Smoking Cessation After Hospital Discharge: Factors Associated With Abstinence

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Hospitalization offers tobacco smokers an opportunity to quit smoking, but factors associated with abstinence from tobacco after hospital discharge are poorly understood. We analyzed data from a multisite, randomized controlled trial testing a smoking cessation intervention for 1,357 hospitalized cigarette smokers who planned to quit. Using multiple logistic regression, we assessed factors identifiable in the hospital that were independently associated with biochemically confirmed tobacco abstinence six months after discharge. Biochemically confirmed abstinence at six months (n = 218, 16%) was associated with a smoking-related primary discharge diagnosis (Adjusted Odds Ratio [AOR] = 1.98, 95% CI: 1.41-2.77), greater confidence in the ability to quit smoking (AOR = 1.31, 95% CI: 1.07-1.60), and stronger intention to quit (plan to quit after discharge vs try to quit; AOR=1.68, 95% CI: 1.19-2.38). In conclusion, smokers hospitalized with a tobacco-related illness and those with greater confidence and intention to quit after discharge are more likely to sustain abstinence in the long term. Hospital clinicians' efforts to promote smoking cessation should target smokers' confidence and motivation to quit.

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Cigarette smoking is the leading cause of preventable deaths in the United States.[1] Smoking contributes to several health problems that require hospitalization. Hospitalization also offers smokers an opportunity to quit because hospital policies prohibit smoking indoors while a health threat increases the motivation to quit.[2] Brief bedside smoking cessation counseling with follow-up contact after discharge increases postdischarge tobacco abstinence rates by 37%.[2] Identifying the characteristics of patients who are most likely to stop smoking after hospital discharge could identify strategies for interventions to help more smokers to succeed. It could also guide hospital clinicians' efforts to provide effective brief messages to promote cessation by inpatients under their care during this teachable moment.

Sociodemographic factors, tobacco use, and psychological and medical factors have been associated with successful quit attempts by smokers in the general population.[3,4] Far less is known about the predictors of success in quitting smoking and maintaining abstinence after hospitalization. The characteristics associated with abstinence at postdischarge follow-up in prior studies of hospitalized smokers were male gender, greater confidence in quitting, greater readiness to quit, less nicotine dependence, and having a smoking-related illness.[5-8] However, most of the prior studies were limited to one geographic region,[5,6] focused only on a specific subgroup (eg, coronary patients[9]), or did not biochemically verify tobacco abstinence.[8] In fact, to our knowledge, only one prior study has examined the predictors of quitting among a broad sample of hospital patients enrolled across multiple hospitals and biochemically verified abstinence.[6] That study was conducted nearly two decades ago in one Midwestern state.

Thus, the present study aimed to identify factors independently associated with sustained postdischarge tobacco abstinence among hospitalized smokers who planned to quit smoking.[10] Building on previous work, this study includes a large number of smokers with varied diagnoses admitted to one of three hospitals in two states, uses biochemically verified abstinence as the outcome measure, and examines multiple variables that were identified during the inpatient stay. We hypothesize that consistent with prior literature on this topic, factors independently associated with cessation in the present study will include confidence and intention to quit, degree of nicotine dependence, and a discharge diagnosis of a smoking-related disease.

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METHODS

We analyzed data from the Helping HAND2 Trial (HH2; NCT01714323), a randomized clinical trial conducted at the following three hospitals: Massachusetts General Hospital (MGH) in Boston, MA; University of Pittsburgh Medical Center (UPMC) in Pittsburgh, PA; and North Shore Medical Center (NSMC) in Salem, MA. Enrollment occurred from December 2012 to July 2014. The study methodology has been reported elsewhere.[11] This study was approved by the Institutional Review Boards of Partners HealthCare and University of Pittsburgh.

PARTICIPANTS

Hospital inpatients were eligible for enrollment if they were ≥18 years old, daily smokers, received smoking cessation counseling in the hospital (ie, standard of care for inpatient smokers), and planned to quit or try to quit smoking after discharge. Exclusion criteria included no access to a telephone, not speaking English, psychiatric or cognitive impairment, medical instability, or admission to obstetric or psychiatric units. All participants were offered nicotine replacement and one counseling session by a tobacco treatment specialist during hospitalization.

