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## BACKGROUND & OBJECTIVE

- Non-fatal myocardial infarction (MI) and ischemic stroke (IS) continue to impose a great economic burden on Taiwan's health care system; however, related data are lacking in Taiwan.
- The aim of this study was to estimate the medical costs associated with non-fatal MI and IS, including both acute and follow-up costs.

# METHODS

## Data Source

Taiwan's National Health Insurance Research Database (NHIRD) and National Death Registry from 2008 to 2017.

## Study Population

### Inclusion Criteria

1. With  $\geq 1$  inpatient primary diagnosis of MI (ICD-9-CM: 410.x; ICD-10-CM: I21.x) or IS (433.x1, 434.x1; I63.x, I64) between 2011 and 2015
2. Each patient had at least 2 years of follow-up after the first non-fatal MI or IS event

### Exclusion Criteria

1.  $< 20$  years of age at first admission of MI or IS
2. With any prior diagnosis of MI, IS or hemorrhagic stroke (using broader definition) within three years before the first admission of MI or IS between 2011 and 2015
3. Death at first MI or IS

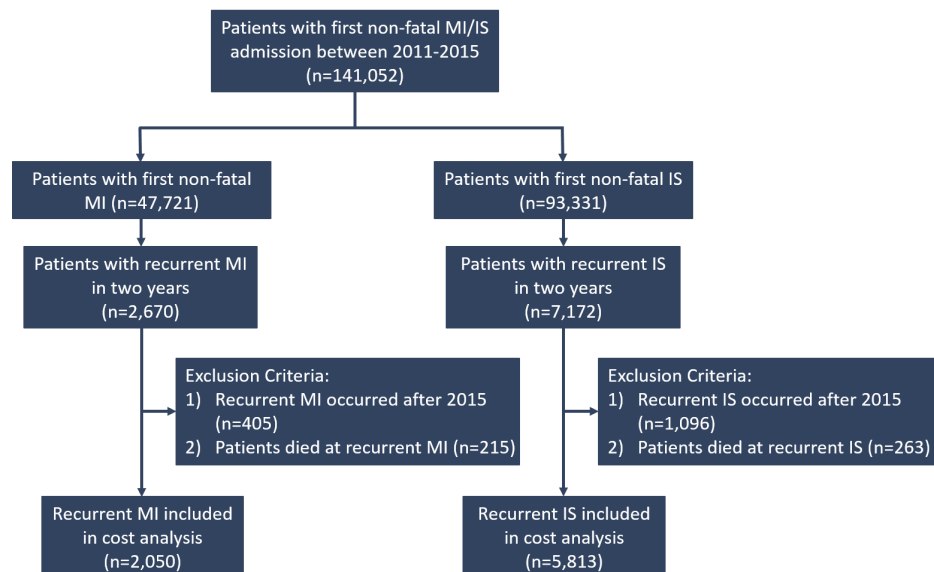
## Study Outcomes

1. **Recurrent rates of MI or IS (fatal or non-fatal):** Cumulative incidence and rate of recurrent events were estimated in the first and second year after the first non-fatal event. The recurrent MI or IS events were defined as hospitalizations with primary diagnosis of MI or IS that occurred at least 28 days after the first event admission.
  2. **Medical costs associated with non-fatal MI or IS:** Costs are presented as median (Q1-Q3) and in 2017 US dollar (\$).
- Acute event cost of non-fatal MI or IS: estimated from hospitalization costs for either first or recurrent events.
  - Total follow-up costs of non-fatal MI or IS (only for first event): estimated in the subsequent first or second year after the first non-fatal event (including inpatient, outpatient, and emergency room visit costs).
  - Incremental follow-up costs of non-fatal MI or IS (only for first event): Each subject's baseline cost was estimated in the one year before the first event. Baseline one-year cost was subtracted from the first- and second-year total follow-up costs of first event to respectively determine first- and second-year incremental follow-up costs.

## RESULTS & FIGURE 1

- A total of 47,721 patients with first MI and 93,331 with first IS were identified (Figure 1).
- The mean age was 62.8 years in patients with first MI and 76.2% were male. The mean age was 68.2 years in patients with first IS and 59.3% were male. Top 2 comorbidities were hypertension (49.2% and 53.2%, respectively) and diabetes mellitus (30.3% and 29.3%) (Table 1).
- First-year recurrent rates were 4.32 per 100 person-years for MI and 5.67 per 100 person-years for IS. Second-year recurrent rates were 1.95 per 100 person-years for MI and 3.10 per 100 person-years for IS (Table 2).
- The median acute event costs for first and recurrent MI were 4,684 and 4,288 and were both numerically higher than those for IS (1,092 and 1,151, respectively) (Table 3).
- The first-year total follow-up cost for first MI was slightly higher than that for first IS, while the second-year total follow-up cost for first MI was slightly lower than that for first IS (Table 4).
- The incremental follow-up costs in the first year and second year were \$1,466 (711-4,432) and \$696 (136-1,781) for first MI, and \$1,137 (325-3,701) and \$750 (84-2,379) for first IS, respectively (Table 4).

