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Improving Smoking Cessation Outcomes Through Tailored-Risk Patient Messages at a University Hospital Tobacco Cessation Service

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Background: Postdischarge follow-up is a critical step for increasing effectiveness of hospital smoking cessation treatment. A quality improvement project was undertaken at an academic medical center tobacco cessation consult service to evaluate whether a tailored message (TM) linking immediate risks of continued smoking—particularly carbon monoxide exposure—to hospital recovery would stimulate more patient interest in the hospital's cessation treatment, including agreement to postdischarge follow-up, compared to patients receiving the usual treatment protocol with a standard message (SM) regarding more general health benefits of abstinence.

Methods: Data from 697 smokers ordered/referred for smoking cessation treatment in 2013 who received either the SM (January–April; $n = 323$) or the TM (April–November; $n = 374$) were analyzed.

Results: Multivariate regression analysis showed that the TM was associated with significantly greater agreement for follow-up (odds ratio [OR] = 10.83, 95% confidence interval [CI] = 3.66–32.04, $p < 0.0001$) than the SM. Those patients who received the TM were more willing to try to remain abstinent postdischarge (willingness score = 10, $p = 0.0052$) and engaged in longer consults (consult time > 10 minutes, $p = 0.0075$) than SM patients. TM patients also self-reported a higher continuous abstinence rate (OR = 2.07, 95% CI = 1.17–3.66, $p = 0.0130$] at follow-up than SM.

Conclusion: Linking risks of continued smoking, particularly carbon monoxide exposure, to hospital patients' immediate recovery following discharge in a treatment protocol resulted in longer consult times and increased agreement to follow-up compared to the usual protocol message. The TM was integrated into the hospital tobacco cessation intervention as standard of care.

Nearly 38 million Americans continue to smoke[1] and some are admitted to smoke-free hospitals every year due to smoking-related disease. Unfortunately, many resume smoking after discharge, risking their recovery and readmission.[2] Continued smoking increases risks for infection,[3] fracture union failures,[4] cardiovascular events and death for those with cardiovascular disease,[5–7] suppressed immune response,[3] connective tissue graft failure,[8] decreased effectiveness of cancer treatments,[9] and reduced survival time for cancer patients,[10] as well as other risks.[2]

It is estimated that direct health care costs for smoking-related illnesses exceed $170 billion annually.[11] The excessive human and financial cost of smoking, particularly for health care, has spurred decades of research into how to intervene with patients as they come through the health care system. Multiple guidelines and recommendations have been developed, and tobacco treatment for hospital patients has been incorporated into Joint Commission quality measures.[12,13]

The tobacco treatment model for hospitals has been adapted from national clinic-based treatment guidelines and clinical trial data. Recommended intervention includes asking each patient about smoking, advising specifically about the importance of quitting, assessing willingness to quit, developing a treatment plan including medications, and, of high importance, providing follow-up after discharge.[2] These components, applied in a variety of hospital randomized controlled trials (RCTs), have been shown to be efficacious for patients eligible and willing to participate.[14–20] Postdischarge follow-up has been shown to be key to the effectiveness of hospital smoking cessation interventions.[2,16,17] Although RCT data provide good evidence for the efficacy of the recommended treatments, study inclusion/exclusion criteria limited participation,[18–21] which may limit generalizability of findings.[22] More restrictive RCT inclusion/exclusion criteria help explain why some hospital-based RCTs report less than 30% of patients with a current smoking history eligible for study entry.[18–21]

There is a modest but growing literature on methods and outcomes for non-RCT hospital-supported cessation services that aim to reach all smoking patients.[23–26] However, even with fewer restrictions and greater opportunity to increase reach, patient lack of interest or willingness to

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participate in treatment remain obstacles. As we discovered in our program, an important reason for lack of interest was that patients were understandably more concerned about their immediate illness/condition and recovery than in quitting tobacco use. We also learned from the tobacco treatment specialists (TTSs) and from the provider advisory board that our medical staff was not regularly informing patients about the link between their continued smoking and the risk it posed to their recovery. In fact, we also learned that there were gaps in the understanding of the medical teams about the nature of these links themselves. Considering this, we wondered if we could adapt our protocol to make it more relevant and compelling for patients by informing them about the link between continued smoking and recovery.

