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Use of Electronic Cigarettes Among U.S. Adults With Medical Comorbidities

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Abstract

Introduction—Electronic cigarette (e-cigarette) use is rising in the U.S. Smokers with comorbidities may increasingly use e-cigarettes if they believe e-cigarettes reduce smoking-related harm. This study examined e-cigarette use among adults with medical comorbidities.

Methods—In 2016, this study analyzed 68,136 U.S. adults in the 2014 and 2015 National Health Interview Survey. Prevalent e-cigarette use by medical comorbidities and adjusted odds of e-cigarette use were calculated.

Results—Among current cigarette smokers, ever use of e-cigarettes was more often reported by adults with one or more medical comorbidity versus those without comorbidity (18–24 years: 73.5% vs 61.4%; 25–44 years: 60.6% vs 54.3%; 45–64 years: 46.5% vs 40.3%; 65 years: 35.2% vs 19.4%; all $p < 0.05$). Current smokers aged 25–64 years with one or more comorbidity reported current e-cigarette use more often than those without comorbidity (25–44 years, 17.8% vs 14.3%, $p = 0.03$; 45–64 years, 15.9% vs 11.5%, $p = 0.02$). Current smokers with chronic obstructive pulmonary disease, asthma, and cardiovascular disease had higher odds of ever e-cigarette use versus those without comorbidity. Current smokers with asthma and cardiovascular disease had higher odds of current e-cigarette use. Former smokers with chronic obstructive pulmonary disease had higher odds of ever and current e-cigarette use and former smokers with cancer had lower odds of current e-cigarette use.

Conclusions—E-cigarette use by current and former smokers with medical comorbidities is substantial, especially among individuals with chronic lung or cardiovascular disease. Clinicians should routinely ask these patients about e-cigarette use, actively consider all pathways to help their patients quit combustible cigarettes, and recommend evidence-based treatments.

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INTRODUCTION

Electronic cigarette (e-cigarette) use has risen rapidly among U.S. adults, from 2% of all U.S. adults reporting they had ever used e-cigarettes in 2010¹ to 12.6% in 2014.^{2,3} There is growing evidence that e-cigarettes are less harmful than combustible tobacco products.⁴ Yet, many unanswered questions remain about the safety and health effects of these newly regulated devices.

More than 16 million Americans with a smoking-attributable illness continue to smoke cigarettes despite the heightened risks of ongoing use.^{5,6} If e-cigarettes prove efficacious for combustible cigarette cessation, individuals with comorbidities could experience the greatest benefit.⁷ The few existing studies that have measured e-cigarette use among adults with comorbidities reported increasing prevalence of e-cigarette use among cancer survivors^{8,9} but lower prevalence of use compared with healthy adults.¹⁰ This study examines the prevalence and patterns of e-cigarette use among U.S. adults with medical comorbidities.

METHODS

Study Population

Data were obtained from the 2014 and 2015 National Health Interview Survey (NHIS), an annual, cross-sectional, nationally representative survey. NHIS collects data from the non-institutionalized U.S. civilian population through multistage area probability sampling and computer-assisted personal household interviews.^{11–13} The adult sample included 36,697 individuals in 2014 and 33,672 individuals in 2015. The authors excluded 238 individuals missing responses for smoking, e-cigarette use, or medical comorbidity in 2014 and 1,995 individuals in 2015. The response rates were 58.9% in 2014 and 55.2% in 2015.

Measures

The NHIS first assessed e-cigarette use in 2014. E-cigarettes were defined as products that *look like regular cigarettes, but are battery powered and produce vapor instead of smoke*. Both years included the same two items to measure e-cigarette use. Ever use was defined as responding *yes* to the question: *Have you ever used an e-cigarette, even one time?* Ever users, were asked: *Do you now use e-cigarettes every day, some days, or not at all?* Those reporting *every day* or *some days* were considered current e-cigarette users. Smoking status was defined as current (every day or some days), former, and never smoker. The 2015 cancer supplement also included items about interest in quitting cigarettes and past 30-day e-cigarette use.

To measure medical comorbidity, participants were asked whether they had ever been told by a doctor or other health professional that they have hypertension, cardiovascular disease (coronary artery disease, myocardial infarction, or angina pectoris), stroke, chronic obstructive pulmonary disease (COPD), asthma, cancer, and diabetes. Participants who reported one or more of these diagnoses were defined as having a medical comorbidity.

