

Original investigation

# Tobacco Use Prevalence and Smoking Cessation Pharmacotherapy Prescription Patterns Among Hospitalized Patients by Medical Specialty

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## Abstract

**Introduction:** Effective smoking cessation medications are readily available but may be underutilized in hospital settings. In our large, tertiary care hospital, we aimed to (1) characterize patient tobacco use prevalence across medical specialties, (2) determine smoking cessation pharmacotherapy prescription variation across specialties, and (3) identify opportunities for improvement in practice.

**Methods:** Using electronic health records at Barnes Jewish Hospital, we gathered demographic data, admitting service, admission route, length of stay, self-reported tobacco use, and smoking cessation prescriptions over a 6-year period, from 2010 to 2016. We then compared tobacco use prevalence and smoking cessation prescriptions across medical specialties using a cross-sectional, retrospective design.

**Results:** Past 12-month tobacco use was reported by patients in 27.9% of inpatient admissions; prescriptions for smoking cessation pharmacotherapy were provided during 21.5% of these hospitalizations. The proportion of patients reporting tobacco use was highest in psychiatry (55.3%) and lowest in orthopedic surgery (17.1%). Psychiatric patients who reported tobacco use were most likely to receive pharmacotherapy (71.8% of admissions), and plastic surgery patients were least likely (4.7% of admissions). Compared with Caucasian tobacco users, African American patients who used tobacco products were less likely to receive smoking cessation medications (adjusted odds ratio [aOR] = 0.65; 95% confidence interval [CI] = 0.62 to 0.68).

**Conclusions:** Among hospitalized tobacco users, safe and cost-effective pharmacotherapies are under-prescribed. We identified substantial variation in prescribing practices across different medical specialties and demographic groups, suggesting the need for an electronic medical record protocol that facilitates consistent tobacco use cessation pharmacotherapy treatment.

**Implications:** Tobacco use cessation pharmacotherapy is underutilized during hospitalization, and prescription rates vary greatly across medical specialties and patient characteristics. Hospitals may benefit from implementing policies and practices that standardize and automate the offer of smoking pharmacotherapy for all hospitalized patients who use tobacco.

## Introduction

Nearly four million tobacco users are hospitalized each year in the United States,<sup>1</sup> presenting a prime opportunity for smoking cessation interventions. Hospitalization provides (1) enforced temporary abstinence or restricted access to tobacco; (2) heightened intrinsic motivation for behavioral change, particularly if the hospitalization is attributable to or complicated by smoking; and (3) ready access to providers and pharmacotherapy within a supportive healthcare environment.<sup>2</sup> The Joint Commission, which accredits healthcare organizations, recommends that hospitals document the smoking status of all patients admitted and provide smoking cessation assistance,<sup>3,4</sup> and prescribing Food and Drug Administration (FDA)-approved medications for smoking cessation is a core component of the Joint Commission's performance measures.<sup>5</sup>

Three types of smoking cessation medications—nicotine replacement therapy (NRT), varenicline, and bupropion—are FDA approved<sup>6-9</sup> and have been shown to be safe and cost-effective treatments for tobacco use disorders.<sup>10-13</sup> Furthermore, although hospitals are required to be smoke free,<sup>14,15</sup> Regan et al. demonstrated that up to one-fifth of hospitalized smokers report cigarette smoking during hospitalization,<sup>16</sup> and provision of smoking cessation pharmacotherapy may reduce this,<sup>16</sup> largely by treating nicotine withdrawal symptoms.<sup>17</sup> Additionally, pharmacotherapy initiated during hospitalization increases the likelihood that it will be utilized post-discharge and may provide a valuable means of communicating to the patient the importance of smoking cessation.<sup>18</sup>

Despite the clear benefits of providing smoking cessation pharmacotherapy, several studies show that it is considerably underutilized in hospitalized patients who smoke, with only 14%–26% of patients who smoke prescribed smoking cessation medications.<sup>17,19-21</sup> Reasons for under-prescribing are not well-understood, though one study found that a patient's age, gender, and education level were correlated with the likelihood of being prescribed medications.<sup>21</sup> Additional provider-level factors may also be important, including perceived lack of training or knowledge, competing time pressures, and beliefs that treatment is not effective, or that patients are not interested in receiving it.<sup>22-25</sup> Physicians may additionally face challenges unique to their respective specialties regarding the implementation of smoking cessation interventions.