**Figure 1.** Flowchart of patient selection



## TABLES

**Table 1.** Baseline characteristics among patients with first MI and first IS

| Characteristics, n (%)                           | First MI<br>(n=47,721) | First IS<br>(n=93,331) |
|--------------------------------------------------|------------------------|------------------------|
| Age, mean $\pm$ SD                               | 62.8 $\pm$ 14.1        | 68.2 $\pm$ 13.3        |
| Male*                                            | 36,345 (76.2)          | 55,355 (59.3)          |
| <b>Comorbidities</b>                             |                        |                        |
| Hypertension                                     | 23,471 (49.2)          | 49,676 (53.2)          |
| Diabetes mellitus                                | 14,452 (30.3)          | 27,349 (29.3)          |
| Coronary artery disease                          | 9,910 (20.8)           | 12,271 (13.2)          |
| Peripheral artery disease                        | 681 (1.4)              | 1,213 (1.3)            |
| Congestive heart failure                         | 3,228 (6.8)            | 5,440 (5.8)            |
| Atrial fibrillation                              | 966 (2.0)              | 4,518 (4.8)            |
| Venous thromboembolism<br>and Pulmonary embolism | 238 (0.5)              | 494 (0.5)              |
| Liver disease                                    | 2,570 (5.4)            | 5,002 (5.4)            |
| Renal disease                                    | 5,967 (12.5)           | 7,225 (7.7)            |
| <b>Comedications</b>                             |                        |                        |
| Antihypertensive drugs                           | 29,946 (62.8)          | 63,019 (67.5)          |
| Antihyperglycemic drugs                          | 14,234 (29.8)          | 27,375 (29.3)          |
| Statins                                          | 12,216 (25.6)          | 17,600 (18.9)          |
| Other lipid-lowering drugs                       | 3,286 (6.9)            | 5,067 (5.4)            |
| Oral anticoagulants                              | 724 (1.5)              | 2,779 (3.0)            |
| Platelet aggregation inhibitors                  | 14,586 (30.6)          | 22,959 (24.6)          |
| Antiarrhythmics, class I and III                 | 2,019 (4.2)            | 4,665 (5.0)            |

\* There are 0.3% missing values in gender for first MI and 0.19% for first IS.

**Table 2.** Recurrent rate of the event in the first or second year after the first event

|                                       | First MI | First IS |
|---------------------------------------|----------|----------|
| <b>First year</b>                     |          |          |
| Patients at risk, n                   | 47,721   | 93,331   |
| Patients with recurrent event, n      | 1,889    | 4,822    |
| Cumulative incidence of recurrence, % | 3.96     | 5.17     |
| Recurrent rate, per 100 person-years  | 4.32     | 5.67     |
| <b>Second year</b>                    |          |          |
| Patients at risk, n                   | 41,511   | 79,650   |
| Patients with recurrent event, n      | 781      | 2,350    |
| Cumulative incidence of recurrence, % | 1.88     | 2.95     |
| Recurrent rate, per 100 person-years  | 1.95     | 3.10     |

## TABLES (CONTINUED)

**Table 3.** Acute hospitalization cost of first and recurrent events

| Costs, median (Q1-Q3) | First MI<br>(n=47,721)    | First IS<br>(n=93,331)  | Recurrent MI<br>(n=2,050) | Recurrent IS<br>(n=5,813) |
|-----------------------|---------------------------|-------------------------|---------------------------|---------------------------|
| Acute event cost      | \$4,684 (\$3,587-\$5,940) | \$1,092 (\$718-\$2,054) | \$4,288 (\$2,556-\$6,067) | \$1,151 (\$714-\$2,253)   |

Note: 2017 US dollar (\$); IS= ischemic stroke; MI= myocardial infarction.