Statistical Analysis

Data were weighted by the probability of selecting the household, the probability of selecting the respondent, and a non-response adjustment. For 2014 and 2015, national prevalence estimates and Wald 95% CIs of ever use and current use (daily or some days) of e-cigarettes were calculated by smoking status and any medical comorbidity. Percentage change in e-cigarette use from 2014 to 2015 was also calculated. Data from 2014 and 2015 were pooled to calculate the age-stratified estimated prevalence of e-cigarette use by report of any medical comorbidity and by individual medical comorbidity. Age-stratified e-cigarette use prevalence was compared by comorbidity status using two-sided *t*-tests ($p<0.05$).

The 2014 and 2015 data were also pooled for logistic regression models. Models calculated the adjusted odds of ever and current e-cigarette use by medical comorbidity stratified by smoking status. Models were adjusted for age, sex, self-reported race/ethnicity, insurance status, education, survey year, and Census region. Complete case analysis was used and missing data were rare (3%).

Analyses were conducted using Stata, version 13.1 *svy* commands to account for the complex survey design with the *subpop* statement for stratified analyses. The *lincom* function calculated the difference in e-cigarette use prevalence from 2014 to 2015. For analyses using pooled 2014 and 2015 data, the final weights were divided by 2.

RESULTS

Of 36,459 adults in 2014 and 31,677 adults in 2015, 55% were women, 42% were aged <45 years, 62% were white, 13% were black, and 17% were Hispanic. Overall, 46% of adults in 2014 and 47% in 2015 reported one or more medical comorbidity. From 2014 to 2015, ever e-cigarette use increased from 12.6% to 13.9% among all adults ($p=0.001$) (Table 1); the increase was greatest among current smokers (47.6% to 53.5%, $p<0.001$). There was no significant change in ever e-cigarette use from 2014 to 2015 among adults with any medical comorbidity (12.2% to 13.1%, $p=0.16$). Ever e-cigarette use increased among those without comorbidity (13.0% to 14.6%, $p=0.001$). There was no difference in ever or current e-cigarette use from 2014 to 2015 among adults with each of the seven comorbidities, except for a 1.2% increase (10.0% to 11.2%, $p=0.04$) in ever use among adults with hypertension. Current e-cigarette use did not change from 2014 to 2015 by comorbidity status or among former or never smokers. Current e-cigarette use decreased from 2014 to 2015 among current combustible cigarette smokers (15.9% to 13.6%, $p=0.03$). Dual use (defined as current use of both e-cigarettes and combustible cigarettes) decreased from 71.1% of current e-cigarette users in 2014 to 58.8% in 2015 ($p<0.001$). In 2015, dual users more often reported that they want to completely quit combustible cigarettes compared with current smokers not using e-cigarettes (75.9% vs 66.8%, $p<0.001$).

Ever e-cigarette use was higher among current combustible cigarette smokers with any comorbidity compared with smokers without comorbidity (18–24 years: 73.5% vs 61.4%, $p=0.03$; 25–44 years: 60.6% vs 54.3%, $p=0.003$; 45–64 years: 46.5% vs 40.3%, $p=0.004$; 65 years: 35.2% vs 19.4%, $p<0.001$) (Table 2). Current smokers aged 25–44 years ($p=0.03$)

and 45–64 years ($p=0.02$) with any comorbidity also reported current e-cigarette use more often than smokers without comorbidity (Table 3). Among former and never smokers, there were no differences in ever or current e-cigarette use by comorbidity status.

In multivariable models of current cigarette smokers, adults with COPD, asthma, and cardiovascular disease had higher odds of ever e-cigarette use compared with current smokers without comorbidity and current smokers with asthma and cardiovascular disease had higher odds of current e-cigarette use (Table 4). Among former smokers, adults with COPD had higher odds of ever and current use of e-cigarettes compared with former smokers without comorbidity and former smokers with cancer had lower odds of current e-cigarette use.

