Using the Taiwan National Health Insurance Database to Design No Claim Discount in Hospitalization

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Outline

● Motivation
● Introduction to Taiwan's National Health Insurance research databases (NHIRD)
● Data Analysis
● No Claim Bonus (Discount) in whole-life medical policies
● Conclusion
Motivation

- Living longer
  - The proportion of population aged 65 and over (or the elderly) is expected to reach 20% in 2025, a big jump from 7% in 1993.
  - Taiwan is also experiencing a huge and steady increment in life expectancy, about 15 years for the past 50 years or 0.3 year annually.

- Lower policy interest rate
  - Taiwan’s interest rate for insurance policies was around 6%~8% in the early 2000’s, comparing to 2%~3% in the recent years.
Motivation

● Current common phenomenon in Taiwan
  ➢ comparing to the economic need, the healthcare need for the elderly does not receive as much attention. --despite that the annual per capita medical expense for the elderly is about 4.6 times of the national average.
  ➢ the medical/health insurance policies only accounts for less than 10% of all commercial insurance policies in Taiwan.
  ➢ the Financial Supervisory Commission (FSC) to review the implementation of the new system, insurers have been stopped in since September 1, 2007 that sales of no claims ceiling of medical insurance.
Motivation

- Higher premium and low income (a recession occurs)?
- Reduce the burden on policyholders
- Adapt the concept of car insurance’s no claim discount (NCD) and apply it to the whole-life medical policies.
- The insured with better medical records can receive discount in premiums.
- Transfer premium discount to increase sum Insured

We use Taiwan's National Health Insurance research databases (NHIRD) to explore the no claim discount probability for the in-patient visit.
Taiwan launched a single-payer National Health Insurance program on March 1, 1995. As of 2014, 99.9% of Taiwan’s population were enrolled.

Each year, Bureau of National Health Insurance (BNHI) collects data from the National Health Insurance program and sorts it into data files, including registration files and original claim data for reimbursement. These data files are de-identified by scrambling the identification codes of both patients and medical facilities and sent to the National Health Research Institutes to form the original files of NHIRD.
The Registration files include:

1. Registry for contracted beds (BED)
2. Registry for contracted specialty services (DETA)
3. Registry for contracted medical facilities (HOSB)
4. Supplementary registry for contracted medical facilities (HOSX)
5. Registry for board-certified specialists (DOC)
6. Registry for medical personnel (PER)
7. Registry for catastrophic illness patients (HV)
8. Registry for medical services (HOX)
9. Registry for drug prescriptions (DRUG)
10. Registry for beneficiaries (ID)
The Original Claim Data include:
1. Monthly claim summary for inpatient claims (DT)
2. Monthly claim summary for ambulatory care claims (CT)
3. Inpatient expenditures by admissions (DD)
4. Details of inpatient orders (DO)
5. Ambulatory care expenditures by visits (CD)
6. Details of ambulatory care orders (OO)
7. Expenditures for prescriptions dispensed at contracted pharmacies (GD)
8. Details of prescriptions dispensed at contracted pharmacies (GO)
Based on the registration files and original claim data in NHIRD, specific data subsets are constructed for research purposes. Brief descriptions of these datasets are as follows:

1. **Registration datasets**: The registration dataset combines seven registration files, namely HOSB, HOSX, DETA, BED, PER, DOC, and HV, and two original claim data files: CT and DT.

2. **Systematic Sampling DD**: 5% of the inpatient expenditures, by admission, (DD), extracted by systematic sampling method on a monthly basis, together with the related records in details of inpatient orders (DO) form the Systematic Sampling DD.
3. **Systematic Sampling CD**: 0.2% of the ambulatory care expenditures, by visit, (CD) extracted by systematic sampling method on a monthly basis, together with the related records in details of ambulatory care orders (OO) form the Systematic Sampling CD.


5. **Longitudinal Health Insurance Database 2010 (LHID2010)**

- LHID 2005 contains all the registration and original claim data of 1,000,000 beneficiaries enrolled in year 2005 randomly sampled from the year 2005 Registry for Beneficiaries (ID) of the NHIRD.
- The registration data of everyone who was a beneficiary of the National Health Insurance program during the period of Jan. 1st 2005 to Jan. 1st, 2006 were drawn for random sampling.
- There are approximately 25.68 million individuals in this registry.
- There was no significant difference in the gender distribution ($\chi^2=0.008, df=1, p\text{-value}=0.931$) between the patients in the LHID2005 and the original NHIRD.
7. Specific subject datasets:

1) Dental dataset (DN):
   Dental original claim data, which is a sub-file in the CD data.

2) Traditional Chinese medicine dataset (CM):
   Traditional Chinese medicine original claim data, which is a sub-file in the CD data file.

3) Inpatient expenditures, by admission (DD):
   Original claim data of inpatients, by admission.

4) Registry for beneficiaries (ID)
   Registration data of all beneficiaries.
7. Specific subject datasets:

5). Cancer dataset (CN):
   Cancer patient original claim data extracted from the CD data file.

6). Injury dataset (IN)
   Injury patient original claim data extracted from the CD data file.

7). Case-payment dataset (NCP)
   Case payment coverage original claim data of patients extracted from the CD data file.

8). Diabetes dataset (DB):
   Diabetes patient original claim data extracted from the CD data file.
7. Specific subject datasets:

9). Psychiatric Inpatient Medical Claim Dataset (PIMC):
   From the inpatient expenditures by admission (DD), we selected the patients whose admitting department was psychiatric or whose diagnosis matched psychiatric. Data of these individuals in CD, DD, OO, and DO were collected to construct the PIMC dataset.

10). Catastrophic illness dataset (HV)
   Catastrophic illness patient original claim data extracted from the CD data file.