STUDY CONDITIONS

Participants were enrolled before discharge and randomly assigned to Sustained Care (Intervention) or Standard Care (Control) conditions.[10,11] In the Standard Care condition, participants received advice to call a free telephone quit line and a tailored recommendation for postdischarge pharmacotherapy. Participants randomized to Sustained Care received a free 30-day supply of their choice of US Food and Drug Administration–approved tobacco cessation pharmacotherapy at hospital discharge (refillable twice) and five automated interactive voice response calls over three months postdischarge to allow them to access counseling or refill medications.

MEASURES

Baseline Demographic and Smoking Characteristics

A baseline survey assessed demographic variables (age, gender, race/ethnicity, education), tobacco use (cigarettes smoked per day, time to first morning cigarette,[12] other tobacco use, and prior quit attempts), intention to quit after discharge (ie,"What is your plan about smoking after you leave the hospital," with the intent measured across four categorical response options), perceived importance of and confidence in quitting after discharge (five-point Likert scales ranging from "not at all" to "very"), and the presence of another smoker at home. Depression and anxiety symptoms were assessed using the Patient Health Questionnaire (PHQ-4[13]). Alcohol use (AUDIT-C[14]) and past-year use of cocaine, stimulants, opioids, and marijuana were also measured. Health insurance, length of stay, and primary discharge diagnoses were abstracted from the medical record. Smoking-related disease categories were derived from the 2014 US Surgeon General's Report.[1]

Follow-up Assessment

Telephone surveys were administered by the research staff six months after hospital discharge. Participants who reported past seven-day tobacco abstinence (ie, abstinence from tobacco for the past seven days reported at the six-month call) were asked to provide a mailed saliva sample to assay for cotinine, a nicotine metabolite, to verify self-reported abstinence. Participants who reported nicotine replacement therapy use were asked to provide an in-person measurement of expired air carbon monoxide (CO) instead. Self-reported abstinence was biochemically verified if saliva cotinine was ≤10 ng/ml or if CO was <9 ppm.[11]

Outcomes

The dependent variable, consistent with the parent trial, was biochemically confirmed past seven-day tobacco abstinence at six-month follow-up. Nonrespondents and those failing to provide a sample for confirmation were considered as smokers. In addition, a sensitivity analysis used complete cases only, excluding cases with missing smoking status outcomes.

Analysis

Bivariate associations of baseline predictor variables and biochemically confirmed abstinence were examined using chi-square tests for categorical variables and *t* tests or Wilcoxon rank sum tests for continuous variables. Using multiple logistic regression analyses, we identified variables that were independently associated with confirmed abstinence. The final models included all factors that were associated with cessation in the bivariate analysis ($P < .10$), factors associated with abstinence in the literature regardless of statistical significance (gender, AUDIT-C score),[4] study site, and study condition. A two-sided *P* value of <.05 was considered to be statistically significant. Analyses were conducted using SAS version 9.4 (SAS Institute, Cary, North Carolina).

RESULTS

Baseline characteristics of the 1,357 smokers enrolled in the trial are reported in Table 1. One-third of participants had a smoking-related discharge diagnosis. The median self-reported confidence in quitting was three on a five-point scale, and nearly half of the participants reported planning to stay abstinent after discharge. At six-month follow-up, 75% of participants completed the assessment, and seven-day tobacco abstinence was reported by 389 participants (29%) and biochemically confirmed in 218 participants (16%).

Results of the multiple logistic regression analysis predicting biochemically confirmed abstinence at six months are presented in Table 2. Factors independently associated with confirmed abstinence were a smoking-related primary discharge diagnosis (AOR = 1.98, 95% CI: 1.41-2.77), greater confidence in the ability to quit smoking (AOR = 1.31, 95% CI: 1.07-1.60), and stronger intention to quit (plan to stay abstinent after discharge vs try to stay abstinent; AOR = 1.68, 95% CI: 1.19-2.38). Similar variables emerged as independent predictors of abstinence when the analysis was limited to complete cases, with

TABLE 1. **Baseline Characteristics of Study Participants Overall and by Biochemically Confirmed Tobacco Abstinence at 6-Month Follow-up**