DISCUSSION

This large sample provides the first national estimates of the prevalence of e-cigarette use among U.S. adults with medical comorbidities. Current smokers with medical comorbidities use e-cigarettes at higher rates than smokers without medical comorbidities. Very few never smokers with medical comorbidities have ever used e-cigarettes, except in the youngest age groups. Current e-cigarette use among smokers declined from 2014 to 2015. However, these products are rapidly evolving and a decline in the use of currently available e-cigarettes may not predict adoption of the next generation of devices. Adjusting for sociodemographic factors, combustible cigarette smokers with asthma and cardiovascular disease are more likely to be ever and current e-cigarette users. Both current and former cigarette smokers with COPD are more likely to have ever tried e-cigarettes compared with those without medical comorbidities, and former smokers with COPD are more likely to be current users. Smokers with asthma, COPD, or cardiovascular disease probably use e-cigarettes for the same reasons as other adults: to quit cigarettes, reduce cigarette consumption, or reduce the harms from smoking.^{14,15} Smokers with these chronic diseases may feel an urgent need to quit or reduce combustible cigarette use and may be willing to try new products. Conversely, among adults with cancer, the low prevalence of e-cigarette use may be because even a reduced harm product is seen as too late to help them.¹⁶

It is unknown whether e-cigarette use is harmful to adults with asthma, COPD, or cardiovascular disease. If e-cigarette use leads to cessation of combustible cigarette use, it is likely to reduce their overall tobacco-related health risks. In the shorter term, it might improve outcomes specific to some chronic diseases, such as lung function or symptoms.^{17,18}

Limitations

This study has several limitations. All data are self-reported and subject to recall bias. Self-report of chronic diseases may produce a higher prevalence estimate than diagnostic codes or biometric data. However, the prevalence of hypertension in NHIS (34%) based on self-report is similar to prevalence in the 2013–2014 National Health and Nutrition Examination Survey (31%) based on biometric data.¹⁹ The definition of e-cigarette ever use may include individuals who have only tried e-cigarettes once and differences in prevalence of ever use are therefore of unclear importance. E-cigarettes are described as looking like cigarettes,

which may exclude users of newer tank-style devices. It is unknown how long e-cigarettes were used, if they were used daily or at all during a quit attempt, or why they were used, and inference cannot be made about the effects of e-cigarettes on tobacco cessation.

CONCLUSIONS

E-cigarette use by current and former smokers with medical comorbidities is substantial, especially among individuals with chronic lung or cardiovascular disease. Clinicians should routinely ask these patients about e-cigarette use, assessing potential risks and benefits in terms of reducing or quitting combustible cigarette use. Clinicians should actively consider all pathways to help their patients quit combustible cigarettes and recommend evidence-based treatments.

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Table 1

Prevalence of E-cigarette Use Among U.S. Adults (≥ 18 Years Old) in 2014 and 2015^a

	2014		2015		Difference	p-value
E-cigarette use	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	Population weighted % (95% CI)	
E-cigarette ever use						
Overall	36,459	12.6 (12.0, 13.2)	31,677	13.9 (13.4–14.5)	+1.3 (0.5, 2.1)	0.001
Smoking status ^b						
Current smoker	6,365	47.6 (45.5, 49.7)	5,094	53.2 (51.2, 55.2)	+5.7 (2.8, 8.5)	<0.001
Former smoker	8,272	12.3 (11.2, 13.3)	7,394	14.8 (13.7, 16.0)	+2.5 (1.1, 4.0)	0.001
Never smoker	21,822	3.2 (2.8, 3.6)	19,189	4.3 (3.8, 4.8)	+1.1 (0.4, 1.7)	0.001
Medical co-morbidities						
No medical co-morbidity ^c	18,575	13.0 (12.2, 13.7)	15,731	14.6 (13.9, 15.4)	+1.7 (0.7, 2.7)	0.001
Any medical co-morbidity	17,884	12.2 (11.2, 13.2)	15,946	13.1 (12.3, 13.8)	+0.9 (−0.4, 2.2)	0.16
E-cigarette current use ^d						
Overall	36,459	3.7 (3.4, 4.2)	31,677	3.5 (3.2, 3.8)	−0.3 (−0.8, 0.2)	0.26
Smoking status						
Current smoker	6,365	15.9 (14.2, 17.6)	5,094	13.6 (12.2, 14.9)	−2.3 (−4.5, −0.2)	0.03
Former smoker	8,272	3.8 (3.2, 4.4)	7,394	4.7 (4.0, 5.4)	+0.9 (−0.1, 1.8)	0.07
Never smoker	21,822	0.4 (0.3, 0.5)	19,189	0.6 (0.5, 0.8)	+0.2 (0.0, 0.4)	0.05
Medical co-morbidities						
No medical co-morbidity	18,575	3.4 (3.0, 3.8)	15,731	3.3 (2.9, 3.7)	−0.1 (−0.7, 0.5)	0.75
Any medical co-morbidity	17,884	4.1 (3.4, 4.9)	15,946	3.6 (3.2, 4.1)	−0.5 (−1.4, 0.4)	0.25

