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Assessing Trends in Tobacco Cessation in Diverse Patient Populations

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Abstract

Introduction: This study examined change in tobacco use over 4 years among the general population of patients in six diverse health care organizations using electronic medical record data.
Methods: The study cohort ($N = 34\,393$) included all patients age 18 years or older who were identified as smokers in 2007, and who then had at least one primary care visit in each of the following 4 years.
Results: In the 4 years following 2007, this patient cohort had a median of 13 primary care visits, and 38.6% of the patients quit smoking at least once. At the end of the fourth follow-up year, 15.4% had stopped smoking for 1 year or more. Smokers were more likely to become long-term quitters if they were 65 or older (*OR* = 1.32, 95% CI = [1.16, 1.49]), or had a diagnoses of cancer (1.26 [1.12, 1.41]), cardiovascular disease (1.22 [1.09, 1.37]), asthma (1.15 [1.06, 1.25]), or diabetes (1.17 [1.09, 1.27]). Characteristics associated with lower likelihood of becoming a long-term quitter were female gender (0.90 [0.84, 0.95]), black race (0.84 [0.75, 0.94]) and those identified as non-Hispanic (0.50 [0.43, 0.59]).
Conclusions: Among smokers who regularly used these care systems, one in seven had achieved long-term cessation after 4 years. This study shows the practicality of using electronic medical records for monitoring patient smoking status over time. Similar methods could be used to assess tobacco use in any health care organization to evaluate the impact of environmental and organizational programs.

Introduction

Globally, tobacco use is one of the top three risk factors for chronic disease[1] and it is estimated that tobacco use will cause 1 billion deaths in the 21st Century.[2] In the United States alone, tobacco smoke contributed to 443 000 deaths and 5.1 million years of potential life lost annually from 2000–2004.[3,4] In addition to increases in mortality, tobacco smoke causes morbidity from many forms of cancer, cardiovascular diseases, pulmonary diseases, and reproductive and developmental diseases.[3,5]

Despite this devastating public health impact, and the availability of evidence-based guidelines for providing effective smoking cessation services,[6] the United States failed to meet national Healthy People 2010 goals for reducing tobacco use. The prevalence of smoking among adults in the United States in 2010 was 19.3%, only

1.3 percentage points lower than in 2005[7] and much higher than the Healthy People 2010 goal of 12%. Healthy People 2020 continues the emphasis on decreasing tobacco use, and includes goals to decrease cigarette smoking prevalence to (again) 12% of adults, increase smoking cessation attempts to 80% of current smokers, and increase recent successful cessation of more than 6 months to 8%.[8] Although the prevalence of smoking has been slow to decline, surveys of smokers indicate considerable interest in quitting. In recent surveys, 68.8% of smokers reported that they were interested in quitting, 52.4% had attempted to quit in the past year, but only 6.2% had quit for at least 6 months.[9]

In 2010 a US tobacco control strategic action plan was developed to help the United States meet these Healthy People 2020 goals. One prominent recommendation was to develop additional surveillance systems to monitor tobacco use overall and within targeted populations such as minority ethnic groups.[10] Standard methods of measuring tobacco use in the United States include representative population surveys, estimating tobacco consumption based on excise tax data,[11] and prevalence rates in individual research projects. Each of these methods has its limitations, and most are costly.

Within health care delivery systems, the electronic medical record (EMR) has the potential to be used as a surveillance system to document smoking prevalence in large patient populations.[12,13] Using the EMR as a surveillance system has multiple advantages over other methods of estimating smoking prevalence. EMR data can be analyzed more frequently, and can be collected at a small fraction of the cost of a national survey. In addition, some major sources of assessment error, such as selection bias, are reduced because EMR data are available for the entire patient population instead of data from a self-selected sample that responds to surveys or is willing to participate in research studies.

This article expands on previous studies and demonstrates how health care systems can use EMR data to analyze trends in tobacco use and quitting as key indicators of patient population health. This article examines the natural history of tobacco use among patients in the six health care organizations participating in the Comparative Effectiveness Research CER-Hub project.[14]

Methods

Participating Organizations

This report combines data from six health care organizations representing a wide variety of delivery systems including a Veterans Administration facility, several closed-panel, group-practice managed care systems, a primary care network associated with a non-HMO integrated health system operating mainly under a fee-for-service payment mechanism, and a large consortium of independent community health care clinics serving low-income populations. To simplify the language in this report, these six entities will be referred to as "health care organizations," with the recognition that the administrative structure and manner in which health care is delivered in these organizations varies considerably. The diversity of these organizations and their patients helps provide some confidence that the overall findings have broader applicability to the general patient population in the United States.

