

# Use of electronic health records to evaluate treatment pathways – a Common Data Model approach

**Tan Hui Xing<sup>1</sup>, Cynthia Sung<sup>1,2</sup>, Chahed Haroun<sup>1</sup>, Ang Pei San<sup>1</sup>, Tan Su Yin Doreen<sup>3</sup>, Dorajoo Sreemanees Raaj<sup>1</sup>, Teo Chun Hwee Desmond<sup>1</sup>**

<sup>1</sup> Vigilance & Compliance Branch, Health Products Regulation Group, Health Sciences Authority, Singapore

<sup>2</sup> Health Services and Systems Research, Duke-NUS Medical School, Singapore

<sup>3</sup> Department of Pharmacy, Khoo Teck Puat Hospital, Singapore

| <b>Presenting Author</b>        |   |
|---------------------------------|---|
| Name:                           | Tan Hui Xing (Ms)   |
| Email:                          | <a href="mailto:Tan_hui_xing@hsa.gov.sg">Tan_hui_xing@hsa.gov.sg</a> ; <a href="mailto:tan.huixing@gmail.com">tan.huixing@gmail.com</a> |
| Presentation type (select one): | Poster  |
| <b>Corresponding Author</b>     |   |
| Name:                           | Desmond Teo Chun Hwee (Mr)  |
| Email:                          | <a href="mailto:Desmond_teo@hsa.gov.sg">Desmond_teo@hsa.gov.sg</a> ; <a href="mailto:desteo.ch@gmail.com">desteo.ch@gmail.com</a>       |

## **Abstract**

**Methods:** We transformed data from a tertiary acute care hospital in Singapore to the common data model (CDM) developed by the Observational Medical Outcomes Partnership (OMOP), and applied a federated query on the transformed data to uncover pharmacological treatment patterns of patients newly diagnosed with diabetes mellitus, hypertension or depression.

**Results:** Data of roughly 250,000 patients from January 2013 to December 2016, comprising approximately 1.1 million rows of diagnoses, 5.2 million rows of ordered medications and 15.5 million lab records, were converted into the OMOP-CDM.

Three cohorts of patients with depression (n=251), hypertension (n=3,175) and diabetes mellitus (n=1,006) were identified. Metformin was the most common first-line medication prescribed for diabetes mellitus (53.5%), while the distribution of first-line agents was more proportionate for hypertension and depression, with mirtazapine (37.1%) and fluvoxamine (19.1%) for depression, and amlodipine (22.1%) for hypertension.

**Conclusion:** There is considerable heterogeneity in treatment patterns for hypertension and depression, whereas for diabetes, metformin is the most common first-line agent. The CDM provides regulators with valuable insights on real world drug utilization patterns, and adherence to recommended treatment guidelines.

## **Introduction**

Electronic medical records offer a potentially rich resource to uncover drug utilization patterns, and evaluate adherence to recommended treatment guidelines. This study demonstrates the use of a common data model (CDM) to harmonise electronic medical records (EMR) to investigate the pharmacological treatment patterns of patients newly diagnosed with diabetes, hypertension or depression.

## **Objectives**

The objectives of the study were to:

- (1) Transform data from an acute hospital in Singapore to the common data model (CDM) developed by the Observational Medical Outcomes Partnership (OMOP)
- (2) Apply analytical tools on the data to uncover the pharmacological treatment patterns of patients newly diagnosed with diabetes mellitus, hypertension or depression.

## **Methodology**

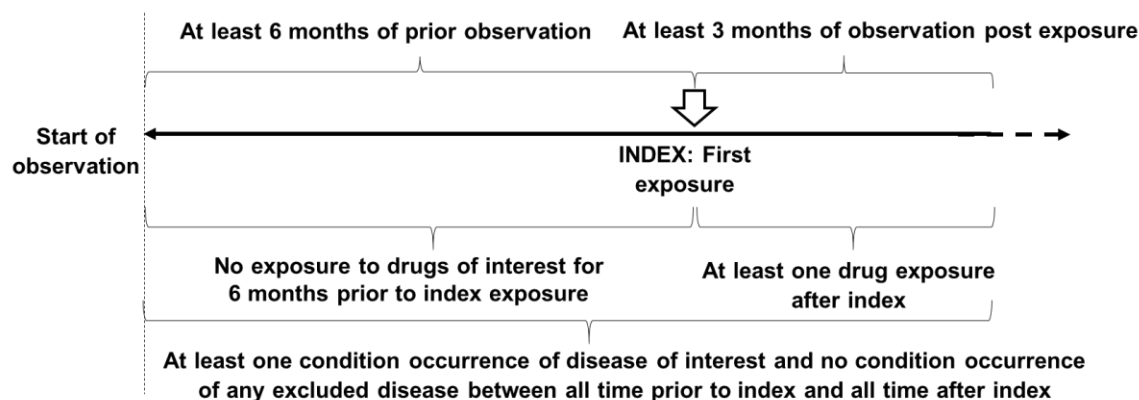
### **Conversion of source data files to the OMOP CDM:**

The data of ~250,000 patients who had visited a tertiary care hospital in Singapore from January 2013 to December 2016 were mapped onto the CDM schema, through a series of Extract, Transform, Load processes written in SQL. The data contained 1.1 million rows of diagnoses, 5.2 million rows of ordered medications and 15.5 million lab records.