^a 238 adults in the 2014 adult sample (N=36,697) and 1,995 adults in the 2015 adult sample (N=33,672) were missing smoking status, e-cigarette use status, or chronic disease status.

^b Current smoker: smoked ≥ 100 cigarettes in lifetime, current daily or non-daily smoker; Former smoker: Smoked < 100 cigarettes in lifetime. Never smoker: Smoked < 100 cigarettes in lifetime.

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No self-reported hypertension, cardiovascular disease, stroke, diabetes, chronic obstructive pulmonary disease, asthma, or cancer.

^d Current e-cigarette use: current daily or non-daily user.

Data Source: CDC/NCHS, National Health Interview Survey, 2014 and 2015.

Age-Stratified Prevalence of Ever E-cigarette Use by Medical Co-morbidity (18 Years Old), N=68,136^a

Table 2

Self-reported co-morbidity	Current smoker			Former smoker			Never smoker		
	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N
18–24 years									
Overall	979	64.7 (59.3, 69.9)	357	58.5 (51.2, 65.5)	4,752	11.6 (10.3, 13.0)			
No co-morbidity ^b	693	61.4 (54.6, 67.7)	259	56.6 (48.2, 64.6)	3,812	11.1 (9.9, 12.5)			
Any co-morbidity	286	73.5 (64.9, 80.6)	98	62.4 (48.5, 74.5)	940	13.4 (10.7, 16.6)			
Asthma ^c	213	73.8 (63.6, 82.0)	66	65.0 (48.3, 78.7)	736	13.1 (10.1, 16.9)			
COPD	-- ^d	--	--	--	--	--			
Cancer	--	--	--	--	--	--			
Cardiovascular disease	--	--	--	--	--	--			
Stroke	--	--	--	--	--	--			
Hypertension	83	76.1 (63.4, 85.4)	--	--	193	15.0 (9.8, 22.4)			
Diabetes	--	--	--	--	--	--			
25–44 years									
Overall	4,431	56.4 (54.3, 58.6)	3,495	28.9 (26.8, 31.1)	14,734	4.1 (3.7, 4.7)			
No co-morbidity	2,831	54.3 (51.6, 56.9)	2,277	28.0 (25.5, 30.6)	10,989	4.0 (3.4, 4.5)			
Any co-morbidity	1,600	60.6 (57.1, 63.9)	1,218	30.5 (27.1, 34.3)	3,745	4.7 (3.8, 5.8)			
Asthma	716	63.5 (58.2, 68.5)	589	33.0 (27.6, 39.0)	1,671	5.5 (4.2, 7.3)			
COPD	88	69.1 (54.4, 80.7)	--	--	56	2.8 (0.7, 11.1)			
Cancer	175	60.4 (48.3, 71.3)	97	21.9 (11.3, 38.0)	278	3.8 (2.0, 7.2)			