All six participating health care organizations use comprehensive EMRs, although of four different types, and all require recording tobacco use as a patient vital sign at each primary care visit. General descriptions of each organization is provided below with additional information provided in Table 1.

The VA Puget Sound Health Care System (VAPSHCS, VA) serves the Pacific Northwest region (Washington, Idaho, Oregon, and Alaska), and is a primary teaching facility for the University of Washington. The facility, located in Seattle, WA, has full inpatient and outpatient services.

Kaiser Permanente Northwest is a federally qualified, not-for-profit HMO located in northwest Oregon and southwest Washington. Kaiser Permanente Northwest is an integrated, group-model health delivery system that provides and coordinates the entire scope of care for its members. Every contact an individual makes with the medical care system and all referrals to outside services are recorded in a comprehensive EMR under the patient's health record number.

Kaiser Permanente Hawaii is a federally qualified, not-for-profit HMO serving more than 230 000 members throughout Hawaii. Comprehensive electronic databases provide longitudinal information about the demographics, health, and health care utilization by the health plan members.

Kaiser Permanente Southeast is a federally qualified, not-for-profit HMO serving more than 265 000 members throughout the state of Georgia. Comprehensive electronic databases provide longitudinal information about the demographics, health, and health care utilization of all health plan members. Kaiser Permanente Southeast is both a group and network model MCO.

Baylor Health Care System is a nonprofit health care delivery organization based in Dallas-Fort Worth. Baylor Health Care System is one of the nation's largest integrated non-HMO health care providers, offering a full range of inpatient, outpatient, rehabilitation, and emergency medical care in eight contiguous counties in Texas. Baylor Health Care System began a full implementation of the GE Centricity EMR in its affiliated primary care network in 2006, and currently, all patient services at those practices are recorded in this data base.

OCHIN, Inc is a non-profit collaboration of public and private community clinics. OCHIN's mission is to meet the data management needs of Federally Qualified Health Centers and other community health centers providing care for indigent, uninsured, and underinsured populations. OCHIN implemented a comprehensive, integrated ambulatory EMR (EpicSystems EpicCare), adapted for the special needs of Federally Qualified Health Centers, beginning in mid-2005. OCHIN processes and manages data from member clinics,

Table 1. Characteristics of the Six Participating Health Care Organizations

	BHCS Dallas, TX	KP Georgia	KP Hawaii	KP Northwest	OCHIN community clinics	VA Seattle
EMR	GE Centicity	Health Connect/Epic	Health Connect/Epic	Health Connect/Epic	Epic	VISTA
Date EMR implemented	2006	2006	2004	1996	2005	2000
Adult patient population in 2007	41 476	190 607	212 764	368 762	42 885	139 965

BHCS = Baylor Health Care System; EMR = electronic medical record; KP = Kaiser Permanente.

providing support to users at over 300 sites in the Pacific Northwest and California. No patient is denied care due to inability to pay, which is consistent with the missions of these clinics and required by their status as community health centers under the Section 330 Health Resources and Services Administration (HRSA) granting program.

Data Collection

Data for this analysis were collected from EMRs. Subjects were limited to adults making primary care office visits with clinicians, and therefore did not include health care provided in other settings such as specialty care, emergency or urgent care visits, or inpatient care. This analysis was focused on primary patient care because the tobacco treatment guidelines in place during the observation period were limited to primary care.

Patient Smoking Status

Individuals seen at one or more primary care visit in 2007 were classified as current smokers if "current smoker" was entered in the vital signs or social history portion of the patient's record or if one or more of the following ICD-9-CM codes[15] indicating current smoking was entered for a given primary care visit: 305.1; 649.01; 649.02; 649.03; 649.04; 989.84. Although there is some variability in how these categories are used in different organizations, the clinical guidelines in each call for the use of the term "smoking" for all forms of burned tobacco (cigarettes, pipes, cigars), but does not include the exclusive use of oral tobacco (moist and dry snuff).

