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Using Electronic Health Records for Public Health Hypertension Surveillance

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Objective

To assess the equivalence of hypertension prevalence estimates between longitudinal electronic health record (EHR) data from a community-based health information exchange (HIE) and the Behavioral Risk Factor Surveillance System (BRFSS).

Introduction

Hypertension (HTN) is a highly prevalent chronic condition and strongly associated with morbidity and mortality. HTN is amenable to prevention and control through public and population health programs and policies. Therefore, public and population health programs require accurate, stable estimates of disease prevalence, and estimating HTN prevalence at the community-level is acutely important for timely detection, intervention, and effective evaluation. Current surveillance methods for HTN rely upon community-based surveys, such as the BRFSS. While BRFSS is the standard at the state- and national-level, they are expensive to collect, released once per year, and their confidence intervals are too wide for precise estimates at the local level. More timely, frequently updated, and locally precise prevalence estimates could greatly improve the timeliness and precision of public health interventions. The current study evaluated EHR data from a large, mature HIE as an alternative to community-based surveys for timely, accurate, and precise HTN prevalence estimation.

Methods

Two years (2014-2015) of EHR data were obtained from the Indiana Network for Patient Care for two major health systems in Marion County, Indiana, representing approximately 75% of the total county population (n=530,244). These data were linked and evaluated for prevalent HTN. Six HTN phenotypes were defined using structured data variables including clinical diagnoses (ICD9/10 codes), blood pressure (BP) measurements (HTN = ≥140mmhg systolic or ≥90mmHg diastolic), and dispensed HTN medications (Table 1). Phenotypes were validated using a random sample of 600 records, comparing EHR phenotype HTN to HTN as determined through manual chart review by a Registered Nurse. Each phenotype was further evaluated against BRFSS estimates for Marion County, and stratified by sex, race, and age to compare EHR-generated HTN prevalence measures to those known and in current use for chronic disease surveillance. Comparisons were made using the two one-sided statistical test (TOST) of equivalence, wherein the null hypothesis is the BRFSS and EHR prevalence estimates are different by +/-5% and the alternative is estimates differ by less than +/-5%. Rejection of the null resulted in the conclusion of equivalence of the estimates for use in population/public health.

Results

In general, the performance of the EHR phenotypes was characterized by high specificity (>87%) and low to moderate sensitivity (range 25.4%-95.3%). The false positive rate was lowest among the phenotype defining HTN by both clinical diagnosis and BP measurements (0.3%), and sensitivity was greatest for the phenotype combining all three structured data elements (95.2%). The prevalence of HTN in Marion County, Indiana (2014-2015) for the EHR sample (n=530,244) ranged between 13.7% and 36.2%, compared to 28.4% in the BRFSS sample (Table 1). Only one EHR phenotype (≥1 HTN BP measurement) demonstrated equivalence with BRFSS prevalence at the county level (difference 0.9%, 90% CI for difference -2.3%-4.0%). HTN prevalence by sex, race, age, sex and age, and sex and race (n=120 comparisons) failed to demonstrate equivalence between EHR and BRFSS measures in all but two comparisons, both among females aged 18-39 years. Differences between EHR and BRFSS HTN prevalence at the subgroup level varied but were particularly pronounced among older adults. As suspected, HTN prevalence precision was improved in the EHR sample with the largest subgroup 95% CI width of 0.7% for male African Americans compared to the BRFSS sample 95% CI width of 29.6%.

Conclusions

The applicability of the tested HTN phenotypes will vary based upon which EHR structured data elements are available to public health (i.e., ICD10, vitals, medications). We found that HTN surveillance using a community-based HIE was not a valid replacement for the BRFSS, although the HIE-based estimates could be readily generated and had much narrower confidence intervals.

Table 1. Hypertension Prevalence for EHR and BRFSS Samples in Marion County, IN 2014-2015

Phenotype	Prevalence (%)	95% Confidence Interval	%Δ (Δ90% CI)
BRFSS 2015 †	28.4	24.6-32.2	-
≥1 Clinical Diagnosis ‡	13.7	13.6-13.8	-14.7 (-17.8,-11.6)
≥1 Vitals Indicated ‡	29.3	29.1-29.4	0.9 (-2.3,4.0)*
≥2 Vitals Indicated ‡	22.4	22.3-22.5	-6.0 (-9.1,-2.9)
≥1 Clinical Diagnosis and ≥1 Vitals Indicated ‡	11.2	11.1-11.3	-17.2 (-20.3, -14.0)
≥1 Clinical Diagnosis or ≥2 Vitals Indicated ‡	25.2	25.1-25.3	-3.2 (-6.3,-0.1)
≥1 Clinical Diagnosis or ≥1 Vitals Indicated or ≥1 Medications Indicated ‡	36.2	36.1-36.4	7.8 (4.7,11.0)

Δ=Difference between BRFSS and EHR HTN prevalence;

*Difference statistically equivalent by TOST ($p<0.05$);

† n = 934;

‡ n = 530,244;

Keywords

Hypertension Surveillance; Electronic Health Record; Health Information Exchange; Community Survey; Public Health Informatics

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