Self-reported co-morbidity	Current smoker			Former smoker			Never smoker		
	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N
Cardiovascular disease	103	65.6 (51.2, 77.6)	52	9.2 (3.4, 22.6)	117	8.6 (3.3, 20.4)			
Stroke	65	67.9 (50.1, 81.6)	--	--	77	5.8 (1.6, 19.2)			
Hypertension	848	58.1 (53.2, 62.8)	637	30.4 (26.0, 35.2)	1,914	4.3 (3.2, 5.8)			
Diabetes	181	59.1 (49.4, 68.2)	99	16.9 (9.7, 27.9)	429	2.9 (1.4, 6.3)			
45–64 years									
Overall	4,531	44.0 (41.7, 46.2)	5,493	9.8 (8.8, 10.9)	12,836	1.1 (0.8, 1.4)			
No co-morbidity	1,793	40.3 (37.2, 43.5)	2,168	9.3 (7.9, 11.0)	6,165	0.9 (0.6, 1.2)			
Any co-morbidity	2,738	46.5 (43.6, 49.5)	3,325	10.1 (8.8, 11.5)	6,671	1.3 (0.9, 1.9)			
Asthma	672	52.9 (48.0, 57.8)	773	10.2 (7.7, 13.5)	1,589	1.7 (1.1, 2.6)			
COPD	602	54.4 (48.7, 60.0)	380	20.1 (15.7, 25.4)	204	1.5 (0.5, 4.2)			
Cancer	408	53.5 (44.6, 62.3)	623	9.7 (6.9, 13.3)	1,078	1.4 (0.6, 3.5)			
Cardiovascular disease	425	52.5 (45.6, 59.3)	533	11.2 (8.3, 15.0)	555	1.2 (0.6, 2.5)			
Stroke	231	46.6 (37.8, 55.6)	209	13.0 (7.8, 20.7)	331	1.6 (0.7, 3.6)			
Hypertension	1,971	43.0 (40.2, 45.8)	2,445	9.2 (7.8, 10.9)	4,803	1.3 (0.8, 2.0)			
Diabetes	620	42.2 (37.2, 47.4)	784	9.5 (7.0, 12.6)	1,587	1.4 (0.7, 2.6)			
65 years and older									
Overall	1,518	32.0 (28.6, 35.5)	6,321	2.6 (2.1, 3.2)	8,689	0.2 (0.0, 0.3)			
No co-morbidity	323	19.4 (14.1, 25.9)	1,026	2.9 (1.7, 4.7)	1,970	0.3 (0.2, 0.8)			
Any co-morbidity	1,195	35.2 (31.4, 39.1)	5,295	2.6 (2.1, 3.2)	6,719	0.1 (0.0, 0.3)			

Self-reported co-morbidity	Current smoker		Former smoker		Never smoker	
	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)
Asthma	160	45.1 (34.6, 56.0)	763	4.2 (2.6, 6.7)	913	0.2 (0.0, 0.7)
COPD	371	44.4 (37.6, 51.4)	888	6.3 (4.5, 8.7)	306	0.2 (0.0, 1.1)
Cancer	281	38.1 (31.1, 45.7)	1,698	2.1 (1.4, 3.1)	1,860	0.2 (0.0, 0.7)
Cardiovascular disease	313	36.6 (29.9, 43.8)	1,440	2.8 (1.9, 4.2)	1,288	0.2 (0.0, 1.1)
Stroke	152	36.0 (25.6, 48.0)	564	3.0 (1.8, 5.1)	587	0.0 (0.0, 0.0)
Hypertension	920	33.0 (28.8, 37.5)	4,156	2.4 (1.9, 3.1)	5,419	0.0 (0.0, 0.3)
Diabetes	299	33.8 (26.6, 41.7)	1,422	1.8 (1.1, 3.0)	1,785	0.3 (0.0, 0.7)

^aData were pooled for 2014 and 2015. 238 adults in the 2014 adult sample (N=36,697) and 1,995 adults in the 2015 adult sample (N=33,672) were missing smoking status, e-cigarette use status, or chronic disease status.

^bNo self-reported hypertension, cardiovascular disease, stroke, diabetes, COPD, asthma, or cancer.

^cIndividual medical co-morbidity categories are not exclusive.

^dEstimate was omitted; the relative SE was >30% or denominator <50.

