Using Taiwan’s National Health Insurance Database to Estimate Inpatient & Terminal Care of the Elderly

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Summary

- Prolonging Life & Medical Expenditure
- Taiwan National Health Insurance (NHI)
- Analysis of Inpatient Visits
- Analysis of Surgical Procedures
- Conclusion and Discussions
Ages 65+ Proportion in Taiwan (2018~2065 Projection)
Predicted Male Life Expectancy (2018~2065)

- South Korea: 88.4 in 2065
- Japan: 85.0 in 2065
- Taiwan: 82.0 in 2065

Year range: 2000 to 2065

Graph showing the trend of male life expectancy for South Korea, Japan, and Taiwan from 2000 to 2065.
Ageing and Prolonging Life

- **Prolonging life** and **population ageing** are common in many countries.
- Many social insurance systems are jeopardized by the increasing longevity (e.g., Medicare).
- Medical expenditure of Taiwan’s elderly is about 5 times of the national average.
- The incidence rates of catastrophic diseases (e.g., cancer) increase with age.
Taiwan’s Incidence Rate of Catastrophic Diseases

log(incidence Rate), per 100,000

Age

Male

Female

2004
2005
2006
2007
2008
2009
2010
2011
2012
Study Goal

- The study objective is on the inpatient and end-of-life needs of Taiwan’s elderly.
- We want to evaluate the impact of population ageing on Taiwan’s national health insurance system. (e.g., in-patient, outpatient, & surgeries)

Note: Not many past studies on these topics.

“Population-based incidence rate of inpatient and outpatient Surgical” (Omling et al., 2018)
Incidence Rates of Surgical Procedures (Sweden 2006-13)

Source: Population-based incidence rate of inpatient and outpatient Surgical (2018)
Taiwan’s National Health Insurance

- Taiwan started the national health insurance (NHI) in 1995, and more than 99% population are covered (excluding oversea workers).
- Researchers can purchase random sample from the NHI database (limit one million people).

→ We purchased two sample data sets:
  (1) 2005 million population sample,
  (2) 2005 million elderly sample.
Data Description

2005 Taiwan Population

- Elderly: 2,186,730

2005 Population Sample

- Elderly Sample: 100,399

Proportion: 4.6%

Timeline:
- 1996
- 2002
- 2005
- 2013

Diagnosis:
- ID
- CD, DD
Data Description (conti.)

2005 Taiwan Elderly
- Population: 2,186,730
- Proportion: 45.7%

2005 Elderly Sample
- Population: 998,726

Timeline:
- 1996
- 2002
- 2005
- 2013

CD, DD
Handling Big Data

- The **size** and **quality** of NHI database make data analysis difficult.

  ➔ The size of two sample data sets is more than 1TB (or 1,024GB).

- Need to rely on information technology and data scientists (e.g., IT experts).

  ➔ We have a team of statistical analyst.

  ➔ Cannot apply regular data analysis software.
Data Preparation and Cleaning

- Data cleaning is a big issue, since the health care data are from different hospitals.
  - At least 50% work of data analysis is on data preparation and cleaning.

- Data Discrepancy?
  - e.g., The death records are not complete in NHI database, and many are questionable!
3 Inpatient Visit

→ Incidence Rate
→ Average Day
→ Number of Visit
Days between Two Inpatient Visits
CDF of Days between Two Inpatient Visits

14 Days (75%)

3 Days (25%)
Days between Two Inpatient Visits

- There is a co-payment for every inpatient visit: 10% first month, 20% second month, ...
- Doctors tend to (temporarily) discharge patients at the end of first & second months.
- It makes sense to combine inpatient visits within 24 hours.
- Taiwan insurance companies combine visits within 14 days (same ICD code).
Male Inpatient Incidence Rate (Official vs. Sample)

2011 Official ▲, 2011 Sample ●, ■ (combining discharge within 1 day)
Sample Data have larger number of Inpatient Visits → Constant Trend
Incidence rates of inpatient visits are very similar for sample data & official records. Usually results of sample data are higher. Results of incidence rates, # of visits, and average days per visit are quite stable. Both data sets show similar patterns and we can combine the estimates from two data sets.
# of Male Inpatient Visits (2 data sets: 0~99 vs. 65+)

Connecting Smoothly
Female Inpatient Days (Pregnant or not, Below 30 days)

- 2006-08 w/ pregnant
- 2009-11 w/ pregnant
- 2006-08 w/o pregnant
- 2009-11 w/o pregnant
Top 3 Male Inpatient Days (Official vs. Sample)

No Obvious Time Trend
Male Age-specific Inpatient Days (2013)

Increasing Function of Age

- Respiratory
- Circulation
- Digestive
Comments on Inpatient Visits

- Results of incidence rates, # of visits and average days are stable (No Time Trend!)
  → Sample data and Official records are similar.
- All results increasing function of age, except mental illness.
  → No obvious time trend and the longevity risk is not as severe as cancer.
Annual increment/reduction of cancer data (LC Model)
Surgical Procedures

→ Inpatient Surgery
→ Outpatient Surgery
→ Surgery related Mortality
Higher Outpatient Surgical Rate, No Time Trend
Male Age-specific Outpatient Surgical Rates (2009-11)
Male Age-specific Inpatient Surgical Rates (2009-11)
Causes of Elderly’s Surgeries (2011)
Mortality Rates of Male Surgeries

Higher Inpatient Mortality Rates!
Comments on Surgical Procedures

- Results of surgical procedure rates are consistent in time and age.
  - No obvious time trend.
  - Outpatient surgical rates are higher.
  - Outpatient surgical rates increase with age.
- Inpatient surgical mortality rates are higher than those of outpatient surgeries.
Conclusions

- It takes lots of efforts to handle big data & apply them into insurance (Domain knowledge).
  - Knowledge in application fields (e.g., ICD codes) and experience accumulation in handling data are important.
- Inpatient and surgical results do not change with time.
  - The longevity still exists since the mortality rates decrease with time (not as severe).
Accumulate more data (small population issue) and be careful about the data quality. → Sensitivity analysis and survival analysis.

Incidence rates of inpatient visit are more than 20% for the elderly. → A potential market for Inpatient visits.

Big data and data scientist → Insurance companies also need experts in big data (& information technology).
Thank you for your attention!