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The Contribution of Tobacco Use to High Health Care Utilization and Medical Costs in Peripheral Artery Disease

A State-Based Cohort Analysis

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ABSTRACT

BACKGROUND Tobacco use is an important preventable cause of peripheral artery disease (PAD) and a major determinant of adverse clinical outcomes.

OBJECTIVES This study hypothesized that tobacco use by PAD patients would be associated with higher health care utilization and associated costs.

METHODS We conducted a retrospective, cross-sectional study using 2011 claims data from the largest Minnesota health plan. The total cohort included individuals with 12 months of continuous enrollment and ≥1 PAD-related claim. Tobacco cessation pharmacotherapy billing codes were queried in a subgroup with pharmacy benefits. Outcomes were total costs, annual proportion of members hospitalized, and primary discharge diagnoses.

RESULTS A PAD cohort of 22,203 was identified, comprising 1,995 (9.0%) tobacco users. A subgroup of 9,027 with pharmacy benefits included 1,158 (12.8%) tobacco users. The total cohort experienced 22,220 admissions. The pharmacy benefits subgroup experienced 8,152 admissions. Within 1 year, nearly one-half the PAD tobacco users were hospitalized, 35% higher than nonusers in the total cohort ($p < 0.001$) and 30% higher in the subgroup ($p < 0.001$). In both cohorts, users were more frequently admitted for peripheral or visceral atherosclerosis ($p < 0.001$), acute myocardial infarction ($p < 0.001$), and coronary heart disease ($p < 0.05$). Observed costs in the total cohort were $64,041 for tobacco users versus $45,918 for nonusers. Costs for tobacco users also were consistently higher for professional and facility-based care, persisting after adjustment for age, sex, comorbidities, and insurance type.

CONCLUSIONS Tobacco use in PAD is associated with substantial increases in PAD-related hospitalizations, coronary heart disease and PAD procedures, and significantly greater costs. The results suggest that immediate provision of tobacco cessation programs may be especially cost effective. (J Am Coll Cardiol 2015;66:1566–74)

Atherosclerotic lower-extremity peripheral artery disease (PAD) affects between 5% and 10% of adults in the United States (7 to 12 million people) (1–3), and has recently been shown to affect at least 202 million individuals globally (4). Atherosclerotic PAD causes major disability by decreasing functional capacity due to exercise-associated limb pain (claudication), with individuals

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experiencing high rates of depression, social isolation, and chronic pain. Tobacco use is the single most important etiological factor for the development of incident PAD (1,2,5–7).

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In individuals with PAD, ongoing tobacco use is also associated with worsened leg ischemic symptoms, a higher incidence of critical limb ischemia, early failure of all revascularization therapies, a higher risk of amputation, and higher short-term rates of nonfatal myocardial infarction (MI), stroke, and death (3,8,9). Furthermore, continuing use of tobacco is associated with poorer measures of exercise capacity during treadmill testing and earlier onset of claudication pain during walking (10–12). Tobacco users with PAD report a lower quality of life than nonusers with PAD (13).

PAD patients with a history of tobacco use but who manage to quit have far higher survival rates than those who continue using tobacco (8,9,14,15). Consistent provision of contemporary intensive tobacco cessation counseling and pharmacotherapies in individuals with PAD can greatly improve the adjudicated quit rate from 6.8% to 21.3% (16).

Among individuals with PAD who use tobacco, the high rates of short-term adverse cardiovascular ischemic events (major adverse cardiac events and major adverse limb events) suggest that the economic burden of disease among users may be of particular significance. Recent studies have estimated high overall PAD-attributable costs (17–20), but none have assessed the direct health economic contribution of smoking in this population. Estimates of tobacco-associated medical care utilization and costs within a PAD population are essential for informing allocation of scarce resources, targeting efforts toward PAD prevention, providing tobacco cessation best practices, offering focus for future PAD clinical care guidelines, and implementing cost-effective treatments. This study was designed to provide these estimates and could inform future practice-based resource allocation.