11). Occupational disease and occupational injury dataset (OC)
   Occupational disease or occupational injury patient original claim data extracted from the CD data file.
7. **Specific subject datasets:**

12). Traffic accident dataset (TR):
   Traffic accident patient original claim data extracted from the DD data file.

13). Rehabilitation therapy dataset (RH)
   Rehabilitation therapy patient original claim data extracted from the CD data file.

14). Medical center dataset (MC):
   Patient original data claimed by medical centers extracted from the CD data file.
Data Analysis

Related Medical Analysis: (Data Source)
The longitudinal health insurance database 2005 (LHID2005)-one million sample data from NHIRD covered Registry for beneficiaries (ID) and Inpatient expenditures by admissions (DD) and the observation years are from 1996 to 2011.

Define:
1. The incidence of Hospitalization = \frac{\text{Number of hospitalizations}}{\text{The number of insured}}
2. Readmission rates = \frac{\text{The number of readmission}}{\text{The number of cases discharged}}
Data Analysis

The incidence of Hospitalization:

Data Analysis

Readmission rates: Male
Data Analysis

Readmission rates: Female
So far, the design of no claim bonus (discount) in medical policy for two consecutive years no claims period probability is based on the hypothesis of independence.

But, for example: within two consecutive years, the incidence of hospitalization of a chronic patient maybe higher than a normal person.

We observed longitudinal cohort of all Patients (dependent situation) compare with that independent situation from 2005-2010 years
NCD(NCB)

- The probability of no claim event occurs within two consecutive years, three years, four years, five years and more than six years:

There are two situations within two consecutive years:

For example:

1) no claims probability of two year:

the probability of a 30 year old policyholder in the past two years the probability of no claims = the probability in claims at 27 years × the probability of no claims at 28 year × the probability of no claims at 29 year.
2) no claims probability of more than 2 years:
the probability of a 30 year old policyholder in the past two years
the probability of no claims = the probability of no claims at 28 year × the probability of no claims at 29 year.

That is:
two status for two consecutive years of no claims record:
○ means a hospitalization claim, √ means no claims
NCD(NCB)

Status 1: The probability of no claims: observed longitudinal cohort of all Patients (dependent situation)
NCD(NCB)

Status 2: The probability of no claims: observed longitudinal cohort of all Patients (dependent situation)
NCD(NCB)
Status 1: The probability of no claims: observed longitudinal cohort of all Patients (dependent vs. independent)
NCD(NCB)

Status 2: observed longitudinal cohort of all Patients (dependent vs. independent)
Application

No Claim Bonus whole-life medical policies
--increase the sum insured

• Example 1: (two cases)

20 Year Payment Fixed Daily Benefit Hospitalization policy (Daily Hospital Income Insured Amount: $1,000, Assumed Interest Rate: 2.5%)
No claim bonus : case 1

Should you file no claim in the previous year, the daily cash benefit will automatically be increased by 10%, up to a maximum of 40%.

<table>
<thead>
<tr>
<th>No Claim Within Previous Years Only</th>
<th>Bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Years Only</td>
<td>10%</td>
</tr>
<tr>
<td>3 Years Only</td>
<td>20%</td>
</tr>
<tr>
<td>4 Years Only</td>
<td>30%</td>
</tr>
<tr>
<td>5 Years Only</td>
<td>40%</td>
</tr>
</tbody>
</table>
No claim bonus : case 2

Should you file no claim within previous 2 years and above, the daily cash benefit will automatically be increased by 10%, up to a maximum of 50%.

<table>
<thead>
<tr>
<th>No Claim Within Previous X Years And Above</th>
<th>Bonus</th>
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<tbody>
<tr>
<td>No Claim Within Previous 2 Years And Above</td>
<td>10%</td>
</tr>
<tr>
<td>No Claim Within Previous 3 Years And Above</td>
<td>20%</td>
</tr>
<tr>
<td>No Claim Within Previous 4 Years And Above</td>
<td>30%</td>
</tr>
<tr>
<td>No Claim Within Previous 5 Years And Above</td>
<td>40%</td>
</tr>
<tr>
<td>No Claim Within Previous 6 Years And Above</td>
<td>50%</td>
</tr>
</tbody>
</table>
No claim bonus : case 1

Net premium for male and female in dependent case are more expensive than in independent case, respectively.

<table>
<thead>
<tr>
<th>age</th>
<th>Male (Dependent)</th>
<th>Male (Independent)</th>
<th>Female (Dependent)</th>
<th>Female (Independent)</th>
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No claim bonus : case 2

Net premium for male and female in dependent case are also expensive than in independent case, respectively.

<table>
<thead>
<tr>
<th>age</th>
<th>Male Dependent</th>
<th>Male Independent</th>
<th>Female Dependent</th>
<th>Female Independent</th>
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</thead>
<tbody>
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</table>
Application

No Claim Bonus whole-life medical policies
--increase the sum insured

- Example 2: (two cases)
  20 Year Payment reimbursement benefits Hospitalization policy (Assumed Interest Rate: 2.5%)

9/8/2015
No claim bonus : case 1

Net premium for male and female in dependent case are expensive than in independent case, respectively.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th></th>
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</table>
No claim bonus : case 2

Net premium for male and female in dependent case are also expensive than in independent case, respectively.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th></th>
<th>Female</th>
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</thead>
<tbody>
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</tbody>
</table>
Conclusion

- We found the premiums calculated under the assumption that no-claim discount events are independent are underestimated.

---20 Year Payment Fixed Daily Benefit Hospitalization policy

---20 Year Payment reimbursement benefits Hospitalization policy (except below 10 years old)

- Average whole life medical Expenditures/person is about NT$ 3 million.

- It should be noted that the longevity risk issue also applies to the medical insurance products, as well as the annuity products.
Thank you for your attention.