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Sensitivity of Claims-Based Algorithms to Ascertain Smoking Status More Than Doubled with Meaningful Use

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ABSTRACT

Background: The “meaningful use of certified electronic health record” policy requires eligible professionals to record smoking status for more than 50% of all individuals aged 13 years or older in 2011 to 2012. **Objectives:** To explore whether the coding to document smoking behavior has increased over time and to assess the accuracy of smoking-related diagnosis and procedure codes in identifying previous and current smokers. **Methods:** We conducted an observational study with 5,423,880 enrollees from the year 2009 to 2014 in the Truven Health Analytics database. Temporal trends of smoking coding, sensitivity, specificity, positive predictive value, and negative predictive value were measured. **Results:** The rate of coding of smoking behavior improved significantly by the end of the study period. The proportion of patients in the claims data recorded as current smokers increased 2.3-fold and the proportion of patients recorded as previous smokers increased 4-fold during the 6-year period. The sensitivity of each *International Classification of Diseases,*

Ninth Revision, Clinical Modification code was generally less than 10%. The diagnosis code of tobacco use disorder (305.1X) was the most sensitive code (9.3%) for identifying smokers. The specificities of these codes and the Current Procedural Terminology codes were all more than 98%. **Conclusions:** A large improvement in the coding of current and previous smoking behavior has occurred since the inception of the meaningful use policy. Nevertheless, the use of diagnosis and procedure codes to identify smoking behavior in administrative data is still unreliable. This suggests that quality improvements toward medical coding on smoking behavior are needed to enhance the capability of claims data for smoking-related outcomes research.

Keywords: administrative data, EHR, sensitivity, smoking.

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Introduction

Mounting evidence has demonstrated the association between smoking and the incidence of many life-threatening diseases, such as lung disease, coronary heart disease, stroke, and cancer. Smoking is a leading cause of premature morbidity and mortality worldwide [1,2]. In the United States alone, estimates from the Centers for Disease Control and Prevention (CDC) showed that the smoking prevalence was 15.1% (~36.5 million individuals) in 2015 [3]. Approximately 480,000 Americans die each year because of smoking, with total annual economic costs reaching \$289 billion [1].

Given the established association between smoking and many diseases, smoking status is an important risk factor to consider in outcomes research. For population-based outcomes research using observational data to explore smoking-related health issues, administrative claims data offer the advantages of real-world representation and large sample sizes. Although claims data have increasingly been recognized as a valuable source for

outcomes research, successful applications of these data to evaluate smoking status as a risk factor hinge upon whether individuals' smoking status can be ascertained by medical codes in claims data—*International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes and Healthcare Common Procedure Coding System/Current Procedural Terminology (HCPCS/CPT) codes.

Even though there are medical codes to indicate smoking status, an important challenge is whether providers properly document this behavioral risk factor in claims because administrative claims data are generated for billing purposes. The Patient Protection and Affordable Care Act in 2010 required health professionals and hospitals to adopt the “meaningful use of certified electronic health record (EHR)” policy to qualify for incentive payments through the Centers for Medicare & Medicaid Services (CMS) EHR Incentive Programs [4,5]. To achieve the “meaningful use” objective, eligible professionals are required to record smoking status for more than 50% of all individuals aged 13 years or older in stage 1 implementation, which started in

Conflicts of interest: The authors have indicated that they have no conflicts of interest with regard to the content of this article.

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Table 1 – ICD-9-CM and CPT/HCPCS smoking behavior–related codes.