METHODS

This study was performed using data derived from a large national health plan, Blue Cross Blue Shield of Minnesota (Blue Cross). With a history of more than 75 years, Blue Cross is the largest and oldest health plan operating in Minnesota and covers 2.7 million members in the state and nationwide through its health plans or plans administered by its affiliates. A retrospective, cross-sectional study design was used.

DATA AND STUDY POPULATION. We extracted insured enrollee 2011 administrative claims data for individuals at least 40 years of age who were either commercially insured, government program enrollees, or enrolled in a Blue Cross Medicare supplemental plan. Commercially insured individuals included members of fully and self-insured health plans; public program enrollees included members in the Prepaid Medical Assistance Program (Minnesota's Medicaid managed-care program), as well as MinnesotaCare, a state-subsidized program for low-income employed persons. We excluded data from employer groups who do not allow Blue Cross to use their data for research purposes (<5%). We restricted our study population to individuals with 12 months of continuous plan enrollment to assure that clinical event and cost data collection were maximally complete. The primary study population focused on all continuous medical plan enrollees (the total PAD cohort). We also a priori identified a subpopulation with both a medical and pharmacy benefit plan (pharmacy subgroup). This pharmacy benefit subgroup ostensibly permitted more specific identification of current tobacco users via their prescribed tobacco cessation medications (e.g., varenicline, nicotine replacement therapies, and buproprion).

As in previous publications (17–20), we used International Classification of Diseases-Ninth Revision-Clinical Modification (ICD-9-CM) diagnosis and procedure codes to identify individuals with PAD in medical claims. The specific diagnosis and procedure codes for case ascertainment are shown in Online Table 1. Diagnosis codes found in the first through fifth positions on medical claims incurred in 2011 were considered positive for PAD. If any of the listed procedure codes were found in these claims, then the individual was identified as having PAD. Those individuals with lower extremity amputation codes (ICD-9: 84.xx) found in combination with diagnostic codes for cancer or trauma on the same service date (Online Table 2) were excluded, as this combination of codes is suggestive of a non-PAD–related amputation. By design, the study population included individuals with prevalent PAD (of unknown duration) and not just newly identified (incident) cases.

Patient descriptive information obtained from 2011 administrative membership files included age, sex, and geographic residence (Minnesota and border counties vs. national). The presence of comorbid conditions in 2011 (renal failure and cancer) or cardiovascular ischemic events (MI or stroke), and known risk factors for PAD (hypertension and

ABBREVIATIONS AND ACRONYMS

CCS = Clinical Classification Software

CHD = coronary heart disease

COPD = chronic obstructive pulmonary disease

ICD-9-CM = International Classification of Diseases-Ninth Revision-Clinical Modification

PAD = peripheral artery disease

diabetes) were also identified using ICD-9-CM diagnosis codes (Online Table 3).

Online Table 4 lists the administrative billing codes used to identify tobacco use as the key exposure variable. For simplicity, we use the terms "tobacco use" and "smoking" interchangeably. In the total PAD cohort, smoking was defined in medical claims using a combination of ICD-9-CM diagnosis codes and Current Procedural Terminology (CPT-4) codes (21–23). As was feasible by review of pharmacy claims, we also included National Drug Codes to assess smoking status with increased specificity in our pharmacy subgroup. Individuals were considered current or recent smokers if at least 1 of these codes was identified in these claims during the study period of interest.

OUTCOME MEASURES/ANALYSIS. The economic analysis was conducted from the health care system perspective with a primary outcome of annual total direct medical costs in 2011, including all Blue Cross expenditures, as well as other insurance and member payments (patient copayments, deductibles, and coinsurances). Total costs included facility-based care (hospital- and skilled nursing facility–billed services and procedures) as well as costs for professional care (primarily, physician-billed services). For the subset of enrollees with pharmacy benefits, we included pharmacy expenditures in the primary outcome of total costs. Other resource utilization outcomes of interest included the number of hospitalizations, the proportion of the population hospitalized, and associated primary hospital discharge diagnoses. All costs presented reflect 2011 dollars and economic results are reported in accordance with guidelines for health economic evaluations from the International Society For Pharmacoeconomics and Outcomes Research and its Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement (24). To better understand the clinical indications for hospitalizations in these PAD cohorts, we classified the associated ICD-9-CM primary diagnosis codes into mutually exclusive diagnosis categories on the basis of clinical similarity using the Clinical Classification Software (CCS). The CCS was developed and is continually updated by the Agency for Healthcare Research and Quality (25) and consists of 2 related classification systems, single- and multi-level. We used single-level classifications to descriptively compare hospital discharge diagnoses between smokers and nonsmokers with PAD.

