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 (EHR) 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
  - Calculated by creating a flag for the first observed ACEI claims dispensing and/or first observed ACEI prescription for each patient during all overlapping enrollment time
- **ACEI Treatment Duration**
  - Assessed in the IACEI cohort and calculated independently within the ORD and EHR databases
  - In the ORD:
    - 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)

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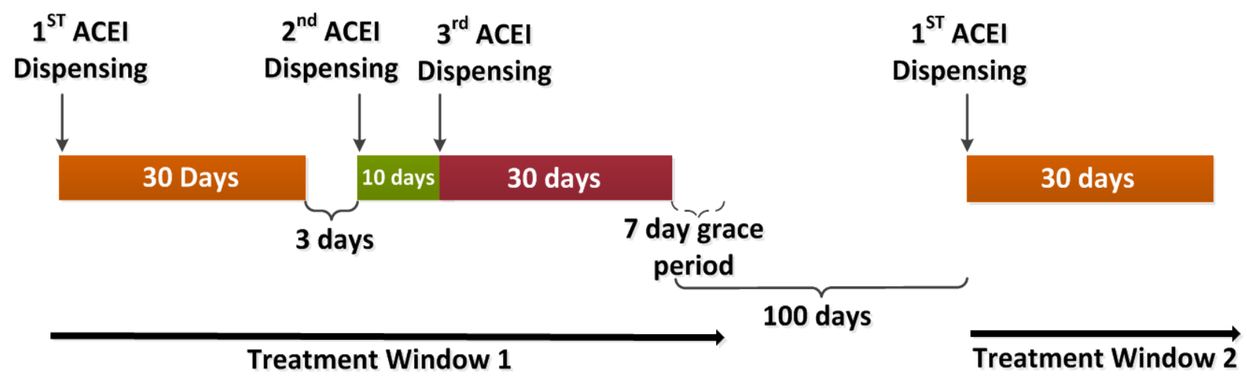
Methods (continued)

Figure 1. Calculating ACEI Treatment Windows in the ORD



- **In the EHR:**
  - Treatment windows were created around each ACEI prescription defined as:

    Prescription date + prescription supply + (0.5*days supply)
  - The total prescription supply used to calculate each treatment window was defined as:

    Days supply *(number of refills +1)
  - Days supply in the EHR is often not directly provided, but can be calculated from multiple variables. For this study, three distinct definitions of days supply were used:
    - **Definition 1:** Local days supply variable as populated in the EHR
    - **Definition 2:** Quotient of the quantity oral tablets prescribed and the dose frequency prescribed (i.e. once per day)
    - **Definition 3:** 30 days for all prescriptions

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

Time Period		ACEI Dispensing in Claims Data	No ACEI Dispensing in Claims Data
All Overlap Time after the HF Cohort Entry Date	ACEI Prescription in Clinical Data	1,328	3,765
	No ACEI Prescription in Clinical Data	881	21,989

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

	ORD		EHR	
Days Supply	Patients N = 2,290	Treatment Duration Median (IQR) (Days)	Patients N = 2,290	Treatment Duration Median (IQR) (Days)
Definition 1	1,624	98 (38 – 187)	472	220 (98.5 – 406)
Definition 2	n/a	n/a	836	226 (76 – 408.5)
Definition 3	n/a	n/a	2,290	82 (46 – 316)

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 exposure 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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