We sought to characterize the prevalence of tobacco use and the pattern of prescriptions for cessation pharmacotherapy for hospitalized patients at Barnes Jewish Hospital (BJH), a large, tertiary care academic hospital located in St. Louis, Missouri, to identify opportunities for improvement in practice. We used the electronic health record (EHR) to systematically determine the prevalence of patient-reported tobacco use in the previous 12 months and the prescription patterns of pharmacologic treatment for tobacco use among hospitalized tobacco users. The findings of this study could be used to improve the treatment of nicotine withdrawal in the inpatient setting and to promote post-discharge abstinence among patients.

## Methods

### Design and Setting

This study is a cross-sectional, retrospective study of tobacco use among hospitalized patients at BJH, a 1200-bed, tobacco-free urban hospital in St. Louis, Missouri. Patients, excepting those admitted to psychiatry, which is a locked unit, are allowed to leave their rooms to use tobacco products in designated smoking areas. Honest data brokers, who comprise a neutral third party unaffiliated with the present

study other than data acquisition, performed a retrospective EHR search for all adult inpatient hospitalizations at BJH from September 1, 2010 to December 31, 2016.<sup>26</sup> This study was approved by the Institutional Review Board at Washington University School of Medicine.

### Sample

Our sample included adult (aged 18 years and older) inpatient admissions to BJH from September 1, 2010 through December 31, 2016. Exclusion criteria included admissions during which the patient died ( $n = 10\,378$ ) and admissions for which diagnostic data were missing ( $n = 127$ ).

### Measures

As part of the BJH admission process, nurses are prompted by the EHR to ask all patients if they have used tobacco in the past 12 months. Optional supplemental questions about cigarette smoking status were incorporated into the EHR in January 2015. Cigarette smoking status was defined as “current every day smoking,” “current some-day smoking,” “former smoking” (defined as smoking 100 or more cigarettes lifetime, but not smoking currently), or “non-smoking” (defined as smoking fewer than 100 cigarettes lifetime). Of note, “current” and “former” smoking is not further defined in the EHR. Additional supplemental questions inquired about smoking heaviness: Smoking 10 or more cigarettes per day was defined as “heavy smoking” and smoking less than 10 cigarettes per day as “light smoking.”

The EHR search conducted by honest data brokers provided patient sex, race and age, admitting medical service, route of admission (ie, emergency department or planned admission), length of stay, year of admission, and all International Classification of Diseases (ICD) 9 or ICD 10 codes associated with each admission.

### Outcome Variables

To determine the prevalence of past year tobacco use, we used the results of the nursing-administered questions described earlier. To determine prescription rates of pharmacotherapy for smoking cessation, the EHR pharmacy record was searched for prescriptions of NRT, varenicline, and bupropion for inpatient admissions where the patient reported using tobacco during the previous 12 months. For admissions during which the patient received a diagnosis of depressive disorder (defined by ICD 9 codes 296.2x, 296.3x, 296.9x, and 311 and ICD 10 codes F32.x, F33.x, F34.x, F38.x, and F39.x), prescriptions for bupropion were considered as treatment for depression and not for smoking cessation.

### Statistical Analysis

For the period of September 1, 2010 to December 31, 2016, we determined the prevalence of past year tobacco use by dividing the number of inpatient admissions during which patients reported past year tobacco use by the total number of inpatient admissions. We then calculated frequency of smoking cessation pharmacotherapy prescriptions for inpatient admissions during which past year tobacco use was reported by patients.

We used multivariable analyses to test the association between the predictors (sex, race, age, admitting service, route of admission, length of stay, and year of admission) and our outcomes (patient-reported past 12-month tobacco use and pharmacy confirmed smoking cessation prescription). As the median length of stay at BJH was

3 days, this predictor was dichotomized into  $\geq 3$  days or  $< 3$  days. All analyses were conducted using SAS version 9.4 (SAS Institute Inc, 2013). Because our unit of analysis was admissions, and patients could be admitted more than once, we used a generalized estimating equation to fit a repeated measures logistic regression.