For this analysis, after a patient was first identified as a current smoker in 2007, a patient's smoking status was assumed to persist until data from a subsequent visit met the criteria for another category. For example, if a patient was classified as a current smoker at a given visit, it was assumed that this status persisted through subsequent visits until a change was made indicating that the patient had quit smoking. If a visit record did not include any information about smoking, the patient's smoking status from their previous visit was carried forward. Therefore, once a patient was identified as a nonsmoker, they were assumed to be a quitter until (or if) they were identified as a smoker again at a subsequent primary care visit. For the purposes of these analyses, patient smoking cessation was classified into three mutually exclusive categories based on duration: short term (<90 days), medium term (90–364 days), and long term (≥365 days).

Other Patient Data

In addition to smoking status, the following patient characteristics were collected from the EMR: age (as of January 1, 2007), sex, race/ethnicity, and a record of the following comorbidities at any time in the overall observation period (2007–2011). The ICD-9 codes using for identifying comorbidities with a close association to smoking included the following with an asterisk (*) indicating all sub-categories within a specified stem: cancer (140.*–149.*, 150.*–159.*, 160.*–165.*, 170.*–176.*, 179.9, 180.*–189.*, 190.*–199.*, 200.*–208.*, 209.0–209.3, 209.75, 338.3, 357.3, 511.81, 789.51, V58.42, and V71.1); CVD (410.*, 411.*, 412, 413.*, V45.81, V45.09, V45.82, and 405.*); asthma (493.*); COPD (491.*, 492.*, 493.22, and 496.*); diabetes (249.*and 250.*); hypertension (401.*, 402.*, 403.*, and 404.*); stroke (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, and 436).

Statistical Methods

Proportions of current smokers, short-term quitters, and long-term quitters were computed for each year. Univariate and multivariable logistic regression models were used to estimate odds ratios for characteristics associated with becoming a long-term quitter. Associations were considered statistically significant at the .05 level.

Results

Selection of the Smoker Cohort

Data for this analysis included primary care visits in years 2007 through 2011. Patients were included in the analysis cohort if they were age 18 years or older on January 1, 2007, had at least one primary care visit in each year from January 1, 2007 through December 31, 2011, and were noted as a current smoker at the end of in 2007. Of the 996 459 adult patients identified in 2007 (Table 1), 238 185 individuals meet the requirement of having at least one primary care visit in each of the next 4 years (Table 2), and of that set of patients, 34 393 were noted as current smokers by the end of 2007. In the first observation year (2007) the mean age of this cohort of smokers (n = 34 393) was 50.6 years and 46.3% were women. Patient race

Table 2. Percentage of Patients Who Were Current Smokers at the End of 2007 (*Note.* These Percentages Were Calculated for a Population of 238 185 Patients Aged 18 or Older in 2007, Who Had At Least One Primary Care or Internal Medicine Visit in Each Year From 2007 Through 2011)

Patient characteristics	Percent "current smoker"
Total (n = 238 185)	14.4%
Sex	
Men	17.6
Women	12.0
Age	
18–34	16.5
35–64	17.0
≥65	7.6
Race	
Black	14.1
White	14.8
Hawaiian/Pacific I	16.5
Native American	36.2
Asian	8.4
Not recorded	15.3
Ethnicity	
Hispanic	8.0
Non-Hispanic	8.8
Not recorded	40.6
Comorbidity	
Cancer (all non-skin)	9.5
Cardiovascular disease (CVD)	18.7
Asthma	25.1
Chronic Obstructive Pulmonary Disease (COPD)	30.8
Diabetes (all types)	16.2
Hypertension	17.1
Stroke	12.7
Organizations	
Baylor	9.8
KP Georgia	11.4
KP Hawaii	11.4
KP Northwest	13.8
OCHIN	28.8
VA Seattle	25.5

KP = Kaiser Permanente.

was recorded in 80.4% of the records, and ethnicity (Hispanic or non-Hispanic) was recorded in 46.7%. Of those with a recorded race, 75.4% were white, 14.1% black, 3.9% Hawaiian/Pacific Islander, 5.4% Asian, and 1.2% Native American. Of those with a recorded ethnicity, 6.2% were Hispanic.

In the smoker cohort, the median number of primary care visits over the 5-year observation period was 13. Over the 4-year period of 2008–2011, 38.6% of the patients in the cohort were noted as a nonsmoker at one or more primary care visits. Between 8.1 and 9.5% of those who were current smokers early in a given year were noted as short-term quitters at years end.