**Table 4.** Total follow-up cost of first and recurrent events

| Costs, median (Q1-Q3)                  | First MI<br>(n=43,013) | First IS<br>(n=83,892) | Recurrent MI<br>(n=1,677) | Recurrent IS<br>(n=4,977) |
|----------------------------------------|------------------------|------------------------|---------------------------|---------------------------|
| Baseline one year cost                 |                        |                        |                           |                           |
| Total                                  | 625 (167-1,575)        | 657 (205-1,484)        | Not estimated             |                           |
| Inpatient                              | 0 (0-0)                | 0 (0-0)                |                           |                           |
| Outpatient                             | 514 (128-1,206)        | 541 (156-1,145)        |                           |                           |
| Emergency room                         | 0 (0-68)               | 0 (0-59)               |                           |                           |
| First year follow-up cost              |                        |                        |                           |                           |
| Total                                  | 2,404 (1,431-5,903)    | 2,151 (1,065-5,210)    | 3,401 (1,695-10,855)      | 3,645 (1,683-7,652)       |
| Inpatient                              | 0 (0-3,277)            | 0 (0-1,263)            | 391 (0-4,498)             | 417 (0-2,883)             |
| Outpatient                             | 1,651 (1,209-2,311)    | 1,507 (867-2,682)      | 1,923 (1,362-3,241)       | 1,935 (1,164-3,501))      |
| Emergency room                         | 0 (0-154)              | 0 (0-150)              | 59 (0-373)                | 42 (0-267)                |
| Second year follow-up cost             |                        |                        |                           |                           |
| Total                                  | 1,478 (810-3,377)      | 1,642 (814-3,752)      | 2,520 (1,163-8,651)       | 2,566 (1,244-5,606)       |
| Inpatient                              | 0 (0-759)              | 0 (0-645)              | 0 (0-3,211)               | 0 (0-1,606)               |
| Outpatient                             | 1,165 (704-1,911)      | 1,228 (664-2,190)      | 1,572 (862-3,038)         | 1,616 (893-2,895)         |
| Emergency room                         | 0 (0-106)              | 0 (0-108)              | 30 (0-295)                | 0 (0-223)                 |
| First year incremental follow-up cost  |                        |                        |                           |                           |
| Total                                  | 1,466 (711-4,432)      | 1,137 (325-3,701)      | Not estimated             |                           |
| Inpatient                              | 0 (0-3,025)            | 0 (0-1,001)            |                           |                           |
| Outpatient                             | 1,039 (539-1,492)      | 763 (253-1,689)        |                           |                           |
| Emergency room                         | 0 (0-97)               | 0 (0-92)               |                           |                           |
| Second year incremental follow-up cost |                        |                        |                           |                           |
| Total                                  | 696 (136-1,781)        | 750 (84-2,379)         | Not estimated             |                           |
| Inpatient                              | 0 (0-452)              | 0 (0-399)              |                           |                           |
| Outpatient                             | 557 (121-1,040)        | 548 (60-1,274)         |                           |                           |
| Emergency room                         | 0 (0-47)               | 0 (0-58)               |                           |                           |

Note: 2017 US dollar (\$); IS= ischemic stroke; MI= myocardial infarction.

## CONCLUSIONS

- The acute cost of MI was much higher than that of IS for both first and recurrent events. The total follow-up costs for the two types of events were more comparable.
- To reduce the great economic burden of non-fatal MI and IS, more efforts should be made to improve the risk factor management for secondary disease prevention.
- Future analysis would be needed to assess the impact of recent changes in reimbursement policy, such as mechanical thrombectomy, on cost estimates.

## DISCLOSURES

The study was funded by Amgen Inc.

## ABSTRACT

**OBJECTIVE:** To estimate the medical costs associated with non-fatal myocardial infarction (MI) and ischemic stroke (IS).

**METHODS:** Patients with their first MI or IS (without diagnosis for three years) that occurred between 2011 and 2015 were identified using Taiwan's National Health Insurance Research Database (2008-2017). Patients were followed for two years for recurrent events. Acute cost was estimated for both first and recurrent events. After the first event, the annual total costs (inpatient, outpatient, and emergency room visits) were compared with annual costs in the baseline prior to the first event to determine the incremental costs. Costs are presented as median (Q1-Q3) and in 2017 US dollar (\$).

**RESULTS:** A total of 47,721 patients with first MI and 93,331 with first IS were identified. First-year recurrent rates were 4.32 per 100 person-years for MI and 5.67 per 100 person-years for IS. Second-year recurrent rates were 1.95 per 100 person-years for MI and 3.10 per 100 person-years for IS. The acute event cost was \$4,684 (3,587-5,940) for first MI, \$4,288 (2,556-6,067) for recurrent MI, \$1,092 (718-2,054) for first IS, and \$1,151 (714-2,253) for recurrent IS. The total annual costs in the first year and second year were \$2,404 (1,431-5,903) and \$1,478 (810-3,377) for MI, and \$2,151 (1,065-5,210) and \$1,642 (814-3,752) for IS, respectively. The incremental costs in the first year was \$1,466 (711-4,432) for MI and \$1,137 (325-3,701) for IS.

**CONCLUSION:** Non-fatal MI and IS continue to impose a great economic burden on Taiwan's health care system, and more efforts should be made to improve the risk factor management for secondary disease prevention. The cost of MI was higher than IS for both first and recurrent events. Future analysis would be needed to assess the impact of changes in reimbursement policy, such as mechanical thrombectomy, on cost estimates.