ASSESSING THE IMPACT OF THE NEW ICD-10-CM CODING SYSTEM ON PHARMACOEPIDEMIOLOGIC STUDIES: AN APPLICATION TO THE KNOWN ASSOCIATION BETWEEN ANGIOTENSIN-CONVERTING ENZYME INHIBITORS AND ANGIOEDEMA

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ABSTRACT

Purpose: To replicate the well-established association between angiotensin-converting enzyme inhibitors (ACEIs) versus beta-blockers and angioedema in the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) era.

Methods*:* We conducted a retrospective, inception cohort study in a large insurance database formatted to the Sentinel Common Data Model. We defined study periods spanning the ICD-9-CM era only, ICD-10-CM era only, and ICD-9-CM and ICD-10-CM eras, and conducted simple-forward mapping (SFM), simple-backward mapping (SBM), and forward-backward mapping (FBM) referencing the General Equivalence Mappings (GEMs) to translate the outcome (angioedema) and covariates from ICD-9-CM to ICD-10-CM. We performed propensity score (PS)-matched and PS-stratified Cox proportional hazards regression to estimate hazard ratios (HRs) and 95% confidence intervals (CIs).

Results: In the ICD-9-CM and ICD-10-CM eras spanning April 1–September 30 of 2015 and 2016, there were 152,017 and 145,232 ACEI initiators and 115,073 and 116,652 beta-blocker initiators, respectively. The PS-matched HR was 4.19 (95% CI, 2.82-6.23) in the ICD-9-CM era, 4.37 (2.92-6.52) in the ICD-10-CM era using SFM, and 4.64 (3.05-7.07) in the ICD-10-CM era using SBM and FBM. The PS-matched HRs from the mixed ICD-9-CM and ICD-10-CM eras ranged from 3.91 (2.69-5.68) to 4.35 (3.33-5.70).

Conclusion: The adjusted HRs across different diagnostic coding eras and the use of SFM versus SBM and FBM produced numerically different, but clinically similar results. Additional investigations as ICD-10-CM data accumulate are warranted.

BACKGROUND & OBJECTIVE

The U.S. Centers for Medicare and Medicaid Services (CMS) formally set October 1, 2015 as the compliance date for conversion from the International Classification of Diseases, Ninth revision, Clinical Modification (ICD-9-CM) to ICD-10 diagnostic (ICD-10-CM) and procedure (ICD-10-PCS) codes.

We previously performed descriptive analyses to assess the impact of the coding transition on changes in the incidence and prevalence of select health outcomes and found that they should be assessed on a case-by-case basis [1].

Two previous investigations in the ICD-9-CM era identified a three-fold increased risk of angioedema in patients taking angiotensin-converting enzyme inhibitors (ACEIs) relative to beta-blockers [2, 3].

Objective: We analyzed the impact of the transition from ICD-9-CM to ICD-10-CM coding on the well-established association between ACEIs and angioedema within a large electronic healthcare database to compare results across the ICD-9-CM and ICD-10-CM eras.

METHODS

Data source and population. Health plan members from the Truven Health MarketScan® Commercial Claims and Encounters and Medicare Supplemental and Coordination of Benefits Databases ≥18 years with continuous medical/drug coverage for ≥183 days were included.

Study design. We used an inception cohort design, employing a 183-day washout period to define new users of the study drug, ACEIs, and the comparator, beta-blockers. The index date was the time of the first outpatient ACEI or beta-blocker dispensing.

Exposure. We identified the first incident treatment episode of ACEIs or beta-blockers taken by the oral route and dispensed in the outpatient setting using National Drug Codes (NDCs). We ended follow-up at the earliest of the following times: 1) an angioedema event; 2) end of a 14-day extension after the last day supply of the final dispensing; 3) death; 4) 90 days after index exposure; 5) study end; or 6) dispensing of aliskiren, angiotensin receptor blockers, or alternative study drug.