Table 3 shows the percentage of the cohort classified as long-term quitters at the end of each follow-up year. Since cohort members were current smokers at the end of 2007, it was not possible to be categorized as a long-term quitter in 2008. The percentage of patients that achieved long-term smoking cessation status increased from 2.7% in 2009 to 15.5% by the end of 2011. Significant bivariate associations with long-term quit status in 2011 were observed for gender, age category, race, ethnicity, comorbidity status, and health care organization (Table 3). In a multivariable model adjusted for all of the above, shown in Table 4, characteristics positively associated with long-term quitting included age 65 or older (vs. those 18–34, *OR* = 1.32, 95% CI = [1.16, 1.49]), or had a diagnoses of cancer (1.26 [1.12, 1.41]), cardiovascular disease (1.22 [1.09, 1.37]), asthma (1.15 [1.06, 1.25]) or diabetes (1.17 [1.09, 1.27]). Characteristics associated with lower likelihood of becoming a long-term quitter were female gender (vs. males, *OR* = 0.90 [0.84, 0.95]), black race (vs. white, 0.84 [0.75, 0.94]) and those with non-Hispanic (0.50 [0.43, 0.59]) or unknown (0.54 [0.46, 0.64]) compared to Hispanics. Odds of quitting also varied significantly by health care organization.

Discussion

Although sustained smoking cessation is notoriously difficult, these results show that a substantial proportion of smokers in the general population do make quit attempts, and over a 4-year period, more than 14% in this study cohort was able to achieve long-term cessation. This overall quit rate is similar to the cumulative quit rate seen in the 13-year follow-up of the COMMIT trial.[16] In that community study, a cohort of 6603 adults were surveyed by telephone 13 years after they were first identified as smokers. Defining long-term smoking cessation as self-reported abstinence for 6 months or longer at the time of the 13-year follow-up, 42% were found to be long-term quitters, for an average annual quit rate of approximately 3.2%, which is quite similar to the 3.5% annual quite rate observed in the current analysis.

This study was designed to provide a demonstration of the usefulness of EMRs for monitoring changes in tobacco use in patient populations. Smoking cessation rates did vary considerably between the various organizations, and these differences may very well have been influenced by a combination of known and unknown factors including differences in the way in which patient data were recorded, un-assessed differences in patient populations, and differences in

Table 3. The Percentage of Patients Identified as Current Smokers at the Beginning of 2007 Who Had Quit Smoking for 365 Days or More by the End of Each Observation Year

	2007	2009	2010	2011	Univariate *OR* (95% CI) for long-term quitter	*P*
Total sample	34 393	2.7%	9.6%	15.4%		
Sex						.001
Men	18 463	2.6	9.1	14.8	Ref	
Women	15 930	2.8	10.2	16.1	1.10 (1.04, 1.17)	
Age						<.001
18–34	4289	2.5	10.0	15.5	Ref	
35–64	25 323	2.6	9.1	14.6	0.93 (0.85, 1.02)	
≥65	4781	3.4	11.9	20.0	1.36 (1,22, 1.52)	
Race						<.001
White	20 838	1.2	10.5	14.3	Ref	
Black	3895	4.9	11.5	15.0	0.97 (0.88, 1.07)	
Asian	1502	1.7	11.2	21.4	1.50 (1.32, 1.71)	
Hawaiian/Pacific Islander	1080	2.0	10.0	18.6	1.26 (1.07, 1.47)	
American Indian	322	1.2	10.5	14.3	0.92 (0.67, 1.25)	
Race not reported	6756	3.3	8.8	14.1	0.90 (0.83, 0.97)	
Ethnicity						<.001
Hispanic	989	4.0	15.5	26.1	Ref	
Non-Hispanic	15 078	1.1	8.3	13.6	0.45 (0.38, 0.51)	
Ethnicity not reported	18 326	3.4	10.4	16.4	0.56 (0.48, 0.64)	
Comorbidity						
Cancer (all non-skin)	2373	3.4	11.0	17.9	0.53 (0.39, 0.68)	<.001
CVD	2200	3.5	12.8	21.2	1.52 (1.37, 1.69)	<.001
Asthma	4959	3.8	12.3	18.0	1.24 (1.14, 1.34)	<.001
COPD	5175	2.9	9.9	15.7	1.02 (0.94, 1.11)	0.60
Diabetes (all types)	7660	3.2	11.1	17.4	1.21 (1.13, 1.29)	<.001
Hypertension	17 226	3.0	9.8	15.8	1.06 (1.00, 1.12)	.049
Stroke	570	5.3	14.7	16.5	1.08 (0.87, 1.35)	.491
Organizations						<.001

OR = odds ratio.

