to-up” referral increased from 2017 to 2020 for all-cause or tumor-specific visits, while “up-to-down” referral was similar in 2018, 2019, and 2020 with 34.7%, 34.2% and 31.7% for all-cause visits, and 30.4%, 35.2%, and 33.6% are for tumor-specific in 2018, 2019, and 2020, respectively. Finally, most bidirectional referral occurred in 2019.

Disease burden

We also assessed medical resource consumption for all-cause and tumor-specific visits. The medical resource consumption results (*Table 5*) indicated that the mean number of outpatient visits was 9.99 visits/person for all-cause visits and 3.94 visits/person for tumor-specific visits, while across the time of analysis, the mean outpatient visit was 8.00 visits per person per year for all-cause visits, and 5.13 for tumor-specific visits. The mean interval for outpatient visits was 64.02 days for all-cause visits, and 68.08 for tumor-specific visits for patients having at least two visits.

The mean number of inpatient visits was 2.56 and

Table 4 Summary of yearly referral rates

Year	All-cause (n=1,154), n (%)			Tumor-specific (n=294), n (%)		
	Up-to-down	Down-to-up	Both	Up-to-down	Down-to-up	Both
Overall (number of patients)	199 (17.2)	130 (11.3)	825 (71.5)	125 (42.5)	25 (8.5)	144 (49.0)
2017.7–2017.12	1 (0.5)	0 (0.0)	12 (1.5)	1 (0.8)	0 (0.0)	2 (1.4)
2018.1–2018.12	69 (34.7)	23 (17.7)	382 (46.3)	38 (30.4)	8 (32.0)	47 (32.6)
2019.1–2019.12	68 (34.2)	51 (39.2)	547 (66.3)	44 (35.2)	6 (24.0)	79 (54.9)
2020.1–2020.8	61 (31.7)	56 (43.1)	489 (59.3)	42 (33.6)	11 (44.0)	63 (43.8)

Table 5 Summary of medical resource consumption for outpatient and inpatients

Characteristics	All-cause (n=3,792)	Tumor-specific (n=3,792)
Outpatient		
Visits (visits/person)	9.99±13.50	3.94±8.59
Visits (visits/person, year)	8.00±7.96	5.13±7.49
Visits ≥2, n (%)	3,132 (87.30)	1,425 (48.0)
Outpatient interval (days)		
Mean ± SD	64.02±79.83	68.08±95.20
Median (Q1–Q3)	40.10 (19.80–77.40)	34.50 (12.00–81.45)
Inpatient		
Visits/person		
Mean ± SD	2.56±2.57	2.19±2.34
Median (Q1–Q3)	1.00 (1.00–3.00)	1.00 (1.00–2.00)
Length of hospital stay (days)		
Mean ± SD	8.62±6.22	9.25±7.05
Median (Q1–Q3)	7.20 (5.00–10.40)	7.80 (5.00–11.00)
Length of hospital stay (days/person, year)	13.45±12.80	16.06±14.6
Visits ≥2, n (%)	1,179 (49.91)	653 (33.6)
Inpatient interval (days)		
Mean ± SD	137.78±166.27	94.09±136.53
Median (Q1–Q3)	72.98 (28.24–178.65)	36.82 (21.52–97.02)
Readmission in 12 months after initial diagnosis, n (%)	2,317 (98.09)	1,923 (98.9)
Length of hospital stay (days/visit)		
Mean ± SD	8.10±6.82	8.20±7.32
Median (Q1–Q3)	6.00 (3.90–10.00)	6.00 (3.80–10.00)
Length of hospital stay (readmission in 12 months after initial diagnosis, days/visit)		
Mean ± SD	8.28±6.96	8.39±7.46
Median (Q1–Q3)	6.00 (4.00–10.10)	6.00 (3.90–10.10)

SD, standard deviance.

Table 6 Cost summary for all-cause and tumor-specific visits in 2018 and 2019

Cost [10,000]	2018			2019		
	Total cost	Outpatient	Inpatient	Total cost	Outpatient	Inpatient
All-cause						
Total	1,447.1	155.6	1,291.5	2,029.0	237.1	1,791.9
Reimbursement, n (%)	1,037.8 (71.7)	28.2 (18.1)	1,009.7 (78.2)	1,480.6 (73.0)	76.5 (32.3)	1,404.1 (78.4)
Self-pay, n (%)	409.3 (28.3)	127.5 (81.9)	281.8 (21.8)	548.4 (27.0)	160.6 (67.7)	387.8 (21.6)
Tumor-specific						
Total	993.3	43.6	949.7	1,508.8	85.4	1,423.5
Reimbursement, n (%)	761.3 (76.6)	9.7 (22.2)	751.6 (79.1)	1,155.0 (76.6)	35.1 (41.1)	1,119.9 (78.7)
Self-pay, n (%)	232.1 (23.4)	33.9 (77.8)	198.1 (20.9)	353.8 (23.4)	50.2 (58.9)	303.6 (21.3)

Table 7 Cost per person for all-cause and tumor-specific visits

Median cost/ person	All-cause			Tumor-specific		
	Total cost	Outpatient cost	Inpatient cost	Total cost	Outpatient cost	Inpatient cost
2017.7–2018.6	1,307.4 (229.2–6,462.5)	299.6 (112.5–715.8)	6,730.0 (3,811.0–6,730.0)	1,605.4 (114.2–6,951.4)	104.4 (29.4–317.9)	6,828.0 (3,853.0–16,671.0)
2018.7–2019.6	1,273.2 (1,273.2–6,880.9)	441.4 (166.5–1,048.3)	7,174.0 (4,112.0–14,950.0)	1,218.0 (145.0–7,182.4)	193.0 (61.2–555.1)	7,538.4 (4,225.7–16,231.5)

2.19 visits/person for all-cause and tumor-specific visits, respectively, and the mean length of hospital stay was 8.62 and 9.25 days for all-cause visits and tumor-specific visits, respectively. The mean interval for inpatient visits was 137.78 and 94.09 days for all-cause and tumor-specific visits, respectively in patients having at least two visits. Almost all patients had readmission in 12 months after initial diagnosis, and the length of hospital stay for readmission were 8.28 and 8.39 days for all-cause and tumor-specific patients, respectively.

Analysis of the economic burden in 2018 and 2019 in Yun County (*Table 6*) showed the total cost of all-cause visits in 2018 was 14.471 million, the outpatient and inpatient cost for these years were 1.556 and 12.915 million, respectively, and medical insurance covered 71.7% of the total cost. In 2019, the total cost for all-cause visits was 20.29 million, with 2.37 and 17.91 million for outpatient and inpatient visit costs, respectively, and medical insurance covered 73% for all costs, with 32.3% and 78.4% for outpatient and inpatient costs, respectively. For tumor-specific visits, the total costs were 9.933 and 15.088 million in 2018 and 2019, and the percentages for insurance coverage were the same

with 76.6% in 2018 and 2019.

We also assessed the median total cost, outpatient cost, and inpatient cost per person (*Table 7*) and median costs per visit (*Table 8*) by year. The median costs per person in the first year (from July 2017 to June 2018) were ¥1,307.4 and ¥1,605.4 all-cause and tumor-specific visits, respectively, while for the second year these were ¥1,273.2 and ¥1,218.0. The median total costs per person increased to ¥2,086.0 and ¥2,300.6 for all-cause and tumor-specific, respectively, in the third year.

An increasing trend in median inpatient costs per visit was observed (*Table 8*), while other costs, including outpatient costs, examination fees, drug costs and surgery fees, showed no change.

Discussion

This retrospective study explored the electronic medical records of patients with malignant tumors in Yun County. The study analyzed the patient demographics, treatment patterns, referral patterns, medical resource consumption, and economic burden in a real-world setting.

