Documentation of Electronic Nicotine Delivery System use in the US

Department of Veterans Affairs Electronic Health Record (2008-2014)

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Introduction

The Department of Veterans Affairs (VA) health system is the largest health system in the United States (US), and the only system with a nationwide presence, with over 1,700 healthcare facilities serving 8.7 million veterans per year\(^1\). Smoking rates among US veterans are substantially higher than in the general population, with 20.1% of veterans smoking,\(^1\) compared to 15.5% of the general US population\(^2\). The VA health system and its associated Electronic Health Record (EHR) provides a unique opportunity in the US context for investigating Electronic Nicotine Delivery System (ENDS) documentation practices using clinical data. However, the VA EHR, like other widely-used EHRs, lacks a structured data field for documenting ENDS use. Typically, ENDS documentation, if it exists at all, is recorded in narrative clinical text, and hence requires the use of text mining methods to extract relevant data. Apart from two studies focused on ENDS documentation in regional health systems in the US\(^3,4\), little is currently known regarding the frequency with which clinicians document ENDS use.

With this letter, we utilize EHR data derived from a cohort of 20,000 documented smokers in the VA system with the goal of investigating the extent to which ENDS documentation frequency has changed between 2008 and 2014.

Methods

We queried the VA Clinical Corporate Data Warehouse to create a nationally representative, randomly sampled cohort of 20,000 patients (8,806,352 clinical notes in total) from veterans who were documented smokers in all of the years 2008 to 2014. Patient ages ranged from 17 to 102 (average: 65), with women constituting only 5.2% of our sample. To identify ENDS-relevant clinical notes we used a list of 14 high precision (i.e. high positive predictive value) keywords (e.g. e cig, e-cig, ecig — see Figure 1 for a complete list) identified and verified in pilot work\(^5\) to
perform a keyword search within the patient clinical notes. High precision keywords were used due to ambiguity associated with ENDS-related keywords like, for example, “vaporizer” which in our dataset refers to nicotine use — as opposed to marijuana or medical nebulizer use — less than 20% of the time\textsuperscript{5}. We automatically determined the year-on-year (2008-2014) change in frequency of ENDS mentions at the patient level. The percentage of patients with an ENDS mention was used as the outcome variable ($n = 7$, for the 7 years), with year as the predictor variable, and modeled using a generalized linear regression model with log link (log transformation of percentage), family Gaussian, and robust standard error to account for time-series autocorrelation.

**Results**

We observed a statistically significant increase ($p < .001$) in the number of patients with at least one documented ENDS mention (0 patients in 2008, 174 patients in 2014, i.e. increasing from 0% to 0.87% of patients). In total, we observed 631 ENDS mentions from 291 unique patients, with the greatest year-on-year increase in patients occurring between 2013 and 2014 (see Figure 1). Interestingly, the percentage of patients with an ENDS mention increased exponentially, essentially doubling each year from the previous year [1.95-fold increase per year, 95%CI (1.76 2.15), $p < .001$].

**Discussion**

Our analysis revealed that patients with ENDS mentions increased in frequency significantly over time, with zero patients in 2008 and 174 patients in 2014, indicating that while clinicians are increasingly likely to document their ENDS-related discussions with patients who smoke, there remains a striking discrepancy between the frequency of patients with ENDS use documentation in the VA EHR (0.87% of patients in 2014) and the much greater prevalence — estimated to be 11.5%\textsuperscript{6} — of ENDS use among US smokers generally, suggesting that ENDS use is currently
massively under-documented by clinicians in the VA system, and that there is an acute need for the inclusion of an ENDS-related structured data field in the VA EHR.

**Figure 1**
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MC conceptualized the study and wrote the first draft. DM conducted the analysis and contributed substantially towards writing the first draft. BS performed the initial data pull and contributed substantially towards writing the first draft. WC and OP provided expertise on working with VA clinical notes and contributed to the first draft. GS provided statistical support. SZ provided expertise in the broad area of ENDS use and its relationship to tobacco use. All authors contributed to the writing and approved the final version of the manuscript.

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References


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Figure 1: Increase in Frequency of ENDS mentions by year in a cohort of 20,000 VA patients

**ENDS Keywords**

- electronic_cig
- electrical_cig
- liquid_tobacco
- ecig
- e_cig
- e_liquid
- electric_tobacco
- liquid_nicotine
- electric_cig
- electronic_tobacco
- ecigarette
- electronic_nicotine