	All (n = 1,357)	Abstinent (n = 218)	Not Abstinent (n = 1,139)	*P* Value[a]
Demographic Characteristics				
Age (Mean±SD)	50±13	51±13	49±13	**.04**
Male (%)	51	55	50	.22
Race (%)				**.04**
White	78	73	79	
Non-White	22	27	21	
Education (%)				.66
≤High school degree	50	49	50	
Some college	35	34	36	
≥ College graduate	15	17	14	
Insurance (%)				**.03**
Medicare	28	26	29	
Medicaid	31	28	32	
Private	28	36	26	
Other	13	11	13	
Smoking Characteristics				
Smokes ≥ 10 cigarettes/day (%)	75	68	77	**.007**
Smoke within 30 minutes of waking (%)	75	68	76	**.009**
Years smoked regularly (median, IQR)	30 (20-40)	31 (20-41)	30 (20-40)	.24
Confidence in quitting (median, IQR)	3 (2-4)	4 (3-4)	3 (2-4)	**<.001**
Importance of quitting (median, IQR)	4 (4-4)	4 (4-4)	4 (4-4)	**.02**
Plan to quit after discharge (%)	48	65	45	**<.001**
Ever tried to quit and abstained for at least 24 hours (%)	90	91	90	.65
Ever used nicotine replacement to quit (%)	63	60	63	.30
Ever used Bupropion to quit (%)	17	18	16	.53
Ever used Chantix to quit (%)	29	29	29	.78
Has a no-smoking policy at home (%)	33	40	32	**.03**
Lives with other smokers (%)	48	42	49	**.03**
Psychosocial				
PHQ-2[b], Depression (median, IQR)	2 (0-3)	1 (0-3)	2 (0-3)	**.007**
GAD-2[b], Anxiety (median, IQR)	3 (1-5)	3 (1-4)	3 (1-5)	.56
AUDIT-C[c] (median, IQR)	1 (0-5)	2 (0-5)	1 (0-4)	.49
Ever used drugs intravenously (%)	7	4	8	**.005**
Illicit drug use in past year[d] (%)	7	4	8	**.04**
Illicit opioid use in past year (%)	3	1	3	**.05**
Hospitalization				
Length of hospital stay (median, IQR)	4 (3-7)	5 (3-8)	4 (3-7)	**.05**
Smoking-related diagnosis(%)[e]	34	49	31	**<.001**
Study Characteristics				**.01**
Study Site (%)	39	42	38	
MGH	17	22	16	
NSMC	44	36	46	
UPMC				
Study Condition (%)				.58
Intervention	50	17	83	
Control	50	16	84	

[a]Bolded values represent $P < .05$.
[b]PHQ-2 (2 depression symptoms, range 0-6) and GAD-2 (2 anxiety symptoms, range 0-6) with higher scores indicating more symptomatology. These four items are derived from the PHQ-4.
[c]AUDIT-C, Alcohol Use Disorders Identification Test-Consumption, assessing alcohol consumption
[d]This variable excluded marijuana use.
[e]Primary discharge diagnosis only. The definition of smoking-related disease used categories from the 2014 US Surgeon General's Report. Specifically, these include neoplasms (ICD-9 codes: 140-151, 157, 161-162, 180, 188-189, 204-208), cardiovascular disease (ICD-9 codes: 410-414, 390-398, 415-417, 420-429, 430-438, 440-448), and respiratory diseases (ICD-9 codes: 480-492, 496).
Abbreviations: IQR, interquartile range; SD, standard deviation.

TABLE 2. **Baseline Characteristics Significantly Associated with Tobacco Abstinence at 6-Month Follow-up: Multiple Logistic Regression Analysis**[a]

	Full Sample[b] *N* = 1,357		Complete Cases only *N* = 1,021	
	Odds Ratio (95% Confidence Interval)	*P* Value	Odds Ratio (95% Confidence Interval)	*P* Value
Confidence in quitting (increment of 1 unit)[c]	1.31 (1.07-1.60)	.009	1.45 (1.10-1.91)	.002
Plan to quit after discharge (vs try to quit)	1.68 (1.19-2.38)	.003	1.76 (1.22-2.54)	.002
Smoking-related discharge diagnosis[d]	1.98 (1.41-2.77)	<.001	1.90 (1.34-2.70)	<.001
Time to first cigarette after 30 minutes of waking		ns	1.47 (1.01-2.13)	.045

[a]Analysis also adjusted for age, gender, race (self-reported White vs non-White), type of insurance, cigarettes per day (<10 vs > 10), importance of quitting smoking, home policy for handling smoking (no one is allowed to smoke in my home vs all other policies), another smoker living in the home (yes vs no), PHQ-2 (Depression), AUDIT-C, lifetime use of illicit drugs intravenously (yes vs no), illicit drug use in the past year (excluding marijuana use) (yes vs no), illicit opioid use in the past year (yes vs no), length of stay in the hospital, study site and study condition (Intervention vs Control).