We conducted sensitivity analyses using the optional supplemental questions that specifically queried current cigarette smoking. From these questions, we identified patients who smoked cigarettes at the time of hospital admission. We repeated our multivariable analyses for the subset of inpatient admissions during which the supplemental questions were available (January 2015–December 2016). A much smaller subset of supplemental questions about heaviness of smoking was asked, which we added to the multivariable analysis for pharmacotherapy prescription.

## Results

Between September 1, 2010 and December 31, 2016, 356 665 inpatient admissions at BJH met our inclusion criteria, and in 99 586 (27.9%) of these admissions, patients reported using a tobacco product in the past year.

We assessed the validity of tobacco use in the past 12 months as a marker for current cigarette smoking by examining the concordance of the report of tobacco use with the optional supplemental questions about cigarette smoking status. From January 2015 through December 2016, 111 741 admissions met our inclusion criteria, and during 70 308 (62.9%) of those admissions the supplemental smoking questions were answered. Of the 19 935 admissions where patients answered “yes” to tobacco use in the past 12 months, 83.7% (16 676) were identified as current cigarette smokers, and 14.7% (2 932) were former smokers who quit in the past 12 months or used another tobacco product in the past 12 months. Only 1.6% (327) of those who reported tobacco use in the past 12 months were identified as never smokers and presumably only used a tobacco product other than cigarettes. Of the 50 373 admissions where patients answered “no” to tobacco use in the past 12 months, 49 947 (99.1%) were identified as never smokers or former smokers (Supplementary Table 1). From these comparisons, we determined that the majority of patients who reported tobacco use in the past 12 months were current cigarette smokers.

### Characteristics Correlated with Tobacco Use in the Past 12 Months

Of the adult inpatient admissions at BJH during the 6-year period studied, 27.9% involved patients who reported past 12-month tobacco use. Men were more likely than women to report using tobacco in the past 12 months (adjusted odds ratio [aOR] = 1.53; 95% confidence interval [CI] = 1.50 to 1.56). Compared with Caucasians, African Americans were more likely to have used tobacco in the past 12 months (aOR = 1.51; 95% CI = 1.48 to 1.55). Using 18- to 34-year-olds as a reference group, older patients—in age ranges 50–64 (aOR = 0.73; 95% CI = 0.71 to 0.75), 65–79 (aOR = 0.34; 95% CI = 0.32 to 0.35), and 80 or older (aOR = 0.12; 95% CI = 0.11 to 0.12)—were less likely to have used tobacco products in the past 12 months. Patients who were admitted through the emergency department were more likely to have used tobacco in the last 12 months than patients admitted directly to an inpatient service (aOR = 1.24; 95% CI = 1.22 to 1.26). Patients who were hospitalized for length of stay of 3 days or longer were more likely to have used tobacco products than those with shorter hospitalizations (aOR = 1.03; 95% CI = 1.02 to 1.04) (Table 1).

There were substantial differences in patient-reported past year tobacco use based on the medical or surgical service to which patients were admitted. Internal medicine was used as the reference group, with 28.6% of admissions involving patients who used tobacco in the past 12 months. In comparison, significantly more admissions through cardiothoracic surgery, general surgery, neurology, otolaryngology, and psychiatry involved patients who reported past year tobacco use ( $p < .001$  for all comparisons), and significantly fewer admissions through gynecology, obstetrics, ophthalmology, orthopedic surgery, and plastic surgery involved patients who reported past 12-month tobacco use ( $p < .01$  for all comparisons). Psychiatry admissions had the highest frequency of patient tobacco use (55.3%), and orthopedic surgery admissions had the lowest (17.1%; Table 1).