Code	Description
ICD-9-CM code	
V15.82	Personal history of tobacco use, presenting hazards to health
305.1X	Nondependent tobacco use disorder
649.0X	Tobacco use disorder complicating pregnancy, childbirth, or the puerperium
989.84	Toxic effect of tobacco
CPT/HCPCS code	
99406	Smoking and tobacco use cessation counseling visit; intermediate, greater than 3 min, up to 10 min
99407	Smoking and tobacco use cessation counseling visit; intensive, greater than 10 min
G0375	Smoking and tobacco use cessation counseling visit; intermediate, greater than 3 min, up to 10 min
G0376	Smoking and tobacco use cessation counseling visit; intensive, greater than 10 min
G0436	Smoking and tobacco cessation counseling visit for asymptomatic patients; intermediate, greater than 3 min, up to 10 min
G0437	Smoking and tobacco cessation counseling visit for asymptomatic patients; intermediate, greater than 10 min
G8402	Tobacco (smoke) use cessation intervention, counseling
G8403	Tobacco (smoke) use cessation intervention not counseled
G8453	Tobacco use cessation intervention, counseling
G8454	Tobacco use cessation intervention not counseled, reason not specified
S4990	Nicotine patches, legend
S4991	Nicotine patches, nonlegend
S4995	Smoking cessation gum
S9075	Smoking cessation treatment
S9453	Smoking cessation classes, nonphysician provider, per session
4000F	Tobacco use cessation intervention, counseling
4001F	Tobacco use cessation intervention, pharmacologic therapy

CPT, Current Procedural Terminology; HCPCS, Healthcare Common Procedure Coding System; ICD-9-CM, *International Classification of Diseases, Ninth Revision, Clinical Modification*.

2011/2012. The required documentation of smoking status was raised to more than 80% in stage 2 implementation, which began in 2014 [6]. This policy can potentially enhance the applicability of administrative claims data in smoking-related outcomes research.

Using data from a large sample of privately insured individuals, we explored whether the use of medical coding to document smoking behavior has increased over time. We also assessed the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of smoking-related diagnosis and procedure codes and determined the accuracy of these codes in identifying current and previous smokers. Ascertaining the quality of medical coding in identifying the smoking behavior of enrollees is an important step toward conducting smoking-related health services research using large administrative claims databases. The findings from our study will inform researchers of the utility of claims data in tobacco research.

Methods

Data Set

For this study, we used the MarketScan Commercial Claims & Encounters (CC&E) and MarketScan Health Risk Assessment (HRA) databases (Truven Health Analytics, Ann Arbor, MI), 2009–2014 [7]. The CC&E is an employment-based health insurance claims database; it collects claims from approximately 45 large, self-insured employers who contract with Truven Health Analytics to manage the cost and design of their health care plans, and also from small- and medium-sized firms. The HRA database provides data from the self-reported health-related survey for a subset of employees enrolled in the aforementioned health insurance plans. The database covers information on biometrics, health status, risk behaviors, and behavioral change. The risk behaviors and behavioral change sections provide

information on tobacco and alcohol use as well as any modification of these behaviors, such as quitting or reducing the consumption of tobacco and alcohol. The HRA database thus supplements health risk and behavioral information that is typically unavailable in claims databases.

Study Population

We identified 5,821,296 individuals aged 18 years and older who had been reported in both the MarketScan CC&E and HRA databases in the 6-year study period. Those with missing information on insurance type and geographic region (0.5%, $N = 27,547$) or those who were not asked to answer the questions related to smoking behavior (6.4%, $N = 369,869$) were excluded, yielding a total of 5,423,880 individuals in the final study population.

Identification of Smoking Status from Claims Data

To identify individuals as current or previous smokers from medical claims of hospital inpatient, outpatient, and physician services (Table 1), we obtained smoking status–related ICD-9-CM codes and HCPCS codes from published literature as well as the insurance policies [8–12]. Individuals with the ICD-9-CM code V15.82 (“has not used tobacco for >6 months”) were defined as previous smokers. Individuals were defined as current smokers if any subsequent ICD-9-CM codes were identified from claims: 305.1X (tobacco use disorder), 649.0X (tobacco use disorder during pregnancy), 989.84 (toxic effect of tobacco), or any of the HCPCS codes that indicate smoking cessation or tobacco use treatment (99406, 99407, G0375, G0376, G0436, G0437, G8402, G8403, G8453, G8454, S4990, S4991, S4995, S9075, S9453, 4000F, and 4001F).

Validation of Smoking Status

We validated smoking status ascertained from the aforementioned claims data–based algorithm against self-reported smoking variables on current and previous smoking behavior from the

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