Data Source: CDC/NCHS, National Health Interview Survey, 2014 and 2015

COPD, chronic obstructive pulmonary disease

Table 3
Age-Stratified Prevalence of Current E-cigarette Use^a by Medical Co-morbidity () 18 Years Old), N=68,136^b

Self-reported co-morbidity	Current smoker			Former smoker			Never smoker		
	N	Population weighted % (95% CI)		N	Population weighted % (95% CI)		N	Population weighted % (95% CI)	
18–24 years									
Overall	979	18.9 (14.4, 24.4)		357	14.2 (9.3, 21.2)		4,752	2.0 (1.5, 2.6)	
No co-morbidity ^c	693	16.3 (12.8, 20.5)		259	12.4 (7.6, 19.6)		3,812	1.9 (1.4, 2.6)	
Any co-morbidity	286	25.8 (14.1, 42.6)		98	17.9 (8.4, 34.3)		940	2.4 (1.3, 4.3)	
Asthma ^d	213	28.6 (14.1, 49.5)		66	18.7 (7.1, 41.0)		736	2.3 (1.1, 4.8)	
COPD	-- ^e	--		--	--		--	--	
Cancer	--	--		--	--		--	--	
Cardiovascular disease	--	--		--	--		--	--	
Stroke	--	--		--	--		--	--	
Hypertension	83	14.3 (7.2, 26.3)		--	--		193	2.4 (0.9, 6.5)	
Diabetes	--	--		--	--		--	--	
25–44 years									
Overall	4,431	15.5 (14.0, 17.1)		3,495	8.3 (7.1, 9.8)		14,734	0.5 (0.3, 0.6)	
No co-morbidity	2,831	14.3 (12.6, 16.2)		2,277	7.7 (6.3, 9.3)		10,989	0.4 (0.3, 0.6)	
Any co-morbidity	1,600	17.8 (15.3, 20.5)		1,218	9.6 (7.1, 12.8)		3,745	0.6 (0.4, 1.0)	
Asthma	716	20.0 (16.1, 24.6)		589	11.3 (7.0, 17.7)		1,671	0.5 (0.2, 1.2)	
COPD	88	11.7 (6.2, 20.8)		--	--		56	0.0 (0.0, 0.0)	
Cancer	175	13.2 (7.8, 21.6)		97	4.2 (1.5, 11.3)		278	1.1 (0.3, 4.4)	

Self-reported co-morbidity	Current smoker			Former smoker			Never smoker		
	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	
Cardiovascular disease	103	22.0 (13.5, 33.7)	52	4.9 (1.0, 20.7)	117	0.6 (0.1, 4.0)			
Stroke	65	20.4 (10.0, 37.0)	--	--	77	1.7 (0.2, 11.0)			
Hypertension	848	15.4 (12.5, 18.8)	637	9.1 (6.7, 12.2)	1,914	0.6 (0.3, 1.2)			
Diabetes	181	23.8 (16.2, 33.5)	99	0.8 (0.2, 3.0)	429	0.8 (0.2, 3.7)			
45–64 years									
Overall	4,531	14.1 (12.3, 16.1)	5,496	3.7 (3.1, 4.4)	12,836	0.1 (0.0, 0.2)			
No co-morbidity	1,793	11.5 (9.7, 13.7)	2,168	3.2 (2.3, 4.3)	6,165	0.0 (0.0, 0.0)			
Any co-morbidity	2,738	15.9 (13.2, 19.0)	3,325	4.1 (3.3, 5.0)	6,671	0.1 (0.0, 0.3)			
Asthma	672	16.5 (12.9, 20.9)	773	4.9 (3.0, 7.7)	1,589	0.2 (0.1, 0.8)			
COPD	602	16.6 (12.7, 21.4)	380	11.0 (7.6, 15.6)	204	0.4 (0.1, 2.9)			
Cancer	408	23.2 (12.8, 38.4)	623	2.8 (1.4, 5.2)	1,078	0.0 (0.0, 0.0)			
Cardiovascular disease	425	21.9 (16.1, 29.3)	533	4.0 (2.3, 7.0)	555	0.2 (0.0, 1.1)			
Stroke	231	15.5 (9.4, 24.4)	209	7.4 (3.6, 14.4)	331	0.0 (0.0, 0.0)			
Hypertension	1,971	14.1 (12.0, 16.4)	2,445	3.5 (2.7, 4.4)	4,803	0.2 (0.1, 0.4)			
Diabetes	620	14.7 (11.3, 19.0)	784	3.9 (2.4, 6.4)	1,587	0.2 (0.0, 1.1)			
65 years and older									
Overall	1,518	10.3 (8.3, 12.8)	6,322	1.0 (0.7, 1.4)	8,689	0.0 (0.0, 0.1)			
No co-morbidity	323	7.0 (3.9, 12.2)	1,026	1.2 (0.5, 3.0)	1,970	0.1 (0.0, 0.5)			
Any co-morbidity	1,195	11.2 (8.7, 14.2)	5,295	1.0 (0.7, 1.4)	6,719	0.0 (0.0, 0.0)			