### Hospital Smoking Cessation Treatment and Prescribing Practices

For admissions during which patients reported using tobacco during the past 12 months, prescriptions for one of the three FDA-approved pharmacotherapies for smoking cessation were given only 21.5% of the time. NRT was the most frequently prescribed medication (94.7%), followed by bupropion (2.7%), varenicline (1.3%), and combination therapy (1.2%). Likelihood of being prescribed medication for smoking cessation differed with patient characteristics. Racial disparities were seen, as African Americans were significantly less likely to have been prescribed smoking cessation pharmacotherapy than Caucasians (aOR = 0.65; 95% CI = 0.62 to 0.68). Using 18- to 34-year-olds as a reference group, patients in the 35–49 age range (aOR = 1.15; 95% CI = 1.09 to 1.21) were more likely to have been prescribed treatment, whereas those in older age groups were less likely. Patients admitted through the emergency department were more likely to have been prescribed smoking cessation pharmacotherapy compared with patients who were admitted directly (aOR = 1.18; 95% CI = 1.13 to 1.23). Patients were also more likely to have been prescribed pharmacotherapy during lengths of stay of 3 days or greater compared with shorter lengths of stay (aOR = 1.72; 95% CI = 1.66 to 1.78). Using 2010 as a reference group, prescriptions increased in years 2013–2016 ( $p < .0001$  for all years; Table 2).

Likelihood of prescribing pharmacotherapy differed markedly across services. Notably, psychiatry had the highest frequency of pharmacotherapy prescription—prescriptions were given for 71.8% of admissions during which patients reported using a tobacco product in the past 12 months. Furthermore, psychiatry was the only service that prescribed pharmacotherapy for more than 50% of admissions involving tobacco users. Surgical services had the lowest rates of prescribing smoking cessation pharmacotherapy, with plastic surgery having the overall lowest rate (4.7%; Table 2).

Analyses were rerun in the smaller subset of admissions during which the optional supplemental smoking questions were available ( $n = 70 308$ ). Results showed similar patterns for frequency of cigarette smoking among hospitalized patients and smoking cessation pharmacotherapy prescriptions (Supplementary Tables 2 and 3). When we included smoking heaviness as an additional predictor in the small subset of admissions for which this variable was available ( $n = 1742$ ), heaviness of smoking was a very strong predictor of receiving a prescription for smoking cessation pharmacotherapy (aOR = 3.59; 95% CI = 2.76 to 4.66). When smoking heaviness was included as a predictor, the adjusted OR predicting smoking cessation prescription in African Americans remained less than 1.0, but was no longer statistically different than the Caucasian reference sample (aOR = 0.90; 95% CI = 0.68 to 1.20).

**Table 1.** Characteristics Associated With Past 12-Month Tobacco Use Among Hospitalized Patients

		Total admissions	% Tobacco users	Adjusted OR [95% CI]	<i>p</i>
Gender	Female	185 716	24.3	Reference	
	Male	170 949	31.9	1.53 [1.50–1.56]	<.0001
Race	Caucasian	231 601	24.5	Reference	
	African American	106,780	36.5	1.51 [1.48–1.55]	<.0001
	Other	8 438	17.2	0.50 [0.46–0.54]	<.0001
	Unknown	9 846	25.2	1.26 [1.18–1.36]	<.0001
Age (years)	18–34	56 059	35.7	Reference	
	35–49	66 320	37.7	0.95 [0.92–0.98]	.001
	50–64	119 281	32.7	0.73 [0.71–0.75]	<.0001
	65–79	85 982	16.1	0.34 [0.32–0.35]	<.0001
	≥80	29 023	6.2	0.12 [0.11–0.12]	<.0001
Admitting service	Internal medicine	175 456	28.6	Reference	
	Cardiothoracic surgery	10 625	26.3	1.25 [1.20–1.30]	<.0001
	General surgery	62 598	29.8	1.04 [1.02–1.06]	<.0001
	Gynecology	12 237	19.7	0.84 [0.80–0.88]	<.0001
	Neurology	15 534	29.6	1.06 [1.03–1.09]	.0004
	Neurosurgery	11 282	24.1	1.01 [0.97–1.06]	.51
	Obstetrics	10 785	20.9	0.52 [0.49–0.55]	<.0001
	Ophthalmology	1 900	20.5	0.86 [0.77–0.96]	.0064
	Orthopedic surgery	25 193	17.1	0.69 [0.67–0.72]	<.0001
	Otolaryngology	6 587	28.6	1.16 [1.10–1.23]	<.0001
	Plastic surgery	3 204	22.0	0.76 [0.70–0.82]	<.0001
	Psychiatry	11 577	55.3	1.41 [1.36–1.46]	<.0001
	Urology	9 687	24.2	1.01 [0.97–1.06]	.64
Admission route	Not through ED	213 924	22.2	Reference	
	Through ED	142 741	36.6	1.24 [1.22–1.26]	<.0001
Length of stay	<3 days	167 279	28.3	Reference	
	≥3 days	189 386	27.6	1.03 [1.02–1.04]	<.0001
Admission year	2010	18 859	27.4	Reference	
	2011	57 609	28.6	1.03 [0.99–1.06]	.11
	2012	56 432	28.9	1.04 [1.00–1.08]	.03
	2013	56 240	28.5	1.01 [0.97–1.04]	.78
	2014	55 784	27.3	0.97 [0.94–1.01]	.13
	2015	58 272	27.7	0.96 [0.93–1.00]	.03
	2016	53 469	26.7	0.93 [0.89–0.96]	<.0001