STATISTICAL ANALYSIS. Continuous data are summarized as mean ± SD and categorical data as frequency (percentage). Patient demographics, comorbid conditions, PAD risk factors, and hospitalization episodes of care (percent hospitalized and number of hospital episodes) were compared between groups (smokers vs. nonsmokers) with Student *t* tests or chi-square tests as appropriate. Observed mean total direct medical costs and its individual components were compared using Student *t* tests and nonparametric bootstrapped confidence intervals were estimated (26).

To adjust for potential confounding by demographics and comorbid conditions, we conducted multivariable modeling. Generalized linear modeling assessed the impact of smoking status on total costs (27), and used a logarithmic link function with a gamma distribution on the basis of the modified Park test (28). The method of recycled predictions was used to assess differences in adjusted costs between smokers and nonsmokers. The mean of the estimated adjusted costs predicted for each individual in the sample of assumed nonsmokers was subtracted from the mean adjusted cost predicted for each individual in the sample of assumed smokers; this statistic is considered the adjusted cost difference attributable to smoking. Bootstrapped 95% confidence intervals (CIs) of this mean difference were calculated and differences assessed using Student *t* tests (29,30). Separate models were run for the total PAD cohort and pharmacy subgroup and for sample-specific total costs and cost components (facility-based care costs and professional service costs). To assess possible effect modification by concurrent cardiovascular disease (CVD) on cost outcomes, analyses were stratified on the basis of the presence or absence of concurrent CVD, defined as at least 1 episode of heart failure, MI, or stroke. The 2 cohorts were also stratified by sex to assess possible differences in costs and smoking-attributable cost differences in men and women.

All statistical tests were two-tailed with an alpha level of 0.05. Analyses were conducted in Stata version 13.1 (StataCorp LP, College Station, Texas). Alluvial diagrams were generated using the open-source RAW data visualization tool (DensityDesign Research Labs, Politecnico di Milano, Milan, Spain).

RESULTS

Very large PAD cohorts were identified for use in this analysis. We identified 1,995 smokers (9.0%) from a total of 22,203 Blue Cross enrollees in 2011 who met our inclusion criteria. Among the subgroup of 9,027 PAD enrollees who had complete pharmacy benefits, we identified 1,158 (12.8%) smokers. In

both the total PAD cohort and the pharmacy subgroup, smokers were younger, male, and had higher rates of MI and cancer than nonsmokers. Nonsmokers were more often hypertensive, diabetic, and experienced heart failure or renal failure (Table 1).

HOSPITALIZATIONS AND CLINICAL EVENTS. We observed a total of 22,220 hospitalizations in the total PAD cohort and 8,152 hospitalizations in the pharmacy subgroup in 2011. Table 2 provides details on these hospital events by cohort and smoking status. The hospitalization rate was higher for smokers compared with nonsmokers in both samples with 49.0% of smokers hospitalized at least once in 2011, compared to 36.4% of nonsmokers ($p < 0.001$) in the larger PAD sample. Hospitalization also was observed in 45.1% of smokers compared to 34.6% of nonsmokers ($p < 0.001$) in the pharmacy subgroup. Individuals with PAD who smoked also experienced a significantly higher annual number of hospital episodes compared with nonsmokers in the total PAD cohort, yet this difference was not found among the pharmacy subgroup. The average hospital length of stay was similar for smokers and nonsmokers who survived to hospital discharge in both cohorts.