[b]Participants with missing outcome data were coded as smokers.

[c]Confidence in quitting after discharge was measured using a 5-point Likert scale ranging from "not at all" to "very" confident.

[d]The definition of smoking-related disease used categories from the 2014 U.S. Surgeon General's Report. Specifically, these include neoplasms (ICD-9 codes: 140-151, 157, 161-162, 180, 188-189, 204-208), cardiovascular disease (ICD-9 codes: 410-414, 390-398, 415-417, 420-429, 430-438, 440-448), and respiratory diseases (ICD-9 codes: 480-492, 496).

an exception that one additional predictor, time to first cigarette after 30 minutes of waking, had statistical significance at the 0.05 level (Table 2).

DISCUSSION

We examined the associations between factors that were identifiable in the hospital and postdischarge tobacco abstinence among a general sample of hospitalized patients enrolled in a smoking cessation trial. The odds of biochemically confirmed abstinence at six months were higher among participants who reported higher levels of confidence in quitting smoking, those reporting having a definite plan to quit (vs try to) after discharge, and those with a smoking-related primary discharge diagnosis.

Our findings are largely consistent with the prior literature on this topic, which has demonstrated that increased confidence in quitting, having a plan to quit smoking, and the presence of a smoking-related disease are associated with quit success at follow-up among hospital patients as well as in the general adult population.[3-7] Our finding that nicotine dependence predicted quit success in the complete case analysis, but not when imputing smoking status, aligns with prior studies of hospitalized smokers, which have shown an inconclusive relationship between nicotine dependence and quit success.[6,8] Despite a clear relationship of dependence to quit success among adult smokers, evidence in the hospital literature has been inconsistent. This inconsistency is likely due to the differing interventions across studies (eg, counseling vs pharmacotherapy), the differing outcome variables (eg, self-report vs biochemically verified), as well as the different patient populations selected to participate.

Unfortunately, smoking cessation is infrequently addressed in routine healthcare settings,[15,16] highlighting a gap in care. For example, one survey study[16] found that while many healthcare professionals report asking about smoking status and advising smokers to quit, fewer clinicians assess smokers' interest or intention to stop smoking, assist with cessation, or arrange follow-up. Our results indicate that assessing an inpatient smoker's intentions, motivation, and confidence for cessation and attempting to improve low levels of these factors could enhance cessation success. Because motivation is a malleable construct, repeated assessment by hospital clinicians of a patient's motivation and confidence to quit is needed.

Our results also confirm that inpatient efforts to improve smoking cessation postdischarge should target smokers' resolve to quit and confidence in the ability to succeed. Motivational interventions and cognitive-behavioral therapy are effective strategies that can resolve ambivalence and increase confidence to quit and should be components of brief interventions delivered in inpatient settings.[17,18] Although individuals with a smoking-related illness may already possess some resolve to quit based on their illness, they may be candidates for interventions focused primarily on developing self-efficacy. Indeed, supporting self-efficacy is a major goal of effective bedside counseling and can be bolstered via problem-solving, motivational techniques, and education about pharmacotherapy during a tobacco-specific consult such as the one that these participants experienced. Armed with these resources, smokers with and without a smoking-related disease may be more likely to execute a plan to quit after discharge.

A study limitation is that our results can be generalized only to hospital inpatients who were willing to try to quit smoking after discharge, because the parent trial excluded smokers with lower levels of motivation. Similarly, these results may not be generalizable to obstetric or psychiatric inpatients, who were excluded from this trial.

In conclusion, our results underscore the importance of assessing motivation and self-efficacy in hospitalized smokers and targeting these factors in intervention efforts. Although

future research should aim to identify better methods to alter these factors, in the short run, hospital clinicians could target these factors when discussing tobacco use with inpatient smokers.

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