Challenges of Using Electronic Health Record (EHR) Data for Medication Exposure and Comparison with Claims Data

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Background
Medication exposure and duration of treatment are well defined in electronic claims data. The transition of research to electronic health records (EHRs) requires a need to assess the use of EHR in defining medication exposure and treatment duration.

Objective
To evaluate the concordance between electronic claims and EHR data in the Optum Integrated Database by assessing exposure to, and duration of, treatment with angiotensin-converting-enzyme inhibitors (ACEI) among a cohort of heart failure (HF) patients.

Data Source
Optum Integrated Database represents the overlap between the following:

Optum Research Database (ORD)
- Contains eligibility, pharmacy and medical claims data from a large US health insurer. It is geographically diverse and represents ~4% of the US population

Optum Electronic Health Records (EHR) Database
- Patient-level database that combines electronic medical record data (medical claims, prescription, and practice management data) from over 60 US hospitals and medical groups
- Information from full-text notes (clinical notes, visit summaries, letters, and reports) are extracted using a generalized natural language processing (NLP) system and organized into concepts with pertinent attributes, sentiments, and other modifiers.

Methods

Study Design and Population
- Retrospective cohort study of adult HF patients, in the Optum Integrated Database (defined by a period of overlapping enrollment in the ORD and EHR database), being treated with ACEI

Cohort Eligibility

Integrated Heart Failure (IHF) Cohort
- ≥ 18 years of age, at least 12 months recorded EHR history, and a diagnosis of HF from 01 July 2010 to 30 June 2015

Integrated ACEI (IACEI) Cohort
- Subset of patients in the IHF cohort who had a prescription for an ACEI in the EHR data during their overlapping enrollment period

Data Analysis

ACEI Exposure
- Assessed in the IHF cohort and based on the first observed prescription or dispensing of an ACEI during any overlapping enrollment period on or after IHF cohort entry date

ACEI Treatment Duration
- Defined as:
  - Treatment windows were created around each ACEI dispensing, defined as:
    - date of dispensing + days supply + 7-day grace period
  - Days supply obtained from dispensing claim in ORD
  - If a second ACEI dispensing was recorded within the first treatment window, a new treatment window was created around the second dispensing date and the treatment window extended
  - Treatment discontinuation defined as the end of overlapping treatment windows
  - Treatment duration calculated as the number of days between the first ACEI dispensing (inclusive) and the calculated end of the treatment window (Figure 1)

Results

ACEI Exposure
- 27,963 patients entered the IHF cohort. 2,209 had ACEI use in the ORD; 5,093 in the EHR; 1,328 patients in both sources. 21,989 (78.6%) patients had no ACEI use in either source. Among the remaining 5,974 with ACEI use in at least one source, 1,328 (22.2%) were found in both sources, 3,765 (63.0%) were found in EHR only, and 881 (14.7%) were observed in claims only.

Table 1. ACEI Treatment Capture Across Claims and Clinical Data in the IHF Patient Cohort, 01 July 2010 through 30 June 2015

<table>
<thead>
<tr>
<th>Time Period</th>
<th>ORD Patients</th>
<th>EHR Patients</th>
<th>All Overlap Patients</th>
<th>No ACEI Prescriptions in Clinical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Overlap</td>
<td>1,328</td>
<td>3,765</td>
<td>2,290</td>
<td>881</td>
</tr>
<tr>
<td>After HF Cohort Entry Date</td>
<td>1,328</td>
<td>3,765</td>
<td>2,290</td>
<td>881</td>
</tr>
</tbody>
</table>

Abbreviations: ACEI, angiotensin-converting-enzyme inhibitors; HF, heart failure

Table 2. Duration of First ACEI Treatment Episodes among All Patients in the IACEI Initiator Cohort, 01 July 2010 through 30 June 2015

<table>
<thead>
<tr>
<th>Days Supply</th>
<th>ORD</th>
<th>EHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition 1</td>
<td>1,624</td>
<td>98 (38 – 187)</td>
</tr>
<tr>
<td>Definition 2</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Definition 3</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Abbreviations: ORD, Optum Research Database; EHR, Electronic Health Records; IQR, interquartile range

Discussion
EHR prescription data may require additional cleaning for research use. In the Optum EHR database, duplicate mentions of prescriptions due to varying data collection processes may result in exposed overestimation. EHR and claims data may also come from different clinical sources resulting in inconsistencies. Prescription data from the EHR will be a useful resource for drug safety research, including the study of primary and secondary non-adherence, but further work is needed to understand the underlying data generating mechanisms.

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Presented at the 34th International Conference on Pharmacoepidemiology and Therapeutic Risk Management, Prague, Czech Republic; August 22-26, 2018, Abstract #3285