OR = odds ratio; CI = confidence interval; ED = emergency department.

## Discussion

Using standardized queries in an EHR system to survey over 356 000 adult hospital admissions over a 6-year period, we demonstrated a significant underutilization of smoking cessation pharmacotherapy among hospitalized patients who reported past 12-month tobacco use. Among admissions involving past year tobacco users, prescriptions for one of the three FDA-approved pharmacologic treatments for smoking cessation were given only 21.5% of the time. We notably observed disparities in pharmacotherapy prescriptions among the different medical and surgical specialties, as well as disparities by patient race.

Psychiatry led all specialties in both the percentage of admissions during which patients reported past year tobacco use (55.3%) and in smoking cessation pharmacotherapy prescriptions (71.8%), with several factors likely contributing to the latter finding. First, unlike other hospitalized patients, psychiatric patients are not permitted to leave the inpatient unit, and so medication is the only option for addressing nicotine withdrawal.<sup>27</sup> Second, when admitting physicians enter orders on the psychiatry service in the BJH system, they are prompted by the EHR to provide smoking cessation therapy, which has been part of the psychiatric admission order set since the EHR was instituted in 2010. EHRs with specific prompting for smoking cessation measures have been shown to increase physician prescribing of smoking cessation

medication.<sup>28</sup> Finally, other factors may contribute to the high level of intervention in psychiatry. For example, the extraordinarily high prevalence of tobacco use among the psychiatric patient population may cause the treatment of smoking behaviors to be a more salient problem for clinicians in that service. Additionally, faculty members in the Department of Psychiatry have established expertise in the treatment of tobacco use disorder, and thus emphasize the importance of smoking cessation treatment in the care of patients.

In this study, African Americans were more likely to report tobacco use, and they were much less likely to be prescribed smoking cessation pharmacotherapy compared with Caucasians. Though Katz et al. showed that African Americans are less likely to receive pharmacotherapy for smoking cessation *upon discharge* following admission for an acute myocardial infarction,<sup>21</sup> to our knowledge this is the first study to show this disparity *during* an inpatient hospitalization. These findings are also in keeping with population level data indicating that African Americans are less likely to use smoking cessation pharmacotherapy than Caucasians.<sup>29–33</sup>

The reasons for the racial disparity in pharmacotherapy prescriptions we observed at BJH are not clear. African Americans tend to be “light smokers,” and thus they may be less likely to receive smoking cessation treatment.<sup>34,35</sup> In part, this appears to be the case in our

**Table 2.** Characteristics Associated With Smoking Cessation Pharmacotherapy Prescriptions for Hospitalized Patients Who Use Tobacco