Outcome. We defined an angioedema event using ICD-9-CM (995.1) and ICD-10-CM codes that appeared on an inpatient, outpatient, or emergency department claim. We used SFM, SBM, and FBM referencing the 2017 GEMs to define angioedema in the ICD-10-CM era based on the ICD-9-CM definition. Since all mapping strategies defined angioedema with a single ICD-10-CM codes, T78.3XXA, we also explored an expanded definition that included T78.3XXA, T78.3XXD, and T78.3XXS.

Analysis. We conducted PS-matched and PS-stratified analyses using the Sentinel Cohort Identification and Descriptive Analysis (CIDA) and the Propensity Score Adjustment (PSA) tools. Covariates composing the PS included those defined in previous investigations [2, 3], and we used SFM, SBM, and SBM to translate the ICD-9-CM definitions to ICD-10-CM. We used Cox proportional hazard regression models to estimate crude and adjusted hazard ratios and 95% confidence intervals.

RESULTS

Figure 1. Analytic Design

Group	2014 Apr May Jun Jul Aug Sep Oct Nov Dec	2015 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	2016 Jan Feb Mar Apr May Jun Jul Aug Sep	ICD version: Variables in washout period	ICD version: Outcome in study period	Mapping Scheme
1				9	9	---
2				10	10	SFM
3				10	10	SBM
4				10	10	FBM
5				9/10	10	SFM
6				9/10	10	SBM
7				9/10	10	FBM
8				9/10	9/10	SFM
9				9/10	9/10	SBM
10				9/10	9/10	FBM
11				10	10†	SFM
12				10	10†	SBM
13				10	10†	FBM

†Expanded definition

Figure 2. Summary of unmatched and propensity score matched analyses

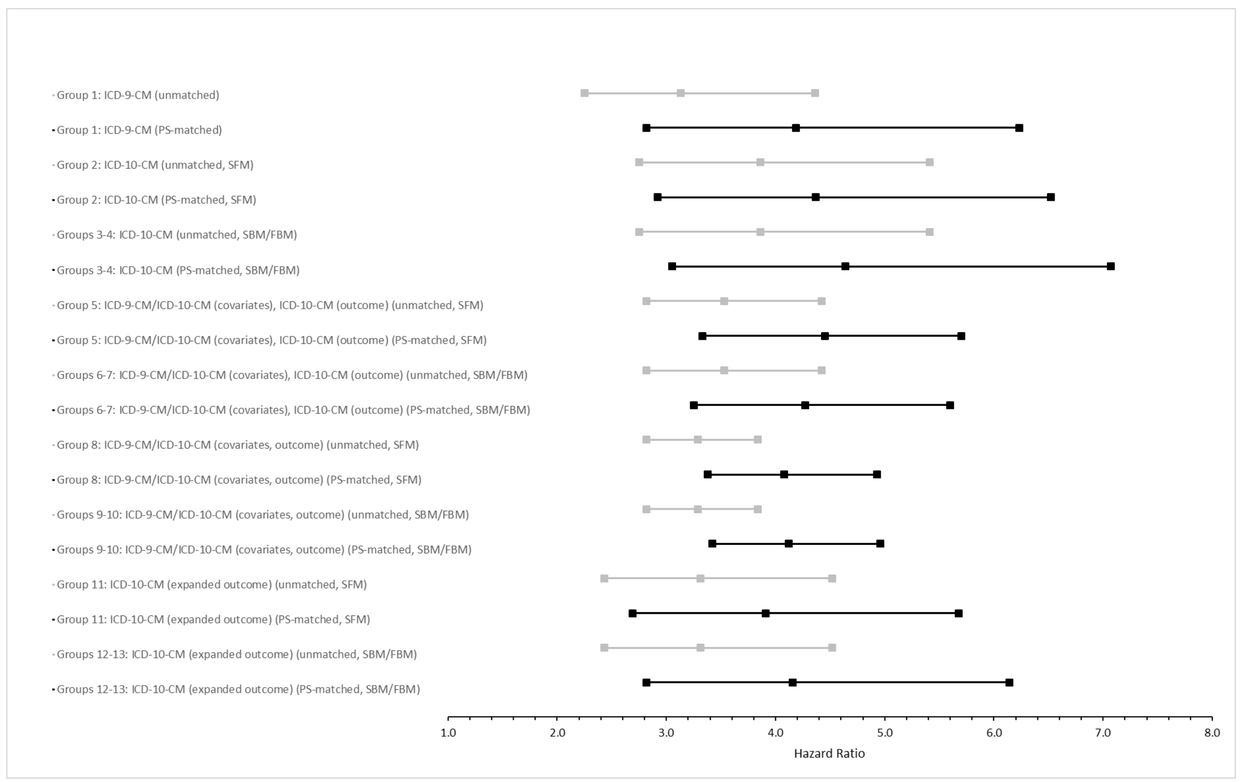
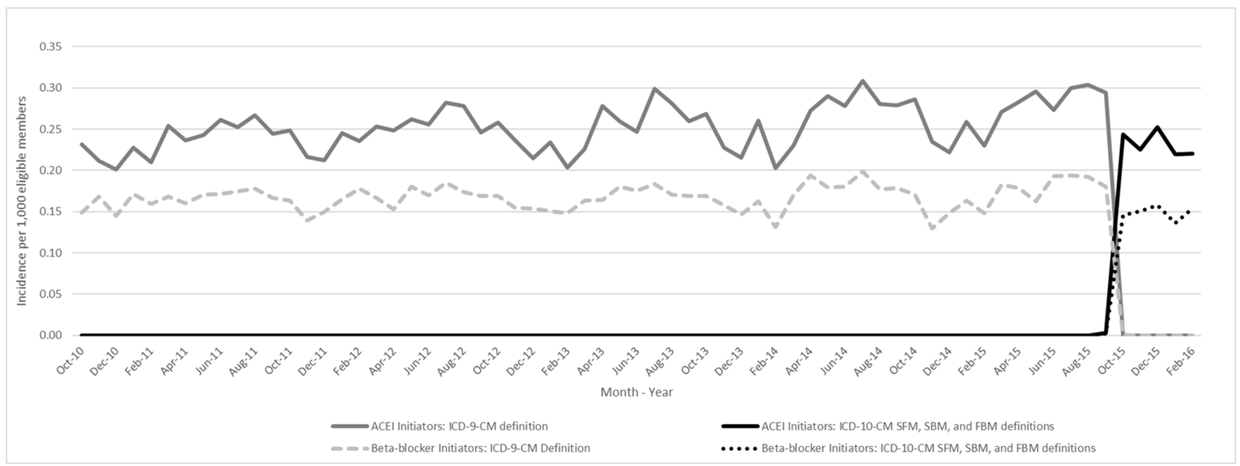