Self-reported co-morbidity	Current smoker		Former smoker		Never smoker	
	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)	N	Population weighted % (95% CI)
Asthma	160	12.5 (5.8, 24.9)	763	1.3 (0.6, 2.6)	913	0.0 (0.0, 0.0)
COPD	371	15.8 (10.7, 22.7)	888	2.3 (1.3, 4.1)	306	0.0 (0.0, 0.0)
Cancer	281	10.6 (6.7, 16.4)	1,698	0.9 (0.5, 1.6)	1,860	0.0 (0.0, 0.0)
Cardiovascular disease	313	12.2 (7.3, 19.6)	1,440	1.0 (0.5, 2.0)	1,288	0.0 (0.0, 0.0)
Stroke	152	14.4 (7.0, 27.4)	564	1.3 (0.6, 2.7)	587	0.0 (0.0, 0.0)
Hypertension	920	10.6 (7.9, 14.0)	4,156	1.0 (0.7, 1.5)	5,419	0.0 (0.0, 0.0)
Diabetes	299	10.0 (5.6, 17.3)	1,422	0.5 (0.2, 1.2)	1,785	0.0 (0.0, 0.0)

^d Current e-cigarette use: current daily or non-daily user.

^b Data were pooled for 2014 and 2015. 238 adults in the 2014 adult sample (N=36,697) and 1,995 adults in the 2015 adult sample (N=33,672) were missing smoking status, e-cigarette use status, or chronic disease status.

^c No self-reported hypertension, cardiovascular disease, stroke, diabetes, COPD, asthma, or cancer.

^d Individual medical co-morbidity categories are not exclusive.

^e Estimate was omitted; the relative SE was >30% or denominator <50.

Data Source: CDC/NCHS, National Health Interview Survey, 2014 and 2015

COPD, chronic obstructive pulmonary disease

Table 4**E-cigarette Use Among Current and Former Smokers**

	Ever e-cigarette use	Current e-cigarette use
Self-reported co-morbidity	AOR ^a (95% CI)	
Current smoker (N=11,459) ^b		
No medical co-morbidity	REF	REF
Asthma	1.48 (1.25, 1.75)	1.50 (1.10, 2.15)
COPD	1.42 (1.14, 1.77)	1.04 (0.76, 1.42)
Cancer	1.15 (0.88, 1.51)	1.12 (0.63, 1.99)
Cardiovascular disease	1.31 (1.02, 1.68)	1.54 (1.10, 2.15)
Stroke	0.97 (0.72, 1.31)	0.94 (0.62, 1.43)
Hypertension	1.00 (0.88, 1.14)	0.92 (0.76, 1.13)
Diabetes	0.97 (0.81, 1.17)	1.14 (0.88, 1.46)
Former smoker (N=15,671) ^b		
No medical co-morbidity	REF	REF
Asthma	1.18 (0.95, 1.47)	1.39 (0.95, 2.03)
COPD	2.46 (1.83, 3.31)	2.75 (1.79, 4.24)
Cancer	0.79 (0.59, 1.07)	0.59 (0.36, 0.99)
Cardiovascular disease	0.88 (0.65, 1.19)	0.80 (0.47, 1.37)
Stroke	1.28 (0.82, 2.00)	1.77 (0.89, 3.49)
Hypertension	0.96 (0.81, 1.13)	0.96 (0.74, 1.23)
Diabetes	0.89 (0.67, 1.17)	0.74 (0.44, 1.24)

Note: Boldface indicates statistical significance ($p < 0.05$).

^a Adjusted for demographics (age, gender, race/ethnicity), SES (insurance, education), Census region, and year.

^b 2014 and 2015 data pooled for analysis. 3% missing data for demographic, socioeconomic or region variables.

Data Source: CDC/NCHS, National Health Interview Survey, 2014 and 2015

COPD, chronic obstructive pulmonary disease