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## Short Communication

Rapid relapse to smoking following hospital discharge<sup>☆</sup>

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## ABSTRACT

Many of nearly 7 million smokers who are hospitalized each year plan to stay quit after they leave the hospital. Most, however, relapse after discharge. This is a secondary analysis of a large Midwestern hospital-based smoking cessation trial that occurred between July 2011 and May 2013 to better understand how quickly smokers relapse and the predictors of rapid relapse. Of 942 participants who completed follow up, 25% returned to smoking within a day after hospital discharge. Among these rapid relapses, 36.6% relapsed within one-hour of leaving the hospital, 35.3% between one and 24 h, and 28.1% relapsed one-day post-discharge. Predictors with the highest odds for rapid relapse (within a day of hospital discharge) included tobacco use during hospitalization (OR, 7.37, [95% CI, 3.85–14.13],  $P < 0.01$ ); low confidence for quitting (OR, 2.07, [95% CI, 1.49–2.88],  $P < 0.01$ ); and not setting a quit date (OR, 1.76, [95% CI, 1.25–2.48],  $P < 0.01$ ). Other significant predictors included higher nicotine dependence, shorter length of stay, and depression. Patients who are vulnerable to rapid relapse may benefit from policies that discourage leaving the hospital to smoke. In addition, hospital interventions that target smokers' confidence in quitting, encourage setting a quit date, and addressing nicotine dependence and depression may also be effective at supporting smoker's intentions to make their pre-admission cigarette their last.

Clinical Trials Registration [NCT01305928](https://clinicaltrials.gov/ct2/show/study/NCT01305928)

## 1. Introduction

Each year, approximately 7 million smokers are hospitalized in the United States (Centers for Disease and Prevention, 2010; Healthcare Cost and Utilization Project (U.S.), United States. Agency for Healthcare Research and Quality, n.d.). Hospitalization presents a teachable moment for quitting because smokers' admission diagnoses are often related to tobacco use (Rigotti, 2000). It is critically important to capitalize on hospitalization for smoking cessation intervention as tobacco use causes nearly half a million deaths, and billions in health care costs annually (United States. Public Health Service. Office of the Surgeon General, 2014). Further, tobacco use disproportionately impacts vulnerable populations such as those suffering from mental illness or comorbid conditions (Bonevski et al., 2017).

The majority of smokers do not smoke during their hospital stay because most hospital environments have become smoke free (Regan et al., 2012). Although many smokers quit permanently, most return to smoking following hospitalization. Hence, the goal of hospital-based

interventions is, in essence, to prevent return to smoking post-discharge. Intensive hospital-initiated cessation interventions that begin during hospitalization and continue for at least one-month post-discharge—compared to less intensive interventions or usual care—help significantly more smokers remain abstinent post-discharge (Rigotti et al., 2012). Unfortunately, most (70%) hospitalized smokers who participate in intensive interventions return to smoking by 6–12-month follow up (Rigotti et al., 2012).

We know little about how rapidly inpatients relapse to smoking or factors related to rapid relapse. A study conducted in Brazil among 90 inpatients found that 17% relapsed within one-day, and 30% within the first week, following discharge (Campos et al., 2018). However, the study did not describe the characteristics of smokers who relapsed quickly or explore the potential causes of relapse. Living with other smokers (Caponnetto and Polosa, 2008), pre-hospital nicotine dependence (Caponnetto and Polosa, 2008), diagnosis (Rigotti et al., 2012) or even hospital length of stay (Rigotti et al., 2012) could affect how quickly inpatients relapse to smoking. Understanding predictors of

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rapid relapse could provide novel targets for hospital-based interventions to increase the efficacy and public health impact of these interventions.

To date, no U.S. studies examined the prevalence or predictors of rapid relapse. For the purpose of this study we have defined rapid relapse as *relapsing within one day of hospital discharge*. In this study, we conducted a secondary data analysis of a large clinical trial (Richter et al., 2016) among smokers planning to stay quit post-discharge, to determine the proportion of patients who relapsed soon after discharge and the baseline demographic and treatment factors that may have contributed to rapid relapse.