In particular, we wondered if patients would benefit from more specific information about carbon monoxide (CO). Because the lay public already had some familiarity with the risks of CO and the importance of having CO monitors in their homes,[27] we thought that providing novel information about the link between CO from their smoking and the risks to their recovery might engage more patients to participate in treatment and follow-up. Specifically, we wanted to help explain how CO, with its higher affinity for hemoglobin than oxygen, reduces blood oxygenation[5,7,28] resulting in increased risks of complications for wound recovery[29,30] increased cardiac stress,[5–7,28] and suppressed immune response.[3]

To explore these questions, we developed a quality improvement (QI) project aimed at modifying our standard approach used with patients referred for cessation services to include more tailored information about the risks of continued smoking to their recovery. The messages, methods, and outcomes are the subjects of this article.

METHODS

Setting

Patients were admitted to a regional academic medical center in Portland, Oregon. Inpatient tobacco dependence treatment was provided by a Tobacco Cessation Consult Service (Consult Service) and managed by our Smoking Cessation Center in the Division of Pulmonary and Critical Care Medicine from 2007 to 2014.

Procedures

Orders/referrals were sent via the electronic health record (EHR) system. A current history of tobacco use was the only criterion required for medical teams to order/refer patients for tobacco dependence treatment. Master's level trained TTSs reviewed patient medical records prior to going to the floors to engage patients in participating in the intervention.

Tobacco Cessation Consult Protocol

The Consult Service Protocols, initially developed in 2007–2008, were established before the more recent Joint Commission guidelines[13] but were consistent with the 2008 update to *Treating Tobacco Use and Dependence*, the US Public Health Service Clinical Practice Guideline.[2] Our standard treatment protocol included an introduction of the TTS, an engagement message about how stopping smoking was important to long-term health, and an assessment of current withdrawal symptoms. From there, patients were asked about their history of tobacco use/abstinence, their willingness to try to remain abstinent postdischarge (0–10 scale; 10 = highest level of willingness), their confidence in remaining abstinent postdischarge (0–10 scale), and their current stress level (0–10 scale). They were also asked if there were other smokers in the household, if smoking was allowed inside the home, if they had support from others for quitting, and if anyone else at the hospital had talked with them about tobacco use. The TTS then answered any questions and provided education regarding other risks of tobacco smoke exposure such as increased clearance rates of psychotropic[31] or anti-cancer drugs,[9] as appropriate; education regarding general health benefits of tobacco abstinence; behavioral counseling to support abstinence; and recommendation/referral to the tobacco quitline.

Discharge planning included recommendations/orders for cessation medications and a TTS staff request for verbal permission from the patient to allow a phone follow-up visit two to three weeks postdischarge. For patients unavailable or unable to engage with the TTS, at least two more attempts were made. For those who opted out, written cessation information, including the quitline number, was left in the room. Information was documented on the Consult Treatment Form and entered into the Administrative Database. For patients agreeing to a follow-up phone visit, three contact attempts were made beginning two weeks after discharge. The TTS recorded patient self-reported smoking status since discharge (continuously abstinent or relapsed to less than, equal to, or greater than before hospitalization), use of cessation medications, use of quitline services, follow-up with primary care provider, and follow-up with the patient's health plan. The TTS then provided behavioral support to encourage remaining/achieving abstinence, entered notes into the EHR, and updated the medical team with the status of the patient's order/referral.

Protocol Changes

Original Approach: Standard Message (SM) Script. In the original approach the TTS delivered the following standard engagement message:

> I'm (staff name) from the Pulmonary Division. We try to talk to everyone who has used tobacco recently, because quitting smoking is one of the best things that you can do for your health. I also want to check on your comfort. Are you having any craving or withdrawal symptoms now?

Education was then provided regarding benefits of remaining abstinent from tobacco on overall health based on patient interest.

Revised Approach: Tailored Message (TM) Script. In the revised approach the TTS delivered the following tailored engagement message:

> I'm (staff name) