

Cancer Patients Medical Utilization and Loss Risks of Cancer Policies in Taiwan

16th International Longevity Risk and Capital Markets
Solutions Conference

Aug 14, 2021

Hsin-Chung Wang, Aletheia University

Jack C. Yue, National Chengchi University

Ting-Chen Chang, National Chengchi University

Outline

- Motivation
- Data Introduction-Taiwan's National Health Insurance Research Databases (NHIRD)
- Exploratory Data Analysis (EDA): Incidence rates, Mortality rates, and Survival rate
- Medical Utilization: Inpatient, Outpatient
- Application
- Conclusion

Motivation

- Aging population

Taiwan is expected to become a **hyper-aged** society in **2025**

- Lower fertility rates

The total fertility rate (TFR) of Taiwan is around **1.08** for the past 5 years (2015–2020)

- The life expectancy is prolonging and medical expenditure grows gradually

➤ In 2018, the life expectancy at birth was 80.69 years, and the healthy life expectancy was 72.28 years==> That is the "**unhealthy survival years**" reached **8.41** years.

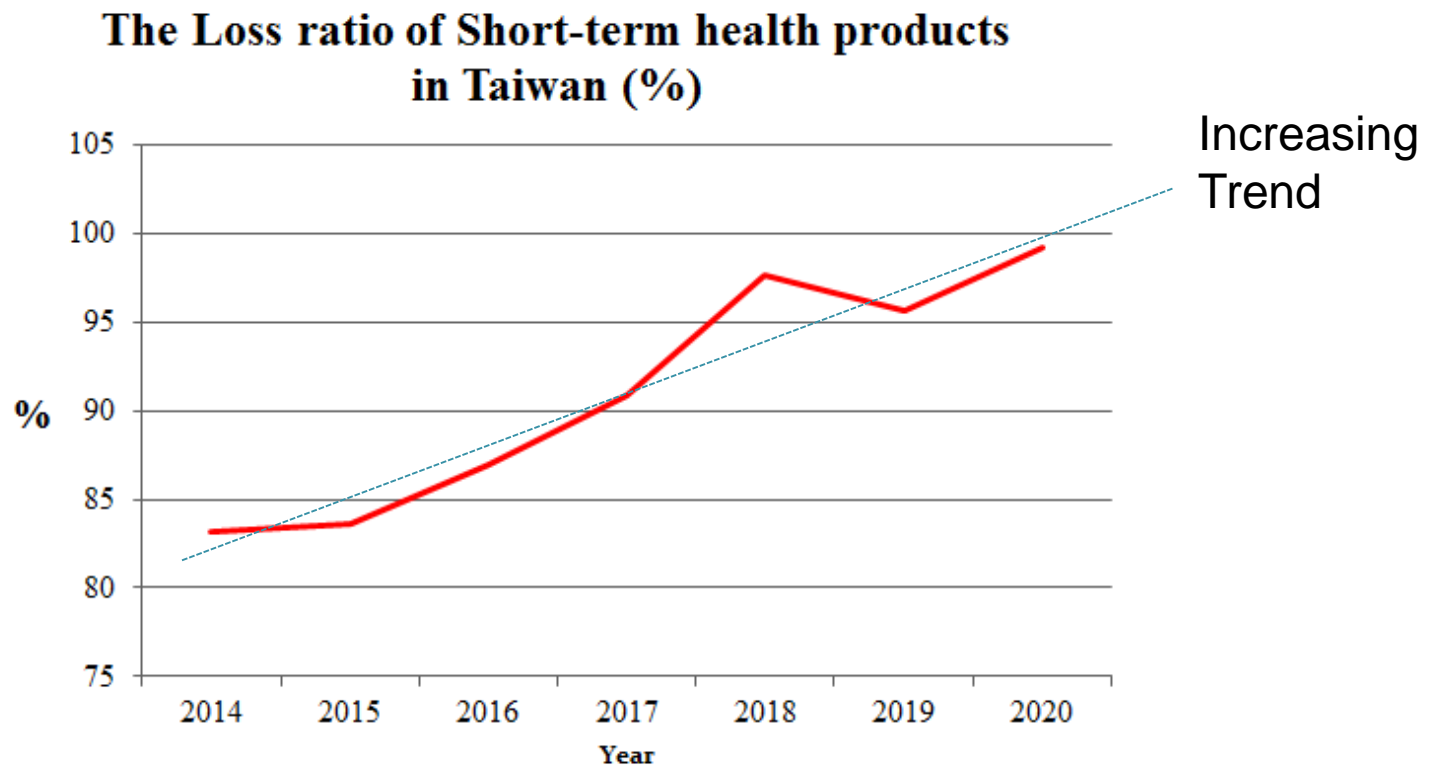
➔ The financial burden of medical (cancer) is likely to increase in Taiwan.

Motivation

- Cancer has been the leading cause of death in Taiwan since 1982.
- In 2019, the Catastrophic Illnesses (CI) patients were 4% of Taiwan population (about 0.9 million) but 27.7% of total National Health Insurance expenditure was spent.
- The cancer patients (about 0.45 million) spent approximately 35% of the total CI expenditures, which was around 75 billion NT dollars (or 2.5 billion US dollars).
- In Taiwan, about **6%** of national health care expenditure is cancer-related.
- The 2018-19 average medical expense **per cancer patient** is around **5.6** times the average medical expense **per person** in Taiwan.
- Cancer is also a leading cause of death in most OECD countries, accounting for between **25%** and **30%** of deaths among men and women and nearly **10 million** deaths in 2020
- Globally, the burden of cancer is expected to increase by **50%** in 2040 compared to 2020

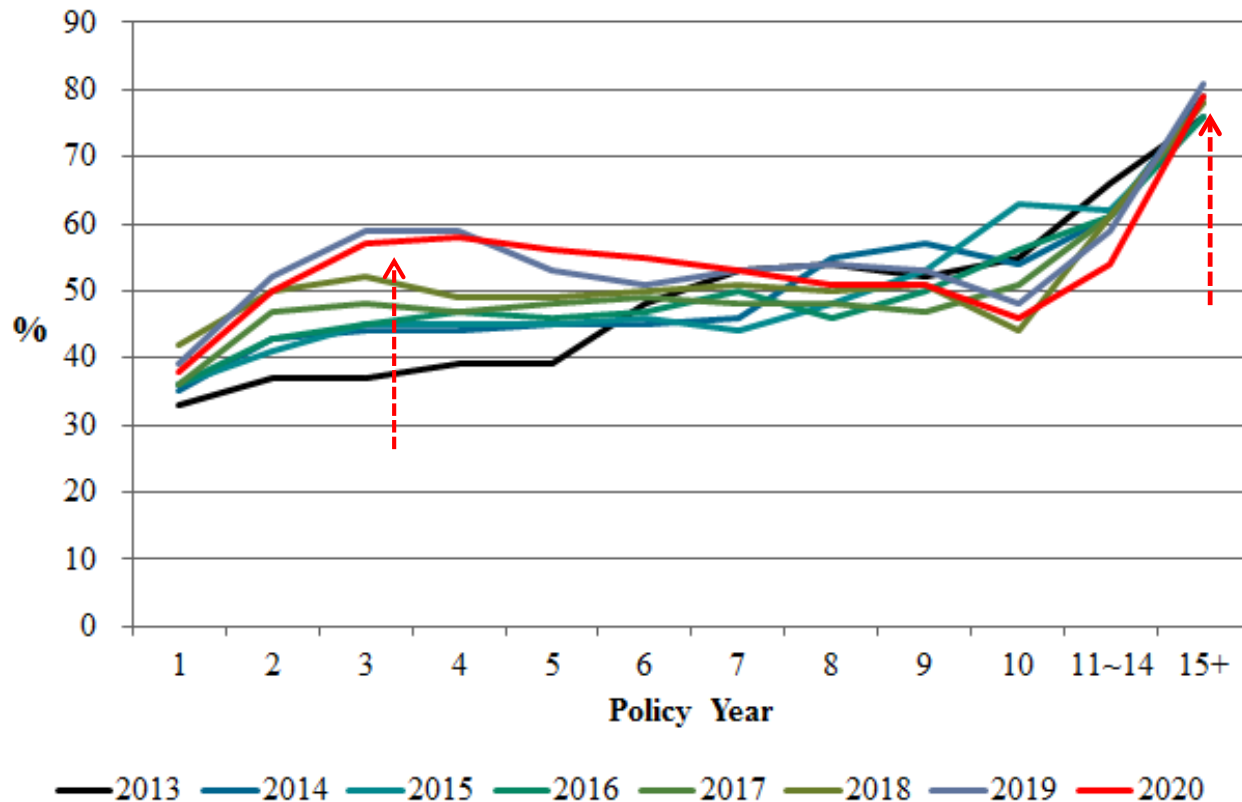
How to reduce the burden of medical expenses? Buy an insurance policy !!

- In Taiwan, the number of Health Insurance Policy per insured was **0.4** in 1995, but it was growing to **4.4** in 2019.
- **Many insurance companies have high payment for medical claims**
- The loss ratio (i.e., the ratio of claim to premium) of **Short-term** health products in Taiwan
- The loss rate has an increasing trend: from **83.14%** in 2014 to **99.27%** in 2020 (Source: Taiwan Insurance Institute)



- The loss ratio (i.e., the ratio of claim to premium) of long-term health products in Taiwan seems to increase with the policy year and many insurance companies have 100% or more loss ratios after 15 years. (Source: Taiwan Insurance Institute)
- First 5 policy year, average loss ratio is from 37% in 2013 increase to 52%
- After 15 years, it is about 80%

The Loss ratio of long-term health products in Taiwan



Motivation

- **Three reasons** can be identified that **cause higher than expected loss ratio** in Taiwan.
 - Not enough experience rates are available.
 - The insurers did not expect longevity risk, like the case of annuity products.
- Underestimated increment and reduction rates when using cancer incidence and mortality to design product.
 - Rapid progress in medical technology is also a key factor.
 - ➔ This creates the possibility of moral hazard.

Motivation

- What are the insurers need to do?
 - Stop selling
 - Renewing design; reducing coverage
 - Refining the experience rate
 - Limit the total amount of payment for medical expenses paid and death benefits

However, these do not work for long-term health insurance products. **Stopping selling and limiting the total amount of payment can only be used as damage control.**

- Major challenges in Taiwan

Longevity issue needs to be considered to prevent occurrence of financial burden to the insurer in future.

- A reliable data set → Taiwan's National Health Insurance database(NHIRD)
- Update cancer incidence and mortality rates that must include improvement rates

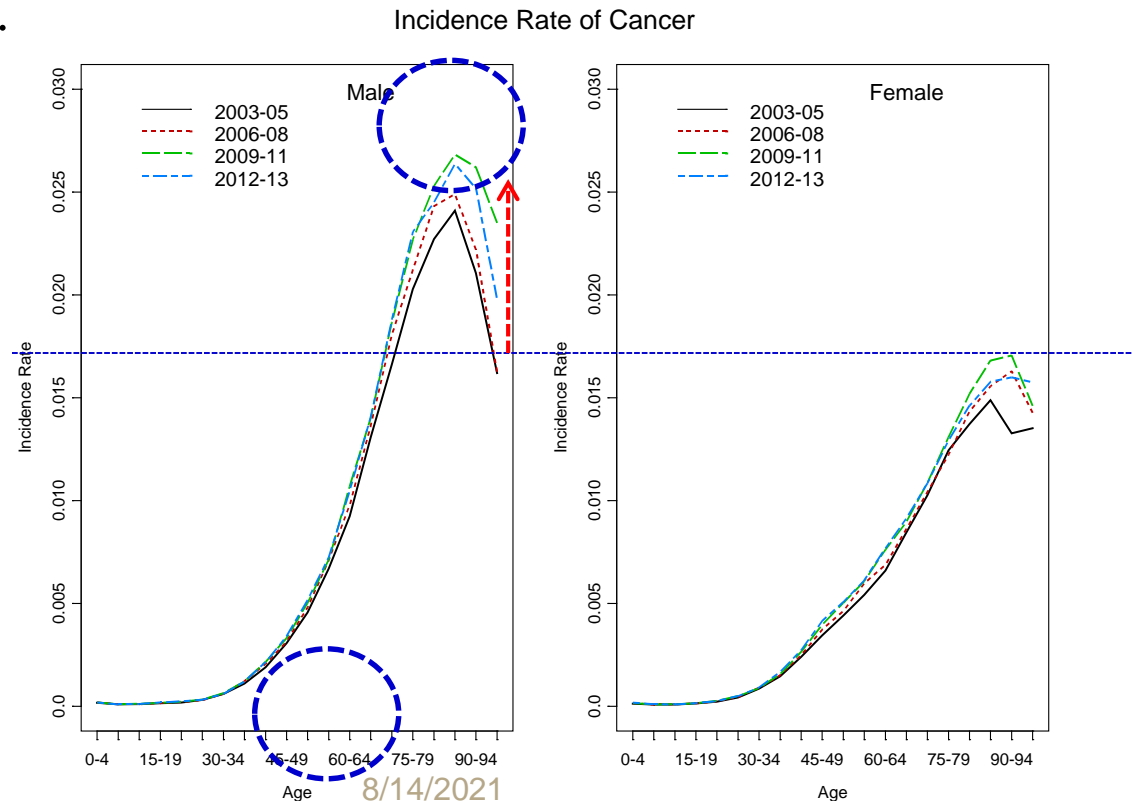
Data Introduction-Taiwan's National Health Insurance research databases (NHIRD)

- Taiwan launched a single-payer National Health Insurance program on March 1, **1995**. As of 2020, 99.93% of Taiwan's population were enrolled.
- There are approximately **23.86 million** individuals in this registry
- We have used all the records of the Catastrophic Illnesses (CI) patients:
 - 1) Inpatient expenditures by admissions (DD): Contains inpatient records of non-catastrophic illnesses
 - 2) Registry for CI patients (HV)
 - 3) Ambulatory care expenditures by visits(CD): Contains outpatient records of non-catastrophic illnesses

Cancer is one of the CI recorded in the NHI database

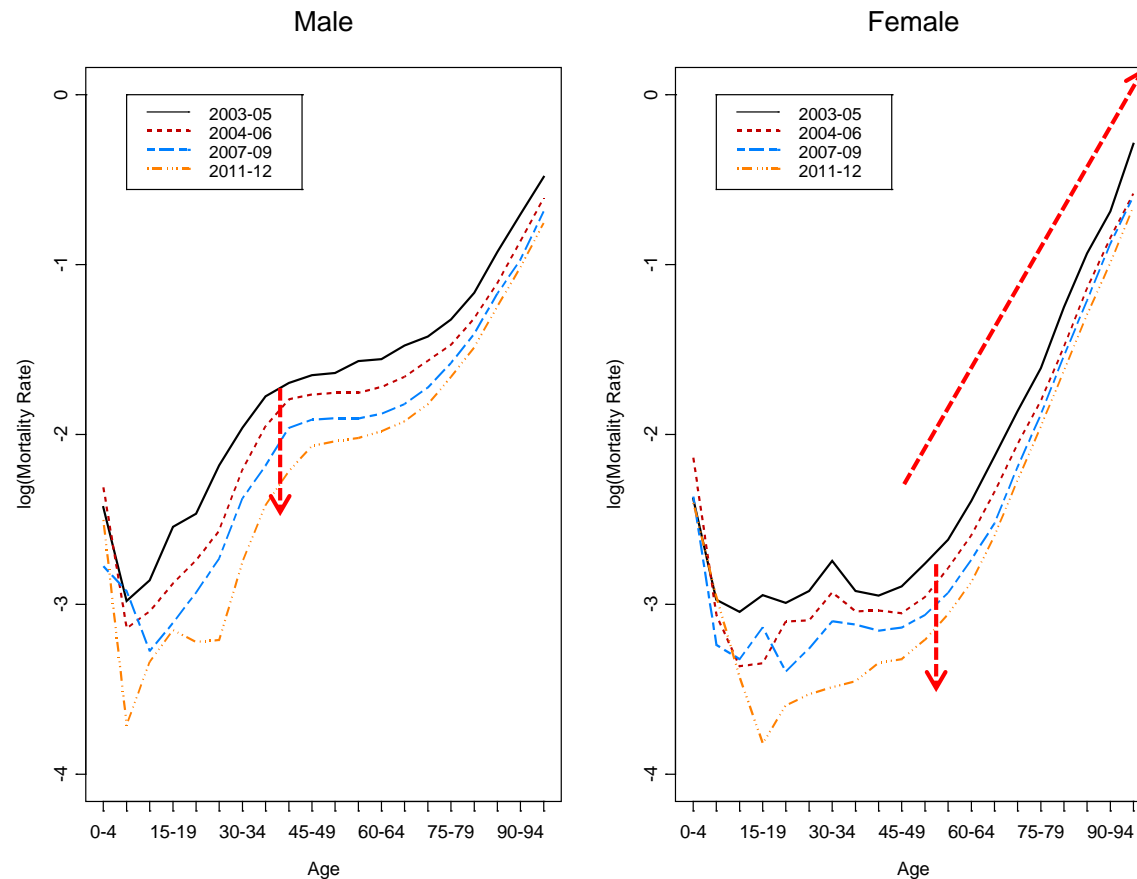
Exploratory Data Analysis (EDA)

- Incidence rates
- The men's cancer incidence rate is significantly higher than that in women's.
- The men's cancer incidence rate **has risen sharply** after the age of **50**.
- The incidence **rate has risen slightly over time**, but the trend seems to have slowed gradually.
- The peak incidence rate of cancer falls between the ages of **80-94**, and it rises significantly in the elderly.



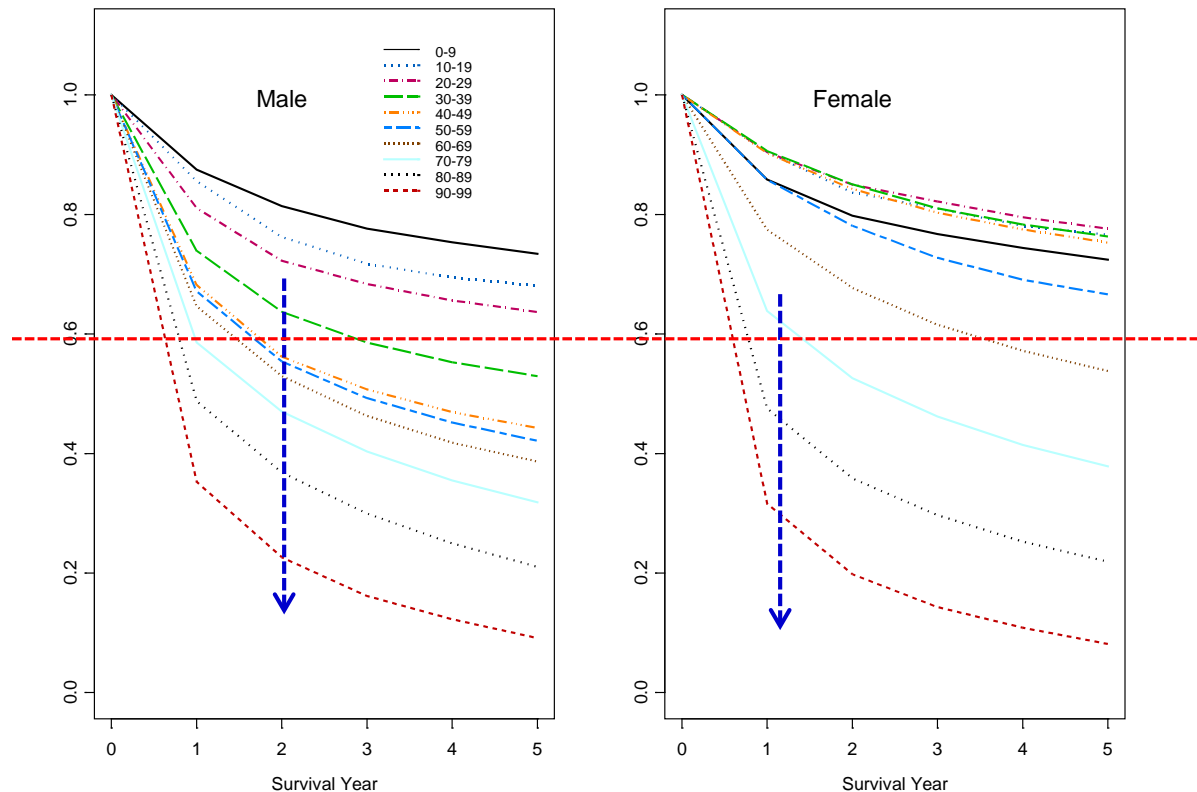
Exploratory Data Analysis (EDA)

- Cancer patients' mortality rates
- Generally, male and female mortality rates show a **decreasing trend over time**.
- **An upward trend** with age on cancer mortality rate.



Exploratory Data Analysis (EDA)

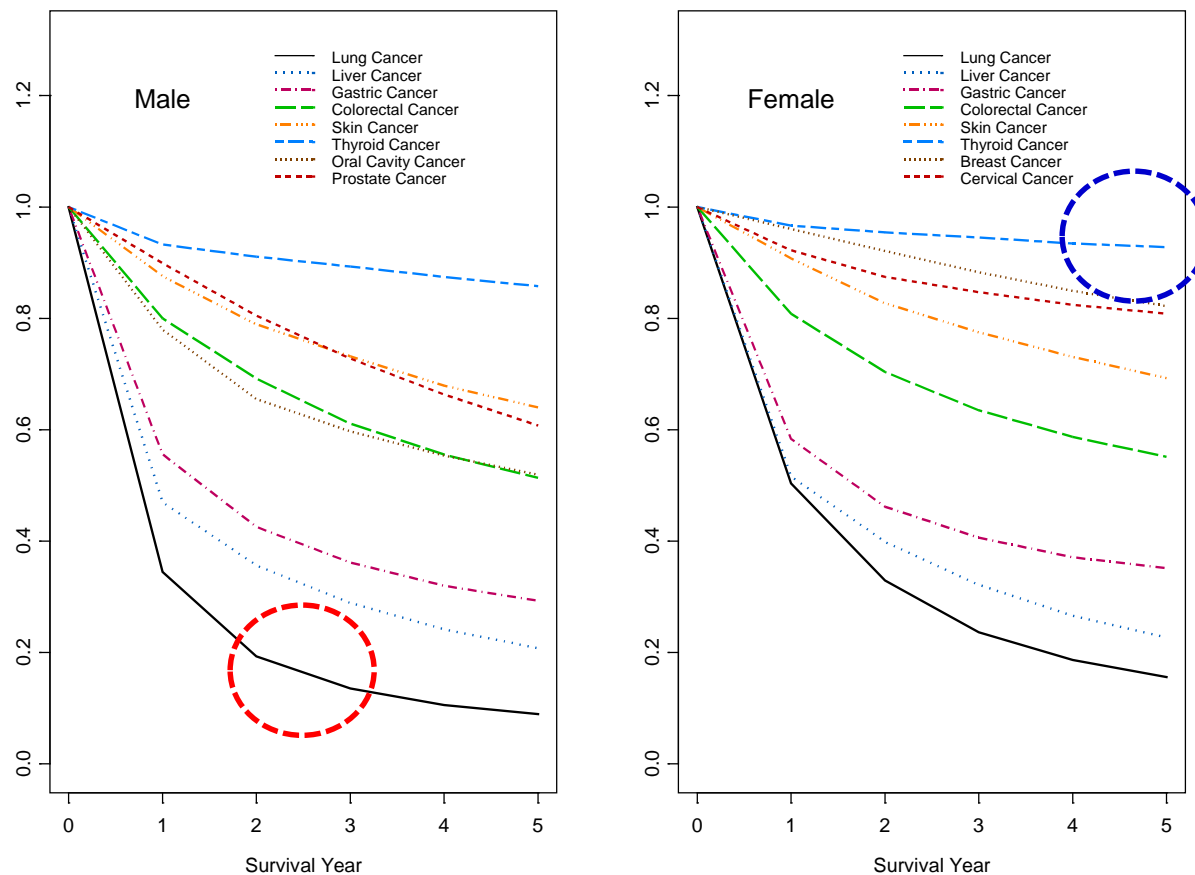
- Cancer patients' Survival rate
- Both male and female 2003-08 survival rates decrease with age.
- The 5-year survival rate for **male before the age of about 40** and **female before the age of about 70** is **60%** higher than after.



Exploratory Data Analysis (EDA)

- Survival rate of 10 types cancer of cancer patient
- The 5-year survival rate of **Lung cancer is the worst.**
- The **thyroid cancer survival rate is the best.**

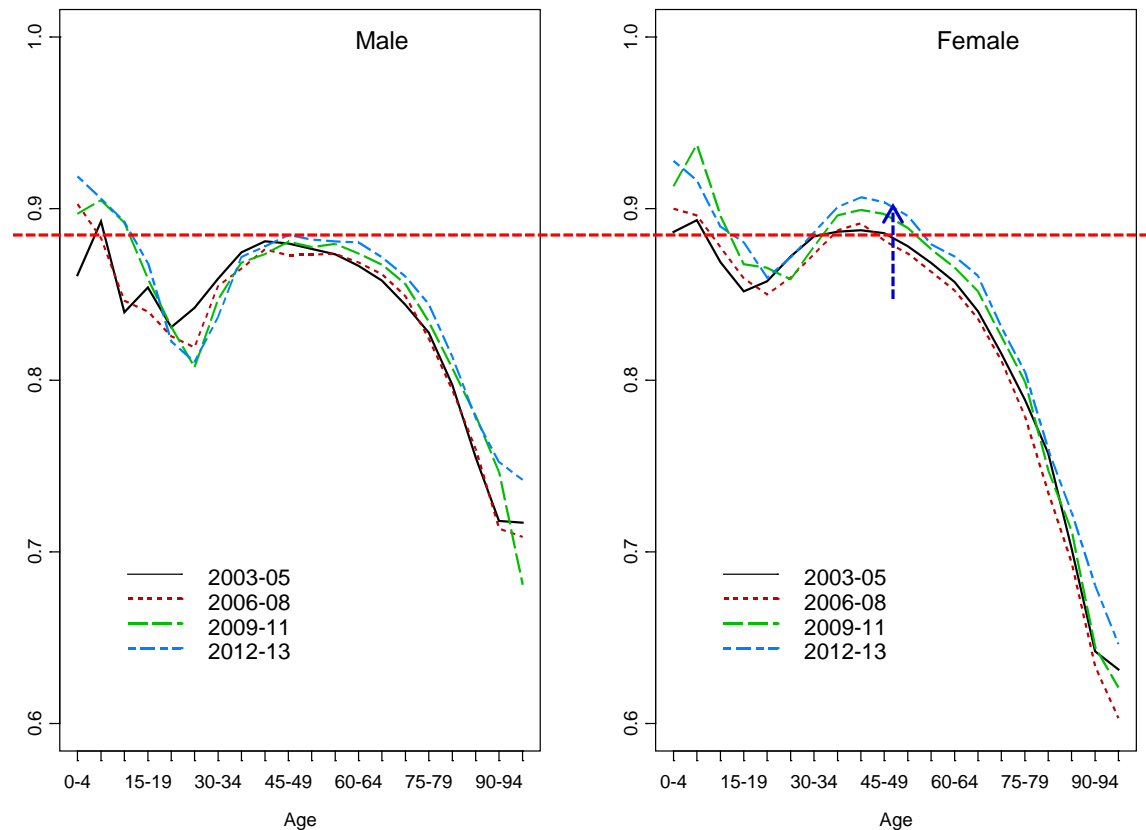
Cancer Average Survival Rate (2003-2008)



Medical Utilization

- Outpatient: Cancer Outpatient Visiting Rate of Cancer Patient
- Generally, the rate of **female** cancer outpatient visits **is slightly higher than male's**
- The rate of **female** medical visits has **gradually increased slightly**, and the male's is less obvious

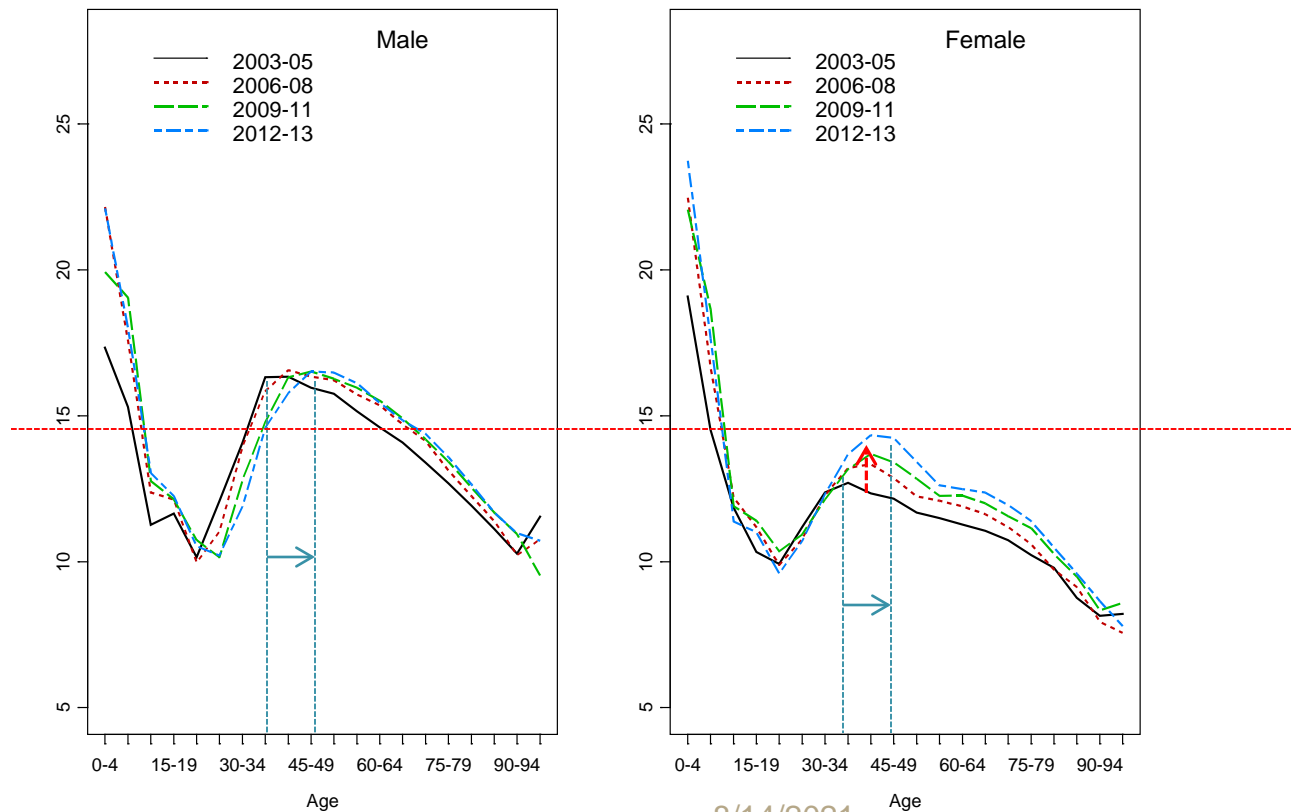
Cancer Outpatient Visiting Rate of Cancer Patient



Medical Utilization

- Outpatient: Number of Cancer Outpatient Visits per Cancer Patient
- The average number of cancer outpatient visits per **woman is lower than man's**.
- **The growth trend of female** cancer outpatient visits is **significant through times**, but less obvious on male.
- The age group at the **peak** of the number of outpatient visits is **deferred to the right over time**

Number of Cancer Outpatient Visits per Cancer Patient



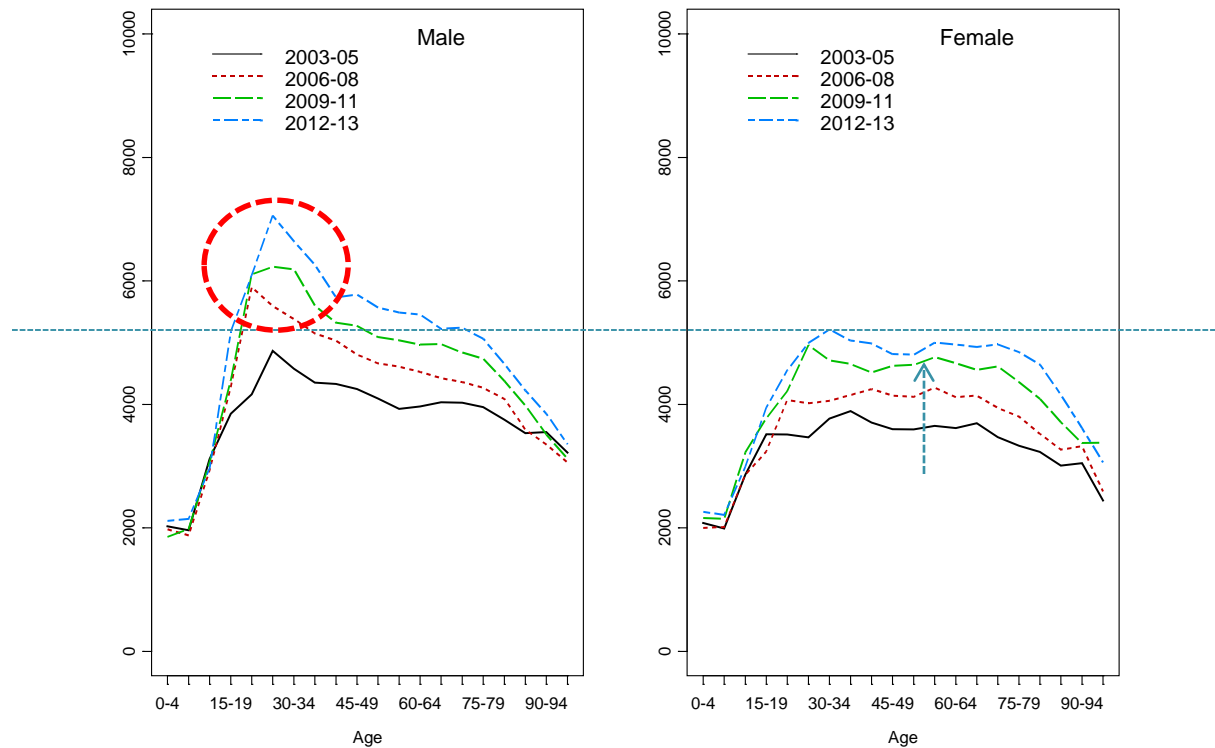
Medical Utilization

- Outpatient: Cancer Outpatient Expenditure per Time

- The average cancer outpatient expenditure per time is generally higher for men than for women and they are growing year by year.

- The average cancer outpatient expenditure per time for **men aged 20-29** is significantly higher than that of other age groups

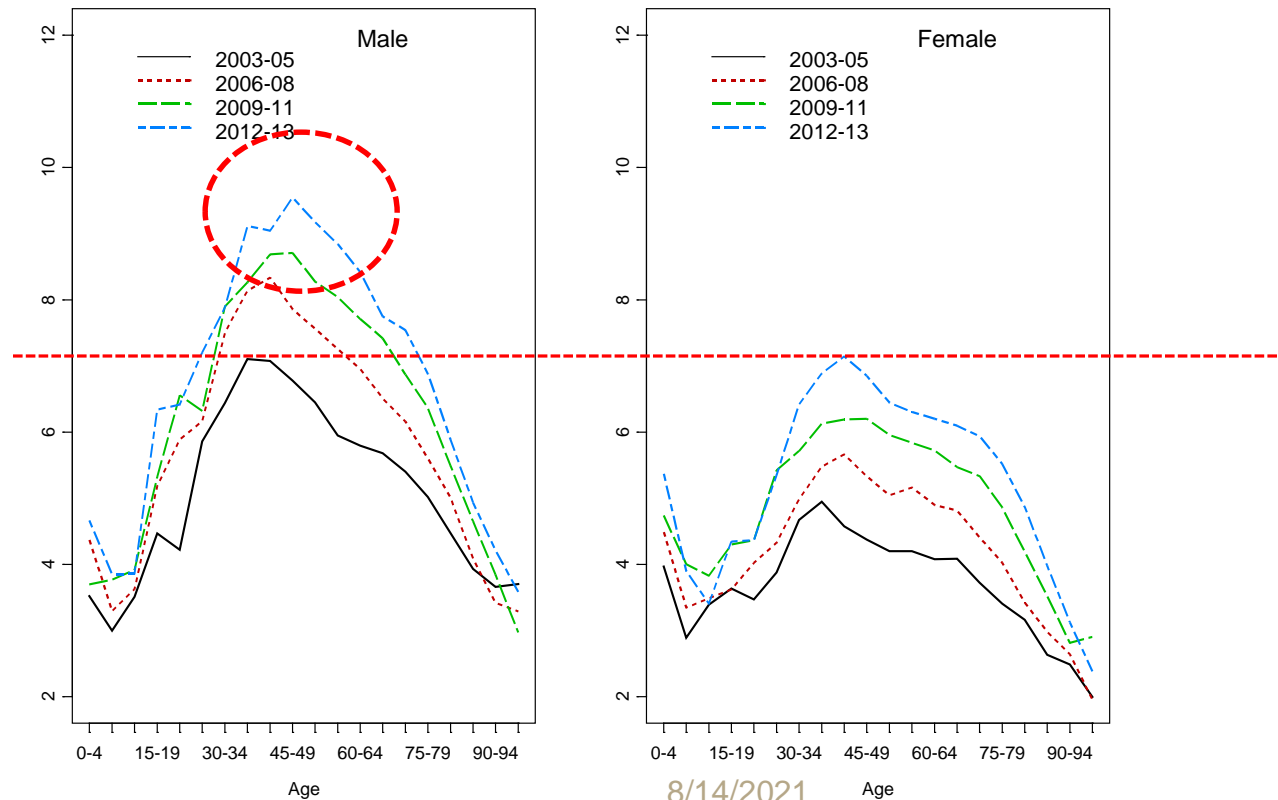
Cancer Outpatient Expenditure per Time



Medical Utilization

- Outpatient: Cancer Outpatient Expenditure per cancer patient
- The average cancer outpatient expenditure per cancer patient for **men is significantly higher than that for women.**
- The age range with the **highest expenses** is concentrated in **the 35-60 years old**, and the expenses are growing year by year.

Cancer Outpatient Expenditure per Cancer Patient (Unit: 10,000)

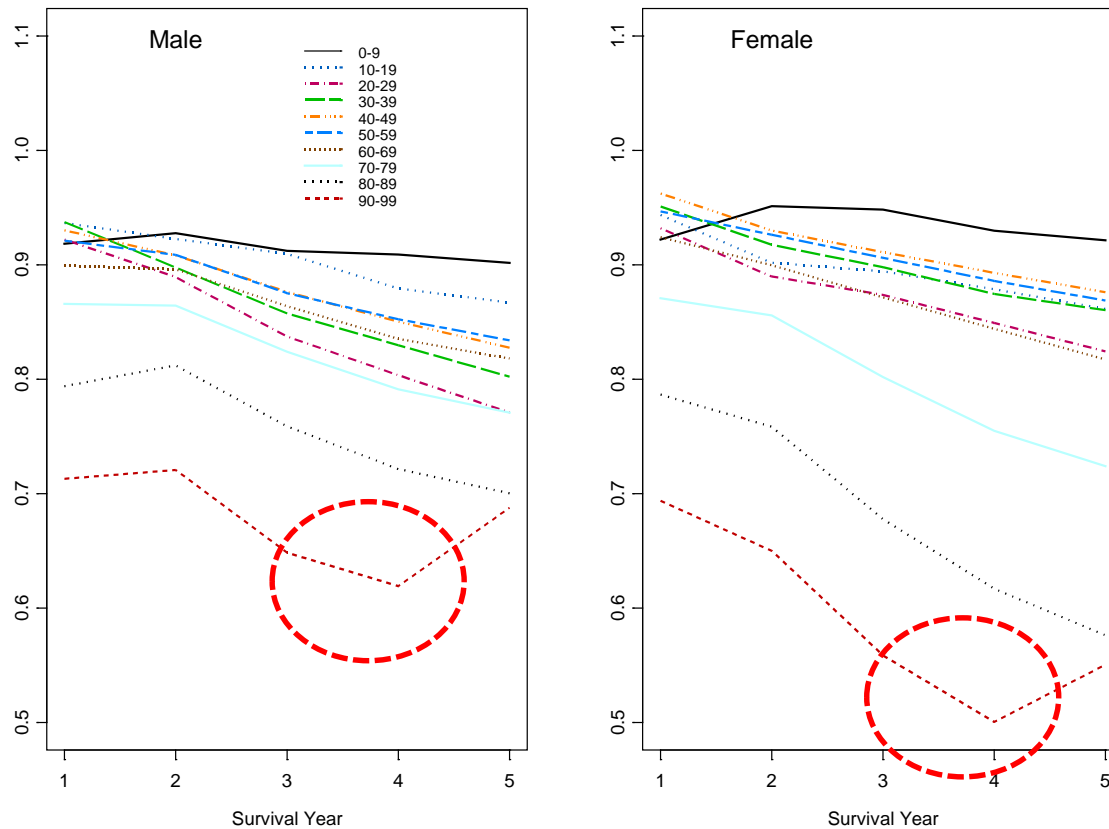


8/14/2021

Medical Utilization

- Outpatient: Cancer Outpatient Visiting Rate of Cancer Patient (2004-08)
- The highest rate of cancer outpatient visits is **in the first year**
- It is worth noting that the rate of outpatient treatment for cancer patients of **the elderly is significantly lower than that of other age groups.**

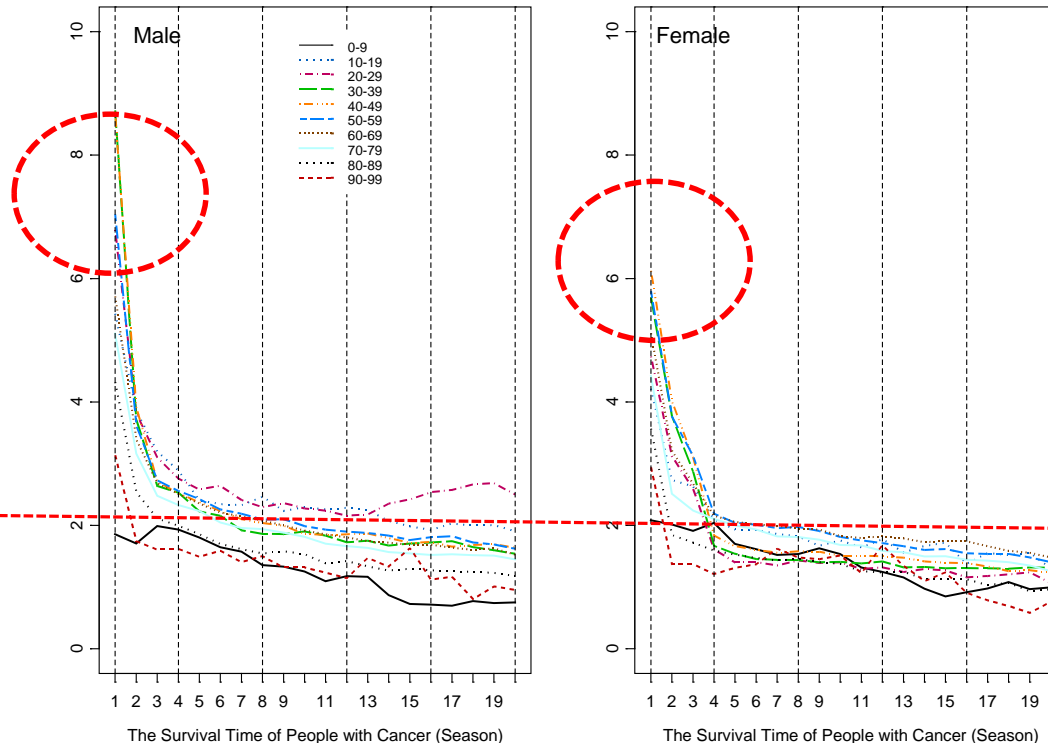
Cancer Outpatient Visiting Rate of Cancer Patient (2004-08)



Medical Utilization

- Outpatient: Cancer Outpatient Expenditure per cancer patient
- Cancer treatment is mainly spent **in the first year** of illness.
- Cancer Outpatient Expenditure per Cancer Patient for men at each Survival time is higher than that for women.

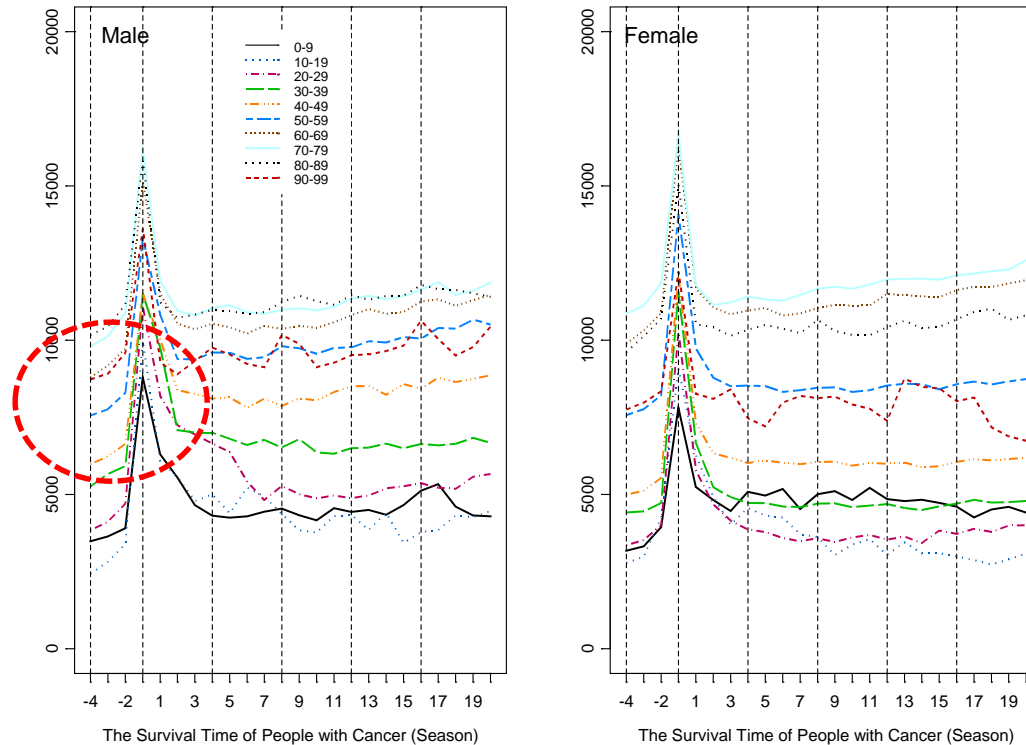
Cancer Outpatient Expenditure per Cancer Patient (2004-08): Unit: 10000



Medical Utilization

- Outpatient: Non-Cancer Outpatient Expenditure per cancer patient
- The average non-cancer outpatient expenditure per cancer patient will still be **higher than before got cancer**
- ➔ Not only the cost of **cancer treatment increase**, but the cost of **non-cancer outpatient expenditure** will also **increase**.

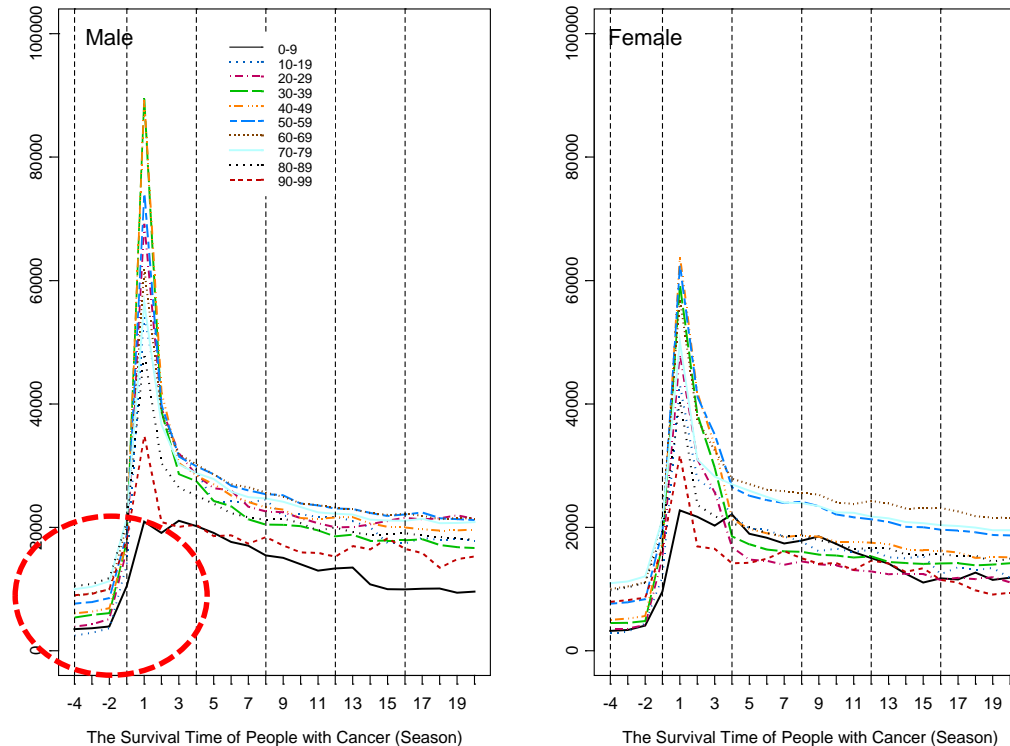
Non-Cancer Outpatient Expenditure per Cancer Patient (2004-08)



Medical Utilization

- Outpatient: Outpatient Expenditure per Cancer Patient (2004-08)
- The first quarter outpatient expenditure of cancer patients is about **4 to 5 times** that of the year before getting cancer.
- Although the overall medical expenses have decreased one year after suffering from cancer, it is still **1.5-2 times** higher than before getting cancer.
- In addition, cancer patients will still have to **bear higher costs for at least 5 years than before getting cancer.**

Outpatient Expenditure per Cancer Patient (2004-08)

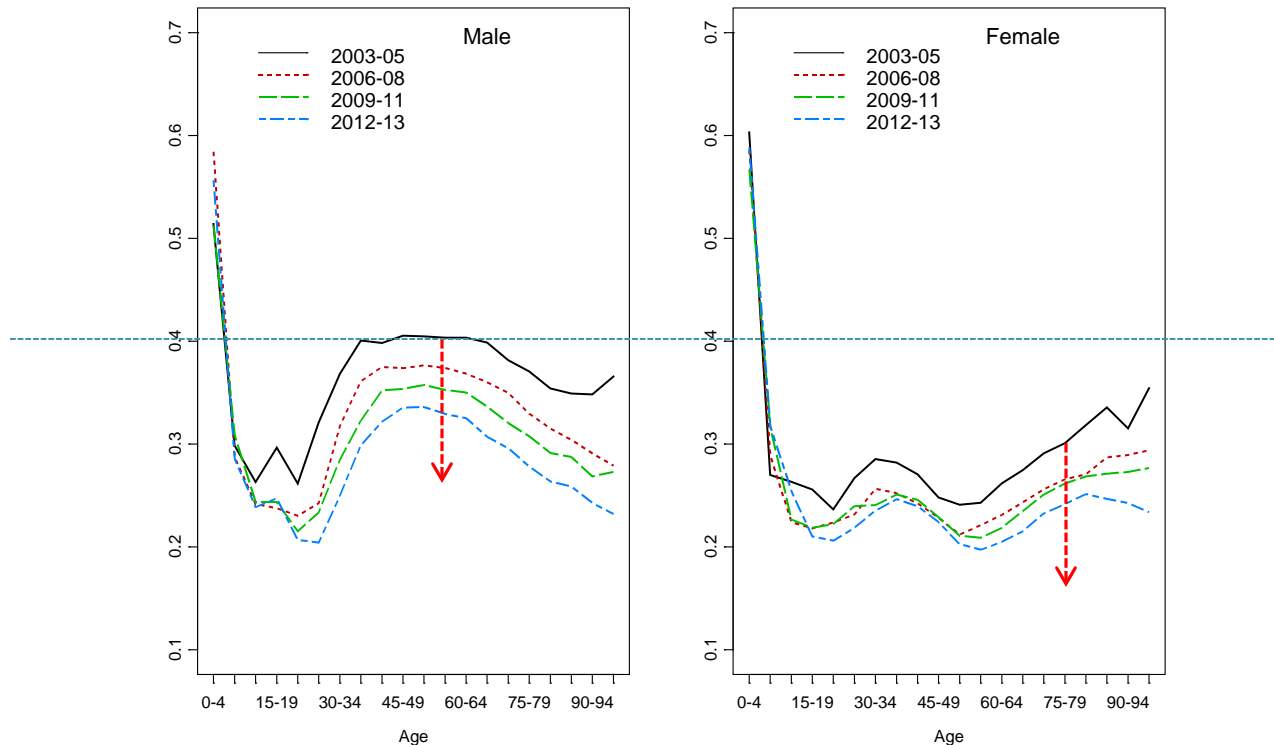


8/14/2021

Medical Utilization

- Inpatient: Cancer admission rate of cancer patient
- The cancer admission rate of **men's cancer patients is higher than that of women**, and they **all decrease with time**.
- The **peak** cancer admission rate for **males** falls between **40-69 years old** and then decreases with age.
- **Female** cancer admission rate between the ages of 40-69 is **lower than male**, and then increases with age

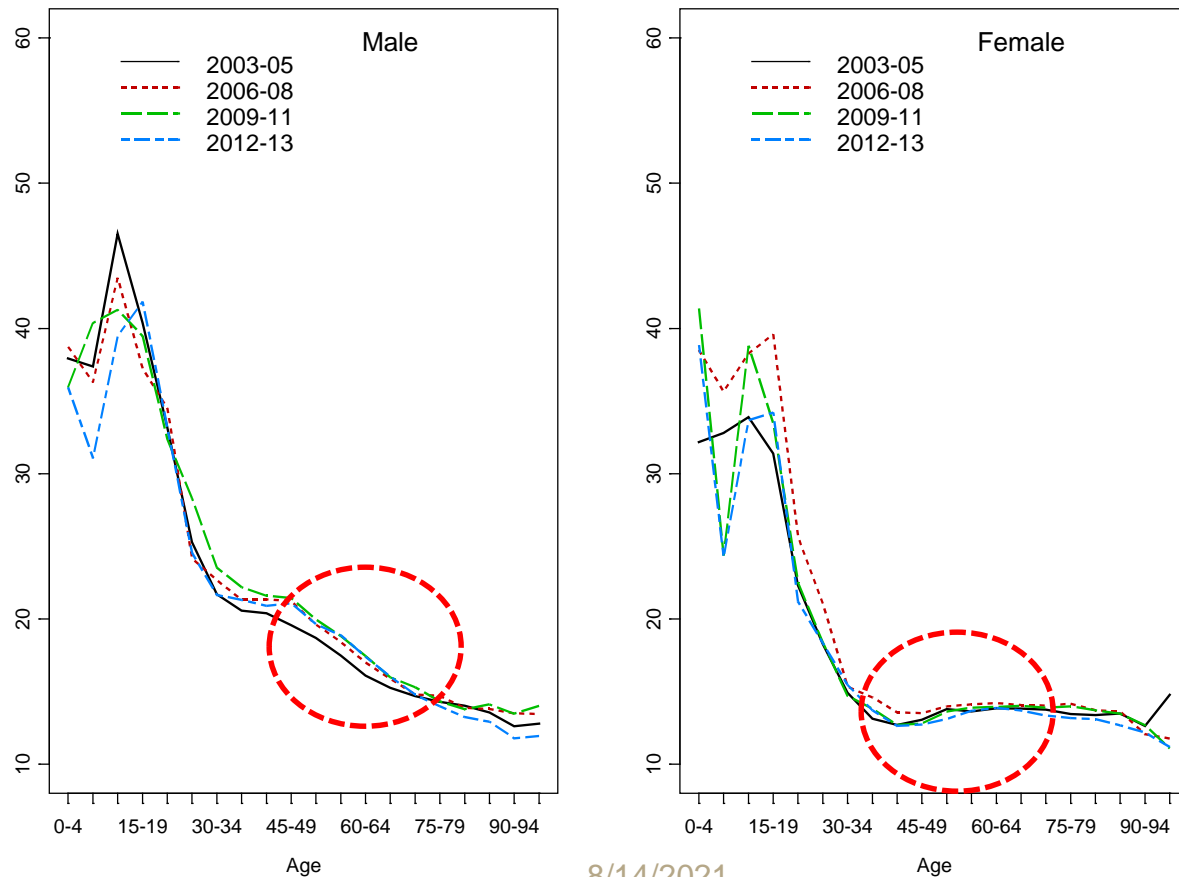
Cancer Admission Rate of Cancer Patient



Medical Utilization

- Inpatient: Average cancer Inpatient Expenditure per cancer patient
- The **male's** average cost of cancer inpatient for cancer patients **is higher than female**
- Compared with outpatient, **there is no significant increase in cancer inpatient expenses year by year**

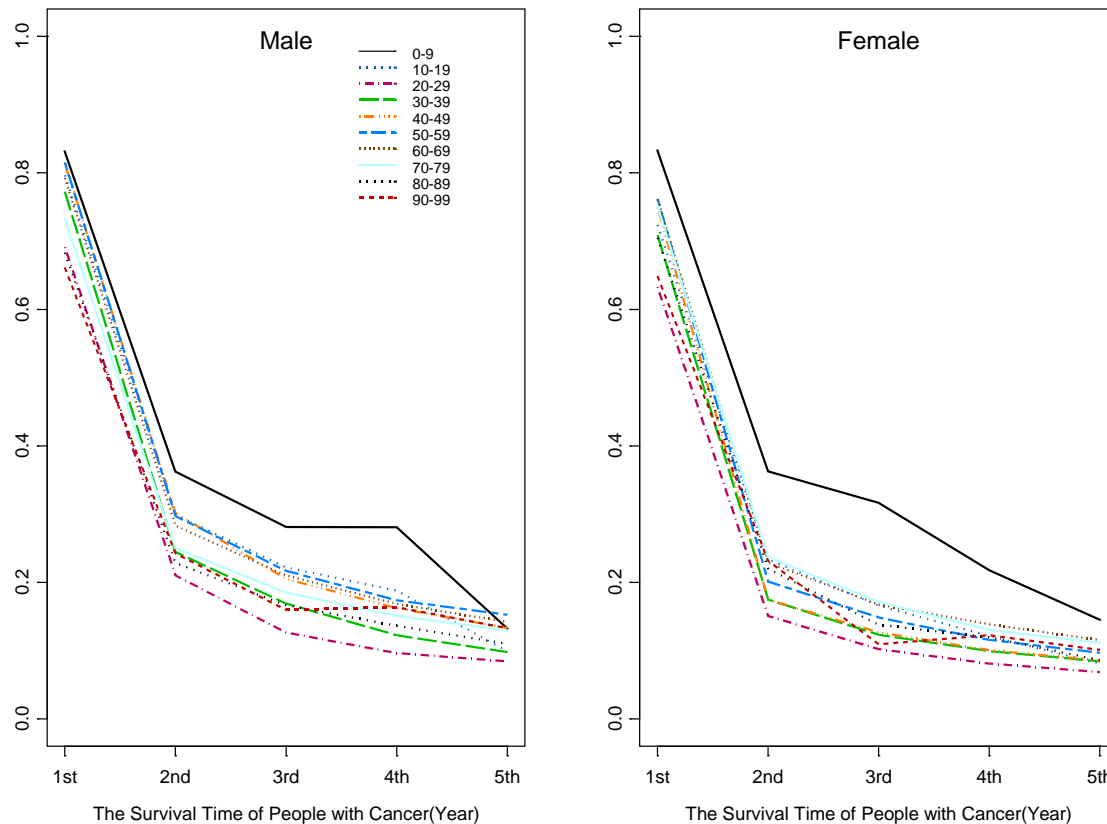
Average Cancer Inpatient Expenditure per Cancer Patient (Unit: 10,000)



Medical Utilization

- Inpatient: Cancer Admission Rate of Cancer Patient
- The inpatient rate for **the first year** of cancer falls between **60%-80%**, and it was **significantly higher than that of other years**
- The cancer inpatient rate after the second year is about **10%-20%**

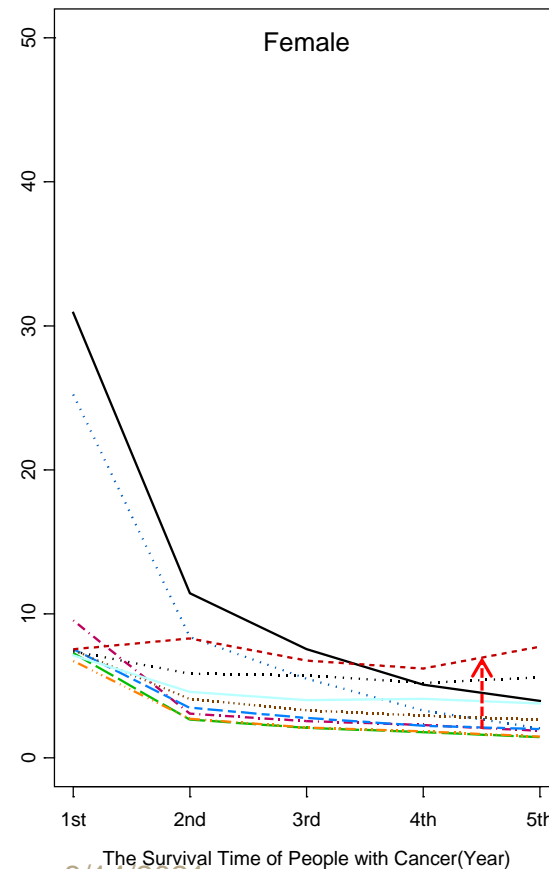
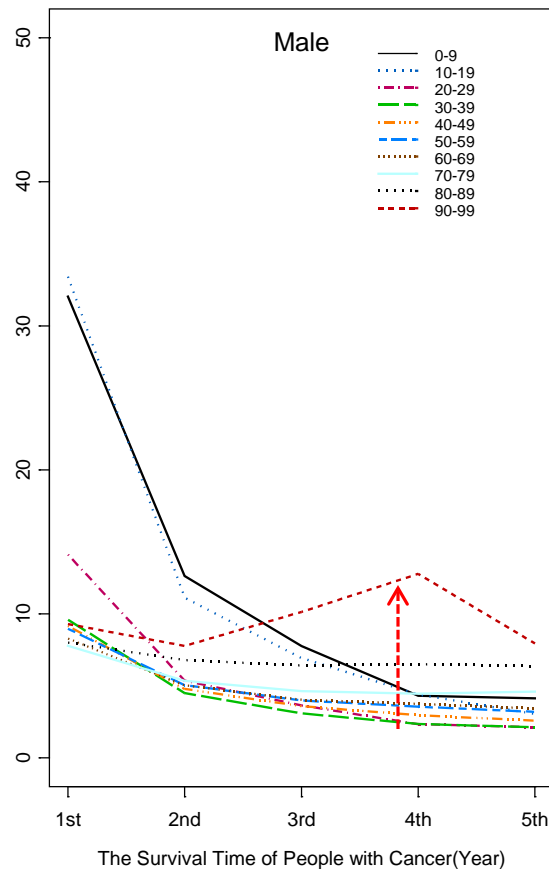
Cancer Admission Rate of Cancer Patient(2003-08)



Medical Utilization

- Inpatient: Average non-cancer Inpatient Expenditure per cancer patient
- Generally speaking, except for age 0-9 the **older cancer patient has a higher cost of hospitalization for non-cancer illness.**

Average Non-Cancer Inpatient Expenditure per Cancer Patient(2003-08): Unit:10000

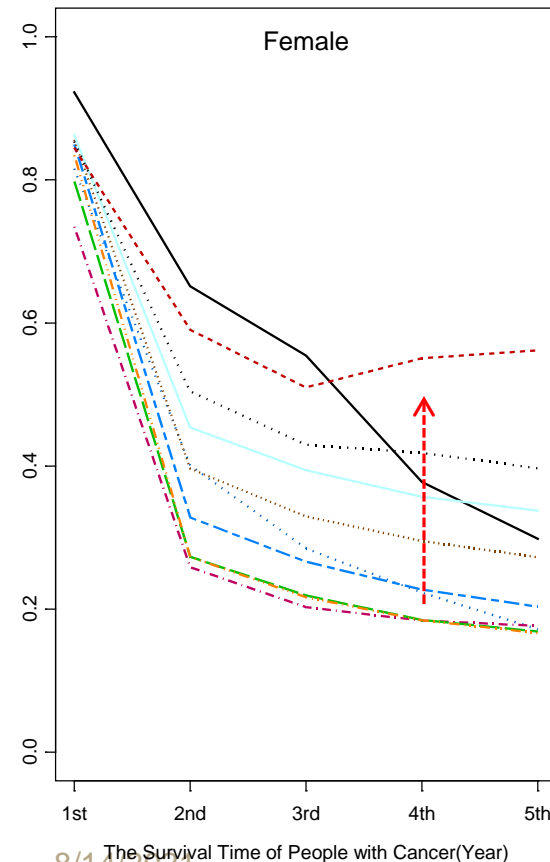
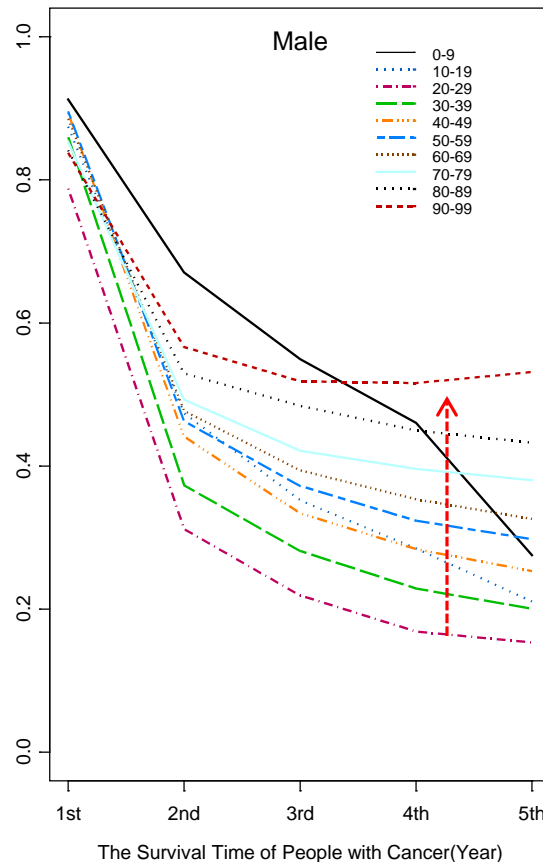


8/14/2021

Medical Utilization

- Inpatient: Admission rate of cancer patient
- The admission **includes cancer and non-cancer illness hospitalization**
- From the second survival year, the total admission rate obviously **increases with age**
- In general, the total admission rate **decreases with the survival year**.

Admission Rate of Cancer Patient(2003-08)

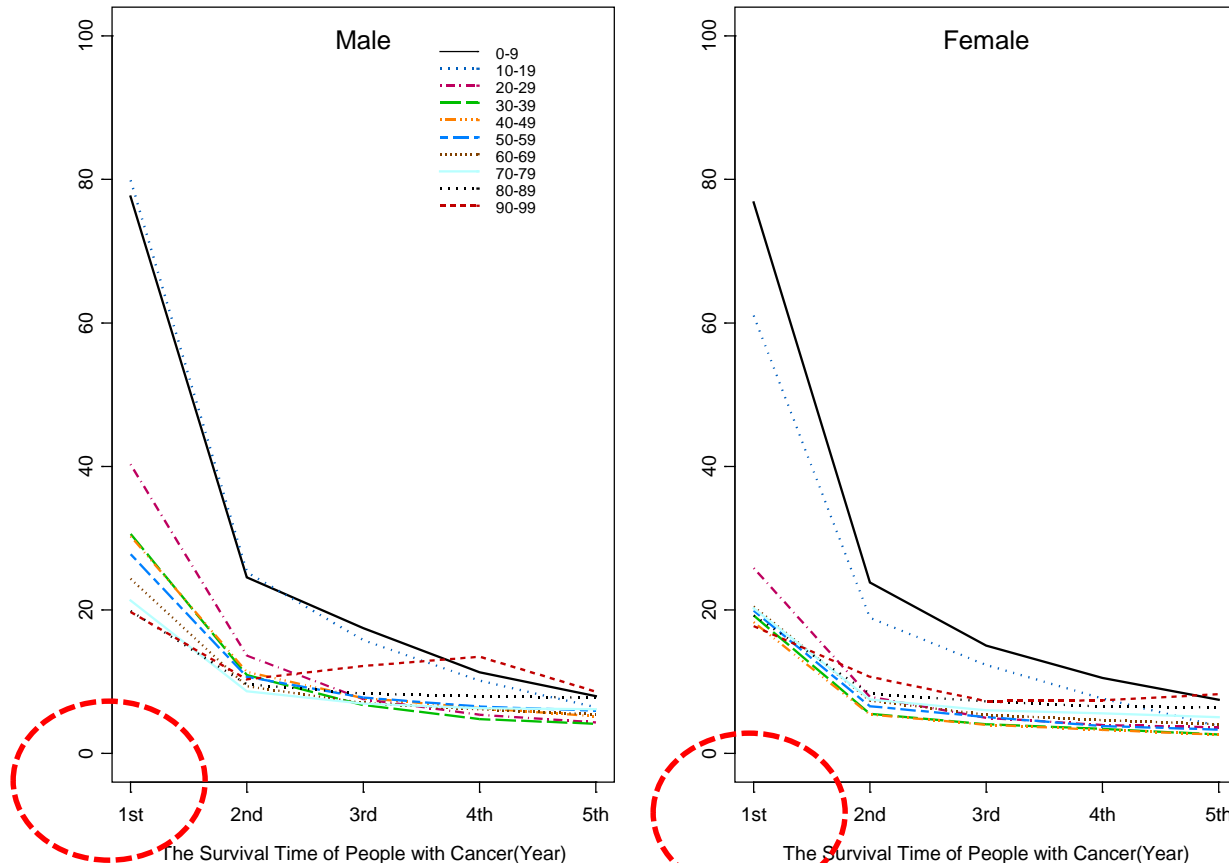


8/14/2021

Medical Utilization

- Inpatient: Average Total Inpatient Expenditure per cancer patient
- The average total Inpatient Expenditure per cancer patient is **the highest in the first survival year**, which is related to the fact that the cost of hospitalization due to cancer is concentrated in the first survival year.

Average Inpatient Expenditure per Cancer Patient(2003-08): Unit:10000

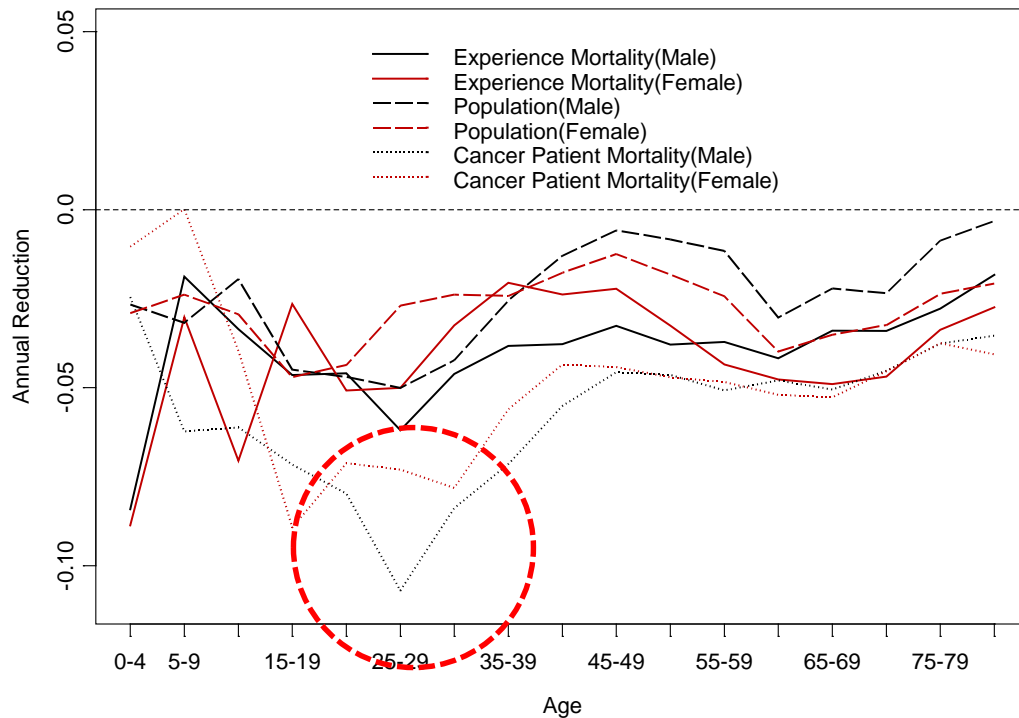


8/14/2021

Application

- We use Lee-Carter model to derive rough estimates of annual reduction/increment in mortality/incidence rates
- The changes in the mortality rates were **negative** which indicated an decreasing trend.
- Cancer patient's mortality rate has a **larger reduction** than total insurance experience mortality.
- It means Insurance companies would **add medical benefits burden and annuity**, which is similar to the longevity risk for annuity products.

2003-2013

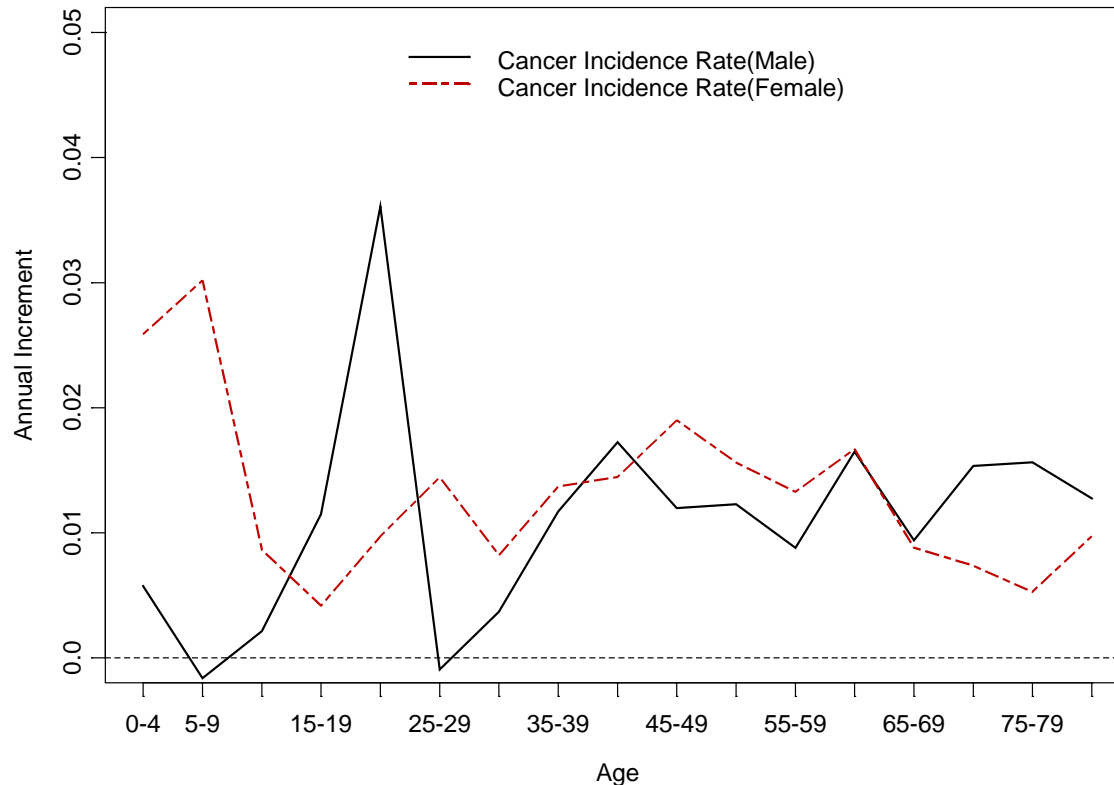


8/14/2021

Application

- The changes in the incidence rates were **positive** which indicated an **increasing** trend. It means the number of new cancer patients will continue to increase every year.
- The risk for insurers is that **the increasing cancer incidence rate should enhance the benefit paid when the insured is diagnosed with cancer.**

2003-2013



Applications

- two types of cancer products: Whole-Life and Term
- A (lump-sum) benefit is paid when the insured was diagnosed with cancer for the first time
1. The contract will be terminated after the benefit is paid.
 2. We used the years 2011-2013 as the base-line years
 3. The insured ages for the cancer insurance products were 30 to 60
 4. The interest rate was 2%.

Applications

Male: Insured Amount: \$1,000 Assumed Interest Rate: 2%:Pure Premium

Age	Whole Life			Term		
	30 Year Payment	20 Year Payment	10 Year Payment	20 Year	10 Year	5Year
30	11.62	20.80	39.43	1.70	0.91	0.64
35	12.90	22.92	43.31	2.74	1.64	1.21
40	14.30	25.16	47.34	4.15	2.71	2.13
45	15.78	27.41	51.29	6.05	4.15	3.37
50	17.33	29.57	54.99	8.47	6.04	5.04
55	18.99	31.56	58.13	11.46	8.63	7.20
60	20.85	33.33	60.51	14.90	11.92	10.34

Applications

Female: Insured Amount: \$1,000 Assumed Interest Rate: 2%: Pure Premium

Age	Whole Life			Term		
	30 Year Payment	20 Year Payment	10 Year Payment	20 Year	10 Year	5Year
30	10.13	18.22	34.58	2.16	1.27	0.93
35	11.06	19.78	37.47	3.15	2.14	1.65
40	11.94	21.22	40.06	4.23	3.28	2.69
45	12.68	22.38	42.10	5.41	4.42	3.95
50	13.21	23.09	43.29	6.60	5.45	4.96
55	13.64	23.49	43.82	7.93	6.70	6.02
60	14.03	23.59	43.67	9.47	8.13	7.48

- Term is cheaper than whole life.

Discussion and Conclusions

- Consider that the incidence rate increased slowly, the mortality rate reduce gradually and the population aging in Taiwan, **the number of cancer patients will continue to increase in the future**
- The number of Taiwan cancer patients increased **34%** from 2003 to 2011.
- Increasing incidence rate and decreasing mortality rate indicated a higher expenditure for cancer insurance, **coinciding with the increasing loss ratio for cancer insurance in recent years.**

Discussion and Conclusions

- The medical cost for cancer treatment is concentrated in **the first survival year** to insured people
- The **longevity risk** should be included in long-term health products
- There are quite a lot of possible remedies for insurance company, such as extending the waiting period, reducing the coverage for the first policy year, and coverage of the actual expenditures only.
- For insured, **one maybe choose a Term than Whole-Life.**



Thank you for your
attention.