## 2. Methods

### 2.1. Design and participants

Data were derived from a two-arm randomized controlled trial (Richter et al., 2012; Richter et al., 2016) of hospitalized smokers ( $N = 1054$ ) who planned to remain quit upon discharge. Hospital tobacco treatment staff recruited, consented and enrolled smokers admitted to all types of units at two large Midwestern hospitals between July 2011 and May 2013. As part of study procedures, staff provided the hospital's standard of care tobacco treatment which included assessing withdrawal, providing brief counseling and education about medications, and referring participants to the state tobacco quitline (Faseru et al., 2011). The parent trial examined two different ways to link hospitalized smokers to tobacco quitlines for post-discharge care. Participants were randomly assigned to receive either a "warm handoff" as inpatients to the state tobacco quitline or fax referral upon discharge to the quitline. A detailed description of the study design and methodology can be found elsewhere (Richter et al., 2012). The study protocol was approved by the University of Kansas Medical Center and Stormont-Vail Health Care Institutional Review Boards.

Patient eligibility criteria included smoking at least one cigarette within the past 30 days; planning to stay quit post-discharge; being aged 18 or older; speaking English or Spanish. Patients admitted through the emergency department (ED) were eligible, but the study did not recruit from the ED. Additional exclusion criteria include any significant cognitive/mental/physical impairment and lack of access to a telephone post-discharge.

### 2.2. Study measures

#### 2.2.1. Demographic and health behavior characteristics

Baseline interviews conducted at patient's bedside included demographics, tobacco use characteristics, smoking history, and prior smoking cessation pharmacotherapy use and treatment acceptance. Diagnoses and hospital care related data were extracted from the hospital electronic medical record. All demographic and health behavior characteristic measures are described in detail in Supplementary Table 1.

#### 2.2.2. Outcome measure

Time to relapse was assessed via telephone at one-month post-discharge. The following questions were used to define self-reported rapid relapse (relapsed within a day of discharge) and abstinence lasting two to 30 days. "Since you left the hospital, have you smoked a cigarette, even a puff?" Patients who said yes to smoking were then asked in days, "How soon after you left the hospital did you smoke your first cigarette, even a puff?" Patients who indicated smoking the day of discharge were subsequently asked "How soon after you left the hospital did you smoke your first cigarette?" Response options included: within 5, 6–30, 31–60, and after 60 min.

### 2.3. Statistical analysis

We included all study participants who completed follow-up at one-month post-discharge. Categorical variables were summarized using frequencies and percentages. Continuous variables were summarized by means and standard deviations. We examined differences between participants who relapsed rapidly (within one-day) versus those who did not relapse within a day using chi-square tests for categorical variables and using two sample *t*-tests for continuous variables. Stepwise logistic regression was utilized to identify predictors of rapid relapse. Variables entered into the model included those whose bivariate associations with rapid relapse had a  $P$ -value  $\leq 0.10$ . Known demographic predictors of relapse (age, sex, race, and education) (Caponnetto and Polosa, 2008; Garcia-Rodriguez et al., 2013) were also entered in the model. The final model was determined by stepwise elimination; the entrance criterion was 0.1 and the level of statistical significance was 0.05. All statistical analyses were conducted using SAS version 9.4.

## 3. Results

### 3.1. Study population

Of the 1054 participants who enrolled in the study, 942 (89.4%) completed follow-up assessment at one-month and were included in the present study. Of the 942 who were randomized at baseline and completed one-month follow-up, one in four ( $n = 235$ ) relapsed within a day of leaving the hospital (i.e., *rapid relapsers*), while three quarters ( $n = 707$ ) did not relapse within one day (Supplementary Fig. 1). Of those who rapidly relapsed, 86 (36.6%) relapsed within one-hour of leaving the hospital, 83 (35.3%) between one and 24 h, and 66 (28.1%) relapsed one-day post-discharge.

### 3.2. Bivariate analysis and logistic regression

Table 1 shows baseline characteristics and hospital treatment among patients who experienced rapid relapse compared to other study participants and Table 2 shows the results of the multivariable logistic regression identifying significant predictors of rapid relapse. Length of stay, heaviness of smoking index (HSI), used tobacco during hospitalization, confidence for quitting, setting a quit date, and home smoking restrictions met our cutoff  $P$ -value  $\leq 0.10$  and were included in the model. Patients with longer stays in the hospital had lower odds of rapid relapse. Patients with depression, who used tobacco during hospitalization, had low or no confidence for quitting, did not set a quit date, and those with greater nicotine dependence as indicated by the HSI had greater odds of rapid relapse. Home smoking restrictions was not a significant predictor of rapid relapse following hospital discharge.

## 4. Discussion

This is the first U.S.-based study to examine rapid relapse among motivated to quit hospitalized smokers. One in four smokers rapidly relapsed, within one day, despite receiving intensive hospital-based intervention that included referral to quitline for post-discharge care. Characteristics of patients most likely to rapidly relapse include that they used tobacco during hospitalization, were depressed, had low confidence for quitting, did not set a quit date with the tobacco treatment specialist, and were more nicotine dependent. Greater lengths of stay were protective – those who stayed longer were less likely to rapidly relapse.

As with previous research, our results show that higher dependence scores are associated with relapse (Caponnetto and Polosa, 2008). Additionally, using tobacco during hospitalization may indicate greater nicotine dependence or under dosing of nicotine replacement medication while hospitalized. These inpatients could benefit from more

**Table 1**  
Characteristics of hospitalized smokers used in the analysis.

Characteristics	Relapsed within one day (rapid relapse) (n = 235)	Did not relapse within one day (n = 707)	P-value
<b>Sociodemographics</b>			
Age, M (SD)	50.1 (12.2)	49.7 (13.1)	0.65
Female, n (%)	140 (59.6%)	386 (54.6%)	0.18
Race, n (%)			0.25
White	170 (72.3%)	471 (66.6%)	
African American	53 (22.6%)	187 (26.5%)	
Other	12 (5.1%)	49 (6.9%)	
Latino, n (%) <sup>a</sup>	12 (5.1%)	43 (6.1%)	0.58
Education < high school, n (%)	52 (22.1%)	154 (21.8%)	0.91
Have health insurance, n (%)	221 (94.0%)	669 (94.6%)	0.73
<b>Mental health co-morbidities</b>			
Depression (PHQ-2) <sup>b</sup> , n (%) <sup>c</sup>	141 (60.0%)	359 (50.9%)	0.01
AUDIT-C <sup>d</sup> , M (SD)	2.2 (3.2)	2.2 (2.8)	0.87
Any mental health disorder diagnosis, n (%)	157 (66.8%)	460 (65.1%)	0.63
<b>Hospitalization history</b>			
Cardiac and cerebrovascular surgery, n (%)	22 (9.4%)	89 (12.6%)	0.18
Patients admitted through the ED <sup>e</sup> , n (%)	132 (56.2%)	429 (60.7%)	0.22
Length of stay (hours), M (SD)	101.6 (93.8)	146.9 (143.9)	< 0.01
<b>Current tobacco use</b>			
Cigarettes per day, M (SD)	17.9 (10.8)	14.9 (10.9)	< 0.01
Heavy smoking index (HSI) <sup>f</sup> , M (SD)	3.2 (1.5)	2.5 (1.7)	< 0.01
Used tobacco during hospitalization, n (%) <sup>g</sup>	36 (15.4%)	17 (2.4%)	< 0.01
Confident in quitting <sup>g</sup> , n (%) <sup>h</sup>	100 (43.7%)	470 (67.1%)	< 0.01
Set a quit date, n (%) <sup>i</sup>	135 (57.7%)	524 (74.1%)	< 0.01
Resides with another smoker, n (%)	116 (49.4%)	351 (49.7%)	0.94
Home smoking restrictions, n (%)	112 (47.7%)	408 (57.7%)	0.01
<b>Tobacco treatment</b>			
Inpatient nicotine replacement, n (%) <sup>j</sup>	64 (27.3%)	167 (24.0%)	0.29
Discharge cessation medication Rx <sup>j</sup> , n (%)	73 (31.1%)	221 (31.5%)	0.90

<sup>a</sup> n = 938.

<sup>b</sup> PHQ-2, Patient Health Questionnaire-2.

<sup>c</sup> n = 941.

<sup>d</sup> AUDIT-C, Alcohol Use Disorder Identification Test-alcohol consumption questions.

<sup>e</sup> ED = Emergency Department.

<sup>f</sup> HSI ranges from 0 to 6. Scores of 4 or higher indicate nicotine dependence.

<sup>g</sup> Confidence to quit smoking scores range 1 to 5. Score of 4 or higher indicate confidence in quitting.

<sup>h</sup> n = 929.

<sup>i</sup> n = 937.

<sup>j</sup> Rx = prescription.

**Table 2**  
Predictors of relapse within one day of hospital discharge<sup>a</sup>.

Factor	Rapid relapse OR (95% CI)	P-value
Length of stay	0.72 (0.60–0.86)	< 0.01
Depression (PHQ-2) <sup>b</sup>	1.42 (1.01–2.00)	0.04
Used tobacco during hospitalization	7.37 (3.85–14.13)	< 0.01
Low confidence for quitting	2.07 (1.49–2.88)	< 0.01
Did not set a quit date	1.76 (1.25–2.48)	< 0.01
Heavy smoking index (HSI)	1.26 (1.13–1.40)	< 0.01

<sup>a</sup> Based on multivariate logistic regression model; OR = odd ratio; CI = confidence interval.

<sup>b</sup> PHQ-2, Patient Health Questionnaire-2.

intensive management of symptoms, perhaps by using combination nicotine replacement therapy or by receiving free nicotine replacement at discharge, which was significantly related to long-term abstinence in two recent trials (Cummins et al., 2016; Rigotti et al., 2014). Policies enforcing a tobacco free campus or prohibiting patients from leaving units to use tobacco might reduce rapid relapse, if patients receive adequate nicotine replacement during their stay to alleviate symptoms.

Other predictors of long-term relapse were also predictive of rapid relapse, including depression and low confidence for quitting. People

with current or past depression are often more nicotine dependent and are more likely to experience negative mood changes while quitting smoking which may affect their ability to quit (van der Meer et al., 2013). Among smokers with current and past depression, a meta-analysis demonstrated increased cessation rates for interventions with a psychosocial mood management component compared to those without (van der Meer et al., 2013). Depressed hospitalized smokers may benefit from health system interventions that include psychosocial mood management in combination with cessation treatment, however, feasibility of such interventions in a hospitalized setting would require further exploration.

We found that low confidence in quitting was a predictor of rapid relapse. This is consistent with previous studies demonstrating that moderate to high self-efficacy (which is strongly related to confidence) is associated with higher abstinence rates (Gwaltney et al., 2009). However, a meta-analysis of studies conducted in primarily outpatient settings found the association to be modest (Gwaltney et al., 2009).

Failing to set a quit date likewise predicted rapid relapse. Other studies have found that smokers who set a quit date have higher self-efficacy, are more likely to make a quit attempt (Balmford et al., 2010), make more quit attempts (Balmford et al., 2010) and have a greater likelihood of maintaining abstinence (de Vries et al. 2013). Although many hospitalized smokers may consider themselves already quit when asked about stopping, asking hospitalized smokers to set a quit date

now or in the future may encourage patients to make a deliberate quit attempt while transitioning care from hospital to home.

Because our study included only motivated smokers, findings may not be generalizable to unmotivated smokers. The study was conducted in two large hospitals by staff of a dedicated tobacco cessation treatment service—findings may differ for hospitals with other systems for helping smokers quit.

Rapid relapse to smoking following discharge occurs before most patients are able to visit their outpatient health care provider or connect with other services for tobacco treatment follow-up. Disciplinary organizations have developed guidelines for transitional care and a number of Joint Commission performance measures now focus on improving transitional care via improved discharge summaries and medication reconciliation (Kripalani et al., 2007). To improve the transition of care from inpatient to outpatient tobacco treatment, inpatient tobacco treatment must address factors that contribute to rapid relapse. Ways that tobacco treatment may fail to support patients include failing to ensure patients are on cessation medication during and after discharge, or failing to anticipate and plan for immediate threats to abstinence such as riding in a smoke-filled car on the way home from the hospital.

## 5. Conclusion

Interventions to help patients stay abstinent until they can connect to post-discharge treatment has the potential to reduce the overall health impact caused by tobacco use and reduce health care costs in this vulnerable population. Rapid relapse presents a significant challenge because it allows little time for outpatient cessation supports to connect with smokers. This study provides strong support for the need to enhance hospital-based interventions—prior to and during the process of discharge—to help smokers maintain their intentions to quit after they leave the hospital environment.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2019.100891>.

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## Declaration of Competing Interest

None.

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