Table 8 Cost per visit for all-cause and tumor-specific visits

Median cost/visit	All-cause			Tumor-specific		
	2017.7–2018.6	2018.7–2019.6	2019.7–2020.6	2017.7–2018.6	2018.7–2019.6	2019.7–2020.6
Total cost	167.3 (44.3–616.4)	116.0 (42.6–335.6)	134.7 (43.6–416.0)	203.8 (37.1–4,095.4)	152.7 (41.3–1,534.9)	201.7 (60.5–2,996.1)
Outpatient cost	91.7 (35.9–207.6)	88.0 (37.6–205.0)	90.00 (38.9–218.5)	55.7 (21.0–170.0)	84.82 (29.8–195.4)	111.81 (41.56–255.00)
Inpatient cost	4,599.0 (3,328.0–6,518.0)	4,820.0 (3,248.0–6,972.0)	5,212.8 (588.4–7,933.4)	4,691.0 (3,552.0–6,586.0)	5,056.0 (3,949.0–7,429.0)	5,499.4 (4,068.4–8,726.0)
Examination fee	340.0 (120.0–1,581.0)	260.0 (107.0–1472.0)	284.0 (107.0–1,483.0)	1,402.0 (540.0–2,300.0)	1,302.0 (195.0–2,313.0)	926.5 (177.0–2,329.8)
Drug cost	135.15 (9.46–651.66)	82.0 (29.9–251.4)	85.0 (33.1–366.8)	169.0 (31.3–1,670.4)	111.2 (31.8–884.9)	203.5 (59.1–1,544.6)
Surgery fee	138.0 (130.0–630.0)	230.0 (120.0–990.0)	220.0 (10.0–800.0)	130.0 (130.0–630.0)	230.0 (130.0–2,078.0)	60.0 (10.0–1,319.0)

The mean age of the 3,792 patients was 56.4 years old and there were more males than females (51.8% *vs.* 48.2%). Han ethnics dominated the study population, and over 80% of patients were covered by medical insurance. Thyroid tumors were the most common cancer, followed by lung, liver, and stomach. The high prevalence of thyroid cancer seen may be because of its less serious nature, making it relatively easy to treat in local centers, and not requiring referral to tertiary hospitals outside the region. The initial treatment for malignant tumors was chemotherapy, followed by surgery, with a small number of patients receiving radiation, target, or immunization therapy. This too may be because sophisticated procedures, such as radiation and immunotherapy, are less likely to be practiced at smaller hospitals.

The number of individuals seeking care for malignant tumors increased yearly, whether all-cause or tumor-specific visits. Moreover, the treatment rate in township central hospitals increased yearly for all-cause visits, while the treatment rate for tumor-specific visits decreased yearly. The results indicated that cancer patients preferred to attend higher level hospitals for treatment, while other patients choose to seek care at local centers. In addition, referral between higher level hospital and township central hospitals for cancer patients was high, whether all-cause visits or tumor-specific visits, with bidirectional referral occurring the most.

The mean number of outpatient visits per person for all-cause and tumor-specific visits were 9.99 and 3.94 visits, respectively, and the median interval for outpatient visits

for all-cause and tumor-specific patients were 40.10 and 34.50 days, respectively. The mean number of inpatient visits per person was 2.56 visits, and the mean length of hospital stay per person was 8.62 days for all-cause visits and 2.19 visits and 9.25 days for tumor-specific visits.

The total cost of care showed a large increase in 2019 compared with 2018, in both all-cause visits and tumor-specific visits. Moreover, medical insurance coverage increased yearly, both in total reimbursement cost and the percentage covered. In addition, while an obvious increase in the year-to-year outpatient and inpatient costs per person was observed, there was no trend in the cost of outpatient and inpatient per visits. This suggests reforms to the medical system may have resolved issues around overtreatment or over examination and may have assisted in controlling the cost of care for patients.

As this study was limited to one county and across a 3-year period only, the results may not be more generally applicable, and studies involving additional counties and across longer periods of time are required. As a part of a trial of a comprehensive reform of county-level public hospitals, the experience and pattern of Yun County will be promoted and popularized to other county areas, thus, more clinical cases, longer research time, the comparison with other regions would be feasible in the future.

Conclusions

Dealing with cancer is time consuming and brings significant financial and emotional stress to individuals,

their families, and the community at large. In addition to prevention and early detection, early treatment for cancer patients is crucial. Changes to the medical environment in Yun County, including medical system reform and medical insurance, have greatly decreased the disease burden for cancer patients.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the ethics committee of Yun County People's Hospital (approval number: 2021-02). All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). Individual consent for this retrospective analysis was waived.

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