Figure 3. Incidence of angioedema among angiotensin-converting enzyme inhibitor (ACEI) versus beta-blocker initiators, October 2010- March 31, 2016



CONCLUSION

Overall, the hazard ratios and incidence rates for the various analyses that included ICD-10-CM data were comparable to the ICD-9-CM era analysis, and while numerical results were relatively sensitive to the mapping approach selected, they did not differ in a clinically meaningful fashion.

LIMITATIONS

- Results may not be generalizable to other exposure-outcome pairs.
- We explored only three mapping techniques (SFM, SBM, FBM).
- Our analyses did not formally account for factors unrelated to diagnostic coding that may have impacted the results (e.g., increase in the incidence of angioedema over time).
- The Sentinel modular program used for analysis did not permit a provider-level analysis so we did not assess if mapping strategies varied by provider.
- Results may be sensitive to changes in coding practices that occur over time.

REFERENCES

1. Panozzo CA, Welch EC, Woodworth TS, et al. Early impact of the ICD-10-CM transition on selected health outcomes on 13 electronic health care databases in the United States. Pharmacoepedmiol Drug Saf. 2018 Jun 26.

2. Toh S, Reichman ME, Houstoun M, et al. Comparative risk for angioedema associated with the use of drugs that target the renin-angiotensin-aldosterone system. Archives of internal medicine. 2012;172:1582-9.

3. Gagne JJ, Han X, Hennessy S, et al. Successful Comparison of US Food and Drug Administration Sentinel Analysis Tools to Traditional Approaches in Quantifying a Known Drug-Adverse Event Association. Clinical pharmacology and therapeutics. 2016;100:558-64.

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