### **Federated query on the transformed data:**

A series of criteria were developed for the federated query. We only included patients whom had no exposure to the drugs of interest for at least six months prior to index exposure of that drug. These patients must also have had at least one condition occurrence of the disease of interest and no condition occurrence of any excluded diseases. We then followed the patients for at least three months post drug exposure, and they should have had at least one drug exposure within the first three months. This criteria is outlined in Figure 1. The drugs, diseases and conditions of interest are highlighted in Table 1.

This query returned the sequences of drug exposure in patients newly diagnosed with diabetes, depression or hypertension. Treatment pathway comparisons were made using sunburst diagrams.



**Figure 1.** Selection criteria for inclusion into study

**Table 1.** Diseases of interest, excluded diseases and drugs used in each cohort

| Cohort       | Disease of interest   | Excluded disease   | Drug classes included   |
|--------------|-----------------------|--|---|
| Diabetes     | Diabetes mellitus     | Findings related to pregnancy                                    | Insulins, biguanides, sulfonylureas, DPP4 inhibitors*, alpha-glucosidase inhibitors, SGLT2 inhibitors^  |
| Hypertension | Hypertensive disorder | Findings related to pregnancy                                    | Antihypertensives, diuretics, peripheral vasodilators, beta blockers, calcium channel blockers, agents acting on the renin-angiotensin-aldosterone system |
| Depression   | Depressive disorder   | Findings related to pregnancy, bipolar I disorder, schizophrenia | Antidepressants   |

## Results

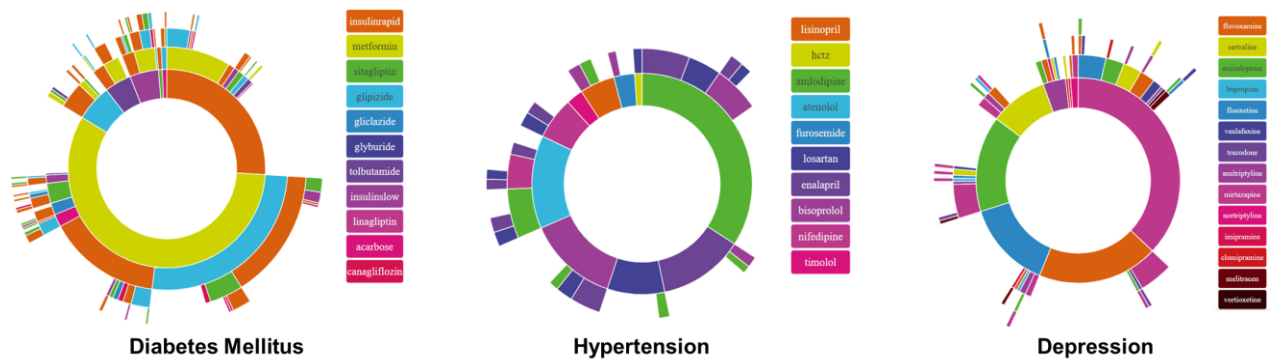
Three cohorts of patients with depression (n=251), hypertension (n=3,175) and diabetes mellitus (n=1,006) with their index prescriptions between 2015 and 2016 were identified. The sunburst diagrams are shown in Figure 2.

### Diabetes Mellitus:

Metformin was most often prescribed as the first medication (53.5%). Sulfonylureas were the most common second line agent used in diabetes. Interestingly, among the agents used, glipizide was the most common (used in 43.3% of all patients), followed by tolbutamide (7.1%) whereas arguably safer newer generation alternatives such as gliclazide and glimepiride were used less frequently, at 5.5 and 0.6%, respectively. Sunburst charts of the treatment pathways also revealed the relative frequencies at which subsequent agents were used as second, third or fourth line therapies.

### Hypertension and Depression:

There was a more even distribution of medication use, with mirtazapine (37.1%) and fluvoxamine (19.1%) being the more commonly used first line medications for depression, and amlodipine (22.1%) being the more commonly used first line medication for hypertension.



**Figure 2.** Sunburst diagrams depicting various treatment pathways for patients newly diagnosed with diabetes mellitus, hypertension and depression respectively (left to right)

## Conclusion

We conclude that there is considerable heterogeneity in treatment patterns for hypertension and depression, whereas for diabetes, metformin is the most common first line agent (used in 53.5% of patients). We also showed that the same query previously used in a similar study<sup>1</sup> on external data sources could be applied consistently to our dataset, demonstrating the feasibility of use of the CDM. These models provide drug regulators valuable insights on real world drug utilization patterns and adherence to recommended treatment guidelines.

## References

1. Hripcsak, G., et al. Observational Health Data Sciences and Informatics (OHDSI): Characterising treatment pathways at scale using the OHDSI network. Proc Natl Acad Sci U.S.A, 2016. 113(27):7329-36.