		Pharmacotherapy prescriptions for hospitalized smokers			
		<i>n</i>	Percent	Adjusted OR [95% CI]	<i>p</i>
Gender	Female	45 037	21.1	Reference	
	Male	54 549	21.8	0.98 [0.94–1.02]	.33
Race	Caucasian	56 641	22.6	Reference	
	African American	39 009	20.1	0.65 [0.62–0.68]	<.0001
	Other	1 454	20.6	0.69 [0.59–0.80]	<.0001
	Unknown	2 482	17.4	0.73 [0.64–0.84]	<.0001
Age (years)	18–34	19 996	23.9	Reference	
	35–49	24 968	25.8	1.15 [1.09–1.21]	<.0001
	50–64	39 022	20.8	0.95 [0.90–1.00]	.05
	65–79	13 808	13.9	0.60 [0.56–0.65]	<.0001
	≥80	1 792	8.1	0.29 [0.24–0.36]	<.0001
Admitting service	Internal medicine	50 131	20.7	Reference	
	Cardiothoracic surgery	2 799	15.0	0.61 [0.55–0.68]	<.0001
	General surgery	18 639	16.1	0.69 [0.65–0.72]	<.0001
	Gynecology	2 415	18.2	0.87 [0.77–0.98]	.02
	Neurology	4 592	28.4	1.47 [1.37–1.58]	<.0001
	Neurosurgery	2 716	13.6	0.57 [0.50–0.64]	<.0001
	Obstetrics	2 257	5.8	0.25 [0.21–0.31]	<.0001
	Ophthalmology	3 89	11.3	0.63 [0.45–0.88]	.007
	Orthopedic surgery	4 315	5.4	0.23 [0.20–0.27]	<.0001
	Otolaryngology	1 884	10.8	0.49 [0.42–0.57]	<.0001
	Plastic surgery	706	4.7	0.22 [0.15–0.32]	<.0001
	Psychiatry	6 402	71.8	6.92 [6.50–7.38]	<.0001
	Urology	2 341	10.9	0.55 [0.48–0.64]	<.0001
	Admission route	Not through ED	47 381	17.2	Reference
Through ED		52 205	25.3	1.18 [1.13–1.23]	<.0001
Length of stay	<3 days	47 369	15.9	Reference	
	≥3 days	52 217	26.6	1.72 [1.66–1.78]	<.0001
Admission year	2010	5 168	18.3	Reference	
	2011	16 449	19.0	1.04 [0.96–1.14]	.34
	2012	16 304	19.5	1.05 [0.96–1.15]	.29
	2013	16 010	21.4	1.20 [1.10–1.31]	<.0001
	2014	15 243	22.4	1.22 [1.12–1.34]	<.0001
	2015	16 128	23.7	1.27 [1.16–1.39]	<.0001
	2016	14 284	24.4	1.30 [1.19–1.42]	<.0001

OR = odds ratio; CI = confidence interval; ED = emergency department.

sample. In a much smaller subset of our data (1742), we were able to adjust for smoking heaviness. African Americans were still less likely to receive prescriptions than Caucasians, but this difference was no longer statistically significant (aOR = 0.90; 95% CI = 0.68 to 1.20). However, power in this small subset was substantially reduced. This disparity might also reflect unfavorable views of pharmacotherapy held by African American patients (eg, harm from medication, perceived lack of efficacy),<sup>32,36</sup> or bias among practitioners vis-à-vis doubts about the ability of African American patients to quit smoking.<sup>32,37</sup>

In contrast to our findings, a recent study examined Veterans Health Administration outpatient data following a system-wide directive, the National Smoking and Tobacco Use Cessation Program, which stated that smoking cessation medications should be made available to all smokers interested in quitting. This study found no difference in receipt of smoking cessation pharmacotherapy between Caucasian and African American veterans in the outpatient setting.<sup>38</sup> These findings suggest that the difference in the frequency of pharmacotherapy prescription for Caucasian and African American patients observed at BJH may not be generalizable to other health systems and may be eliminated by systematic implementation of smoking cessation directives and protocols.

Although our study also highlights the disparities for smoking cessation prescriptions among different medical services, it does not identify reasons for these disparities. For example, physicians treating cancer patients may be more inclined to focus on the direct treatment of the cancer with less focus on lifestyle modification, particularly in the acute, inpatient setting. Additionally, surgeons may be hesitant to prescribe NRT given unclear effects on wound healing,<sup>39</sup> or obstetricians may be reluctant to discuss smoking cessation medications in an effort to limit polypharmacy in pregnant patients.<sup>40</sup> Efforts to improve smoking cessation prescribing practices may prove ineffective without more information on the barriers to prescribing for the different medical or surgical services.