Classification of the primary hospitalization discharge diagnoses in both cohorts showed that smokers were significantly more likely than nonsmokers to be hospitalized for peripheral or visceral atherosclerosis ($p < 0.001$), acute MI ($p < 0.001$), and coronary heart disease (CHD) ($p < 0.05$) (Figure 1).

SMOKING-ATTRIBUTABLE HEALTH COSTS. Smoking was associated with a very high differential cost compared to nonsmokers in these 2 large PAD cohorts per the 2011 data (Table 3). Observed costs were $18,123 higher for smokers versus nonsmokers (95% CI: $13,125 to $23,121) in the total PAD cohort and $11,795 (95% CI: $6,244 to $17,346) higher for smokers in the pharmacy subgroup. These differences persisted after adjustment for age, sex, comorbid conditions, insurance type, and Minnesota residence in both the total PAD cohort (adjusted cost difference of $17,673; 95% CI: $13,225 to $22,339) and the pharmacy subgroup (adjusted cost difference of $11,780; 95% CI: $7,105 to $16,538). Substantial smoking-attributable costs were also observed in analyses of cost components within both cohorts. In the total PAD cohort, expenditures for facility-based care were estimated to be $16,233 higher for smokers ($p < 0.001$) whereas mean professional costs were estimated to be $1,502 higher for smokers compared with nonsmokers ($p < 0.001$). The increased adjusted mean smoking attributable costs are likely due to more hospital encounters in smokers.

In a further analysis of cost, we stratified our 2 PAD cohorts by those with or without concurrent CVD. Costs were much higher for those with concurrent CVD, but the differences between smokers and nonsmokers were only slightly higher in the group with concurrent CVD (Online Table 5a and b). With respect to sex, stratified analyses showed that men not only incurred greater costs than women in adjusted models, but the differential cost between smokers and nonsmokers was higher in men than in women (data not shown).

TABLE 1 Population Characteristics (2011)*

	Total PAD Cohort (N = 22,203)			Pharmacy Subgroup (n = 9,027)		
	Smoker (n = 1,995)	Nonsmoker (n = 20,208)	p Value	Smoker (n = 1,158)	Nonsmoker (n = 7,869)	p Value
Age, yrs	69 ± 11	78 ± 10	<0.001	64 ± 10	76 ± 12	<0.001
Male	55.9	44.8	<0.001	56.1	44.2	<0.001
Minnesota/border residence	84.4	78.8	<0.001	94.6	91.5	0.003
Plan type			<0.001			<0.001
Commercial	37.3	23.1		58.4	58.0	
Government programs	26.6	25.1		19.5	19.6	
Medicare supplement	36.1	51.8		22.1	22.5	
Hypertension	78.0	81.7	<0.001	73.6	78.0	0.007
Diabetes	11.1	16.4	<0.001	10.9	17.5	<0.001
Myocardial infarction	44.4	39.2	<0.001	40.0	35.5	0.003
Heart failure	18.0	23.0	<0.001	14.4	22.9	<0.001
Stroke	28.2	26.0	0.028	22.3	23.2	0.48
Renal failure	15.8	21.5	<0.001	13.6	20.5	<0.001
Cancer	14.4	11.2	<0.001	12.3	9.6	0.005

Values are mean ± SD or %. *Comorbidities and risk factors defined by International Classification of Diseases, Ninth Revision, Clinical Modification administrative diagnosis and procedure codes.
PAD = peripheral artery disease.

TABLE 2 Annual Hospitalizations (2011)

	Total PAD Cohort (N = 22,203)			Pharmacy Subgroup (n = 9,027)		
	Smoker (n = 1,995)	Nonsmoker (n = 20,208)	p Value	Smoker (n = 1,158)	Nonsmoker (n = 7,869)	p Value
Percent hospitalized	49.0	36.4	<0.001	45.1	34.6	<0.001
In those with ≥1 hospitalization						
Number of hospital encounters*	1.91 (1)	1.78 (1)	0.014	1.89 (1)	1.81 (1)	0.51
LOS, days†	8.81 (5)	8.72 (5)	0.29	9.05 (5)	8.67 (5)	0.24
All patients						
Number of hospital encounters‡	0.94 (0)	0.65 (0)	<0.001	0.85 (0)	0.63 (0)	<0.001

Values are % or mean (median). *Number of hospital encounters calculated only among those who had any hospitalization. †Per hospital encounter for individuals who survived to discharge. ‡Calculated among all patients; those without a hospitalization were given a value of zero.
LOS = length of stay; PAD = peripheral artery disease.