Table 4. Multivariable Logistic Model for Predictors of Long-Term Smoking Cessation. All Individuals Were Noted as Current Smokers in 2007 ($N = 34\,391$), and This Model Defined Long-Term Quitting as Cessation for 365 Days or More by the End of 2011

	OR (95% CI)	*P*
Sex		.001
Men	Ref	
Women	0.90 (0.84, 0.95)	
Age		
18–34	Ref	
35–64	0.97 (0.88, 1.07)	.551
≥65	1.32 (1.16, 1.49)	<.001
Race		
White	Ref	
Black	0.84 (0.75, 0.94)	.002
Asian	1.17 (0.99, 1.38)	.063
Hawaiian/Pacific Islander	1.09 (0.89, 1.34)	.407
American Indian	0.87 (0.63, 1.20)	.403
Other/unknown	0.97 (0.83, 1.12)	.637
Ethnicity		
Hispanic	Ref	
Non-Hispanic	0.50 (0.43, 0.59)	<.001
Unknown	0.54 (0.46, 0.64)	<.001
Comorbidity		
Cancer (all non-skin)	1.26 (1.12, 1.41)	<.001
CVD	1.22 (1.09, 1.37)	<.001
Asthma	1.15 (1.06, 1.25)	.001
COPD	1.00 (0.91, 1.09)	.981
Diabetes (all types)	1.17 (1.09, 1.27)	<.001
Hypertension	1.03 (0.97, 1.11)	.269
Stroke	1.16 (0.92, 1.47)	.204

CI = confidence interval; *OR* = odds ratio.

patient access to smoking cessation services both within the health care organizations and in their communities. For this reason, a meaningful comparison of smoking cessation rates in the various organizations was beyond the scope of this study.

Physicians often find it discouraging to provide smoking cessation advice because it is hard for them to see much success.[17] However, as these results show, when only 3%–4% of smokers achieve long-term cessation each year, the cumulative effect is considerable. Given that smoking addiction can be a decades-long health problem, even a relatively small annual success rate can result in a substantial cumulative benefit. Unfortunately, this small annual increment in long-term success is difficult for front line clinicians to appreciate. Helping primary health care providers to recognize this cumulative benefit might encourage more attention to providing smoking cessation services and thereby increase the annual cessation rate.

The primary strengths of this study include the longitudinal observation of a particularly large cohort of smokers from diverse health care organizations, and the fact that this cohort was drawn from the general population of patients receiving primary care in various types of care systems. That is, this cohort was not limited to individuals who had volunteered to enter a randomized clinical trial. On the other hand, the most important limitation of this study is that the analyses have been restricted to those with at least annual medical care visits in the same care organization. No doubt this cohort differs in many ways from those patients who receive less frequent primary care, but a large proportion of middle aged and older patients do have annual or more frequent primary care visits. This is, of course, the key population for evaluating smoking cessation treatments delivered in primary care.

Another limitation for this study is that smoking status recorded in medical records reflect self-reported point prevalence of smoking or cessation, and it is likely that some patients identified as long-term quitters in this study may have had some unreported smoking between assessment points. Also, the variation in number of visits and time between visits limits the precision of time estimates. Of course, all self-reported data have limitations, but systematic studies of this issue have shown that patients provide reasonably accurate reports.[18–20] Another unknown factor is the proportion of patients who achieved long-term cessation but did not return for confirming visit before the end of the observation period.

This study shows the practicality of using patient EMRs for tracking patient smoking status over a number of years. The selection criteria for the smokers cohort in this study required a minimum of annual primary care visits over 5 years, and using a less stringent criterion would have resulted in a much larger patient cohort. We selected those that meet this criterion so that change over time could be more accurately assessed. Similar methods could be used to assess tobacco use by any health care organization using electronic patient records.

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Declaration of Interests

None declared.

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