The percentage of inpatient admissions at BJH during which past year tobacco users received pharmacotherapy prescriptions increased from 18.3% in 2010 to 24.4% in 2016. This increase likely reflects various external factors, namely that multiple guidelines encourage pharmacotherapy use. For instance, the American Heart Association guidelines recommend smoking intervention, including pharmacotherapy, for the treatment of ST segment elevation myocardial infarction,<sup>41</sup> and guidelines from the American Heart Association and American Stroke Association encourage the delivery of smoking

cessation treatment, including pharmacotherapy, for prevention of recurrent stroke.<sup>41</sup> On a policy level, the Affordable Care Act has expanded coverage for smoking cessation medications, thus increasing accessibility and likelihood that physicians will prescribe them.<sup>42,43</sup> Thus, shifts in practice standards towards preventive medicine may have fostered increased prescribing of smoking pharmacotherapy.

### Limitations

Our study has several limitations. First, it analyzes data using a single, retrospective cross-sectional design. Such quasi-experimental design increases the chances of confounding and weakens conclusions regarding causality. Second, this study was conducted in a single, urban hospital in Missouri, which has a smoking prevalence greater than that of the United States as a whole,<sup>44</sup> possibly limiting generalizability. Third, tobacco use was ascertained from patient report without biomarker confirmation, possibly leading to underreporting.<sup>45</sup> Furthermore, the routine question regarding tobacco use in the past 12 months may have captured some tobacco users who would not necessarily be appropriate candidates for smoking cessation pharmacotherapy. For instance, a patient who quit smoking within the past year would not necessarily need pharmacotherapy. However, when we analyzed the data using the optional supplemental questions that were more specific regarding current cigarette smoking, patterns of predictors of receiving pharmacotherapy remained the same.

Importantly, evidence-based smoking cessation during hospitalization includes counseling plus medications as well as post-discharge treatment. Our analyses focused on one piece of comprehensive smoking cessation treatment—prescription of medication for smoking cessation during hospitalization. The data for actual administration (ie, did the patient actually receive the medication) were not available. Our study did not examine psychosocial interventions for smoking cessation. Though counseling is an effective cessation-promoting intervention for hospitalized smokers,<sup>2</sup> these data were not available in the EHR and were thus not included in our study.

These limitations notwithstanding, our study benefits from: (1) a large sample size (356 665 total admissions, 99 586 admissions involving past year tobacco users) when compared with similar studies<sup>20,21,46,47</sup>, (2) a description of predictors for both tobacco use behavior and smoking cessation prescription practices among various medical and surgical specialties, and (3) examination of hospitalized patient tobacco use and smoking cessation prescribing over time.

### Conclusion

Ideally, all hospitalized patients who use tobacco should receive cessation pharmacotherapy to reduce withdrawal symptoms and encourage smoking cessation. Several hospital-based strategies may increase the delivery of evidence-based smoking treatment during hospitalization. Hospitals may benefit from implementing policies and practices that standardize and automate the offer of smoking cessation pharmacotherapy for all hospitalized patients who smoke.<sup>48,49</sup> Additionally, training nurses in bedside delivery of pharmacotherapy may improve utilization.<sup>50</sup> Our results also suggest that when smoking cessation pharmacotherapy is protocolized in the EHR, as on the psychiatric service, patients who use tobacco are much more likely to receive smoking cessation pharmacotherapy.

EHR data can be used to drive plans for improving smoking cessation services institution-wide. The BJH hospital system is currently undergoing transition to a new EHR, and we hope to use this

period to protocolize smoking cessation therapies hospital-wide as a quality improvement measure. This standardization of care may reduce smoking during hospitalization, reduce disparities in care, and enhance communication from provider to patient regarding the importance of smoking cessation. We are optimistic that enhanced implementation and improved dissemination of evidence-based pharmacotherapies for smoking cessation will lead to long-term reductions in hospital and post-discharge smoking, offering our patients a significant preventive measure against both the acute and chronic consequences of smoking.

### Supplementary Material

Supplementary data are available at *Nicotine & Tobacco Research* online

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### Declaration of Interests

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