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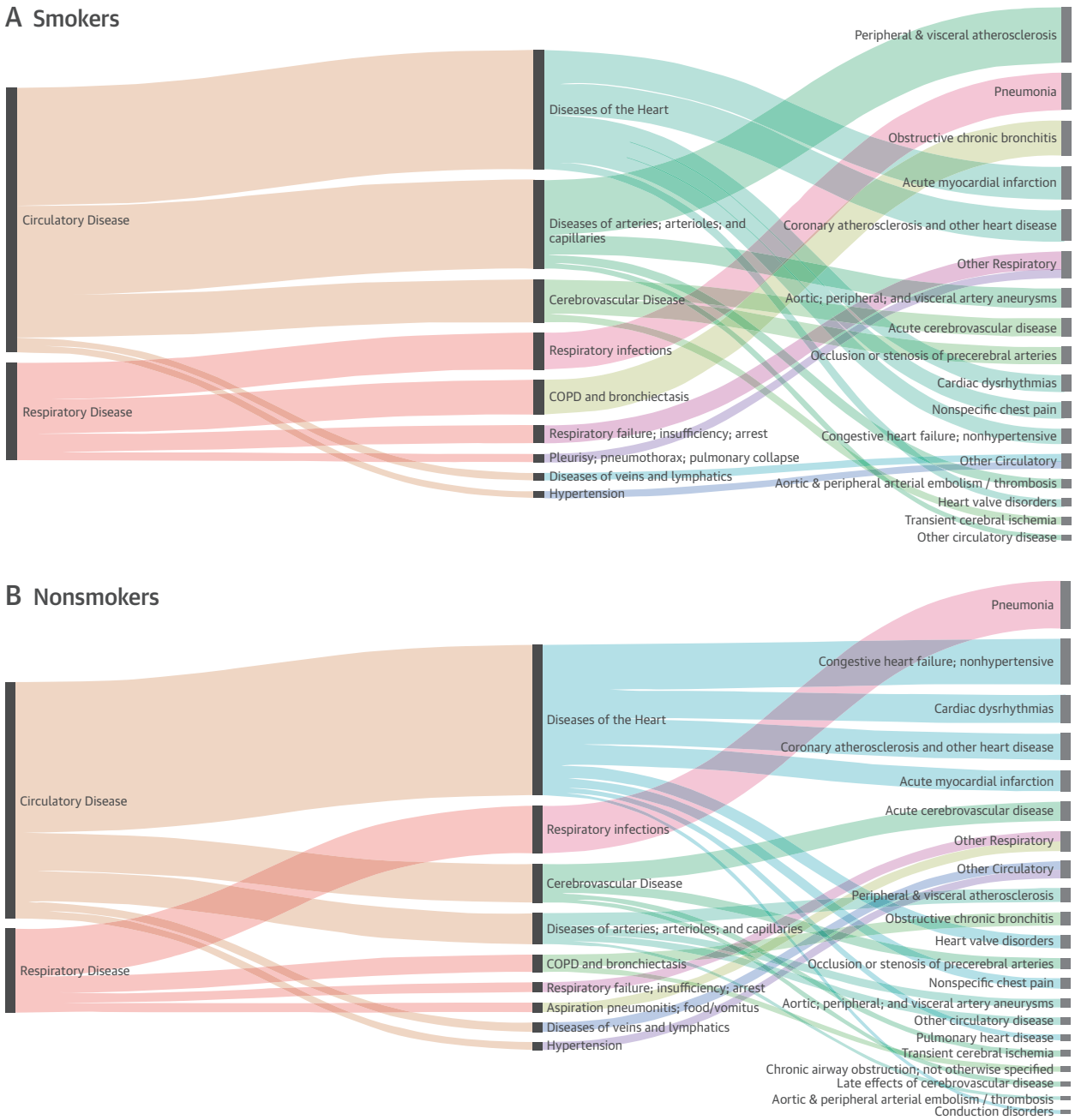
FIGURE 1 **Reasons for Hospitalization in Pharmacy Subgroup**



These alluvial plots display the broadest CCS-defined primary discharge diagnosis during hospitalization (on the left) in smokers **(A)** and nonsmokers **(B)** in the pharmacy subgroup, with 2 sequentially more specific CCS-defined discharge diagnoses in the mid-figure and to the right. The height of the **black bars** (nodes) indicates the relative proportion attributable to that condition, with discharge diagnoses ranked in descending order. COPD = chronic obstructive pulmonary disease; CCS = clinical classification software.

DISCUSSION

These data show that smoking is associated with an extremely high rate of hospitalizations and cardiovascular ischemic events and procedures in this high-risk population (**Central Illustration**). Although it has long been known that tobacco exposure exacerbates PAD-related clinical events, these are the first data to describe the impact of smoking on event rates. The contribution of tobacco use to these acute and

TABLE 3 Cost* and Cost Differences† Between Smokers and Nonsmokers (2011)

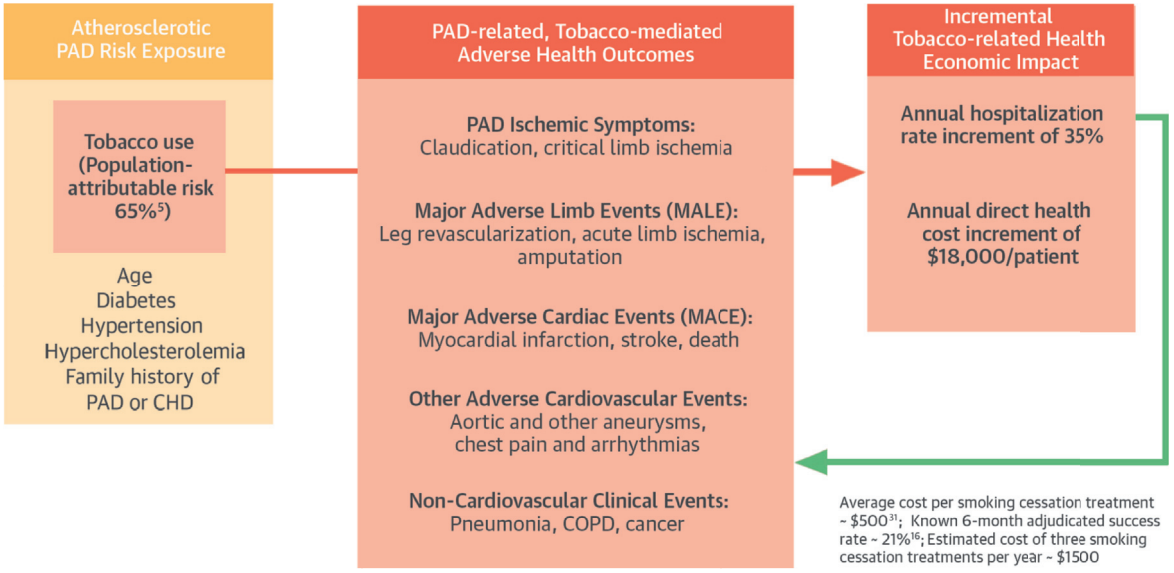
Total PAD Cohort	Smoker (n = 1,995)	Nonsmoker (n = 20,208)	Difference (Observed)‡	Difference (Adjusted)‡	p Value
Total costs	$64,041 ($59,223-$68,859)	$45,918 ($44,602-47,234)	$18,123 ($13,125-$23,121)	$17,673 ($13,225-$22,339)	<0.001
Total professional costs	$9,049 ($8,452-$9,646)	$5,757 ($5,629-$5,885)	$3,292 ($2,686-$3,899)	$1,502 ($1,000-$2,033)	<0.001
Total facility-based care costs	$54,992 ($50,413-$59,571)	$40,162 ($38,903-$41,421)	$14,830 ($9,965-$19,696)	$16,233 ($11,818-$21,008)	<0.001
Pharmacy Subgroup	**Smoker (n = 1,158)**	**Nonsmoker (n = 7,869)**	**Difference (Observed)‡**	**Difference (Adjusted)‡**	**p Value**
Total costs	$56,826 ($51,618-$62,034)	$45,031 ($42,904-$47,158)	$11,795 ($6,244-$17,346)	$11,780 ($7,105-$16,538)	<0.001
Total professional costs	$10,196 ($9,294-$11,098)	$6,647 ($6,387-$6,907)	$3,549 ($2,617-$4,483)	$1,812 ($1,043-$2,601)	<0.001
Total facility-based care costs	$44,093 ($39,267-$48,919)	$36,189 ($34,180-$38,198)	$7,904 ($2,609-$13,199)	$9,880 ($5,404-$14,708)	0.003

Values are cost (95% confidence interval). *Total costs include costs for facility-based care (hospital- and skilled nursing facility–billed services and procedures) as well as costs for professional care (primarily physician-billed services). †Cost differences are adjusted for age, sex, hypertension, diabetes, heart failure, renal failure, insurance type, and Minnesota residence. ‡Difference data are reported as cost differences between smokers and nonsmokers (95% confidence interval, generated using bootstrap [percentile method]).

Abbreviations as in Table 1.

chronic CHD and limb ischemic events is biologically direct, as tobacco use is known to accelerate atherosclerosis, increase blood thrombogenicity, and risk of plaque rupture (8). Ongoing exposure to tobacco is associated with a very high short-term (1 year) incremental cost increase of $18,000 per year in individuals with atherosclerotic lower extremity PAD. Remarkably, medical costs in PAD nonsmokers are

CENTRAL ILLUSTRATION Impact of Tobacco on PAD Clinical Events and Cost: The Price of Inaction



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Tobacco is the single most powerful modifiable cause of atherosclerotic PAD, markedly increasing the risk of CVD (MACE and MALE) and non-CVD clinical events and hospitalizations. This is associated with an immense increase in annual health care costs. Smoking cessation is effective and costs very little. CHD = coronary heart disease; COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; MACE = major adverse cardiac event(s); MALE = major adverse limb event(s); PAD = peripheral artery disease.

lower than those in smokers, despite the fact that the nonsmokers are older and have a high prevalence of diabetes, renal failure, and cancer, all of which are known to increase costs. These much higher hospitalization and clinical event rates, as well as significantly greater costs might, if better known to patients, health care professionals, and payers, immediately inform care standards (i.e., greater use of prescription of tobacco cessation interventions) and increase the priority given to smoking cessation services. Each tobacco cessation attempt is remarkably inexpensive (31).

Prior investigations of the impact of smoking in PAD patients have usually described the effect of tobacco use on outcomes in small case series or limited outcomes registries. The current study provides a more powerful contribution to the PAD knowledge base by its evaluation of the impact of smoking in a very large PAD population (not a hospital-based vascular specialty cohort) in which other key variables that might alter health outcomes could be reasonably evaluated.

These data confirm that tobacco use leads to very high short-term worsening in adverse cardiac and limb ischemic outcomes. Parallel findings have been reported for patients with chronic obstructive pulmonary disease (COPD) and the documented effect of smoking cessation intervention for COPD patients is instructive. Ongoing tobacco use negatively impacts lung function and increases hospitalization rates for individuals with COPD (32). Provision of smoking cessation interventions is associated with a profound beneficial impact on subsequent hospitalization rates, which were shown to decline by as much as 43% in a Danish cohort (33). Such data have served as the basis for emplacing tobacco cessation programs within current care systems. For example, the Minnesota Department of Health provides state-based surveillance of COPD and actively promotes tobacco cessation interventions to lower the health impact and cost of COPD within the population (34). Similar efforts could be used to lower the impact of atherosclerotic PAD on clinical events and costs.

To our knowledge, no such effort now exists within any national PAD clinical population. The methods that are effective in achieving smoking cessation in hospitalized patients are well-defined and the efficacy of these interventions has been shown by a series of randomized controlled trials in medically compromised patients (35). Similarly, these methods have also proven to be effective in individuals with PAD (16). Thus, the current data indicate a major opportunity to improve individual and population health, and to do so cost effectively.

STUDY LIMITATIONS. Although the current data are informative and define the very high impact of smoking in a contemporary PAD population, this study has relevant limitations. First, administrative datasets are not able to fully characterize the study population, and risk factor exposures, for example, precise estimates of the severity of dyslipidemia, hypertension, and diabetes control, as well as use of risk reduction medications, are not precisely known. Similarly, the clinical PAD syndrome present in these individuals (e.g., claudication vs. critical limb ischemia) cannot be defined. Physiologic data, such as pulmonary function and ankle-brachial index values that might predict clinical events are also unknown. The impact of smoking in asymptomatic populations also cannot be defined from this dataset.

Smoking status in this study (9% to 13%), as defined by claims data, must certainly be understated, as this prevalence is lower than that observed in other PAD clinical cohorts, where current smoking prevalence was 17% to 28% (1,36,37). This is a commonly observed consequence of administrative datasets, which are derived from clinician and coder use of relevant ICD-9 codes. Readers can best interpret such administrative smoking exposure data by noting that the reported "smoking prevalence" in the general cohort represents a sampling of "past and current smoking."

We also report improved smoking ascertainment within the pharmacy cohort subgroup, presuming that active use of smoking cessation pharmacological medications would provide a more precise estimate of current tobacco use. Although tobacco use appears low, note that contemporary smoking prevalence among Minnesota seniors is, indeed, very low and was recently reported as 5.4% (38). Although smoking prevalence in our study is low, it is higher than the general Minnesota population and represents a sample of those with PAD who smoke. Any under ascertainment of tobacco exposure would have assigned smokers inappropriately to the nonsmoking population, diminishing the measured intergroup event and cost differences. Thus, the true differential event and cost effects of smoking are almost certainly higher and this study provides a minimal estimate of the tobacco use effect.

Assuming this directionality, the cost impact of variable smoking cessation detection via billing code use cannot be known securely. For example, smoking identification in billing codes (the general cohort) and in the pharmacy cohort could represent physician

identification of the sickest PAD patients and, thus, lead to higher health care costs.

Smoking in individuals with PAD also is associated with other key negative health effects (e.g., worsened claudication) that we cannot measure. These impacts may affect the ability of patients to remain employed or participate in community activities. A more complete estimate of cost would include these unmeasured impacts. Future studies should be performed to define these impacts from other large national insured populations. An adequately sized prospective cohort study or randomized clinical tobacco cessation trial, with a predefined clinical event and health economic study outcome, would provide the most reliable estimate of the health and cost impact of tobacco in the PAD population.

CONCLUSIONS

Tobacco use in patients with PAD is associated with a very large increase in hospitalized clinical events and, when individuals with PAD smoke, a much higher fraction of hospitalized events are due to adverse cardiac and PAD ischemic events. The tobacco-related detrimental health impact is associated with a substantial 30% increase in annual health expenditures. This smoking-attributable health and economic burden strongly suggests that tobacco cessation programs would be especially cost effective for this population.

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PERSPECTIVES

COMPETENCY IN SYSTEMS-BASED PRACTICE: Tobacco use has substantial adverse clinical and economic impact upon patients with atherosclerotic PAD. Health systems commonly provide access to endovascular, surgical and pharmacological interventions to treat PAD but evidence-based smoking cessation interventions are inconsistently available.

TRANSLATIONAL OUTLOOK: Prospective trials are needed to compare the individual and population health and associated economic impact of various tobacco cessation techniques and services for individuals with PAD who smoke.

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APPENDIX For supplemental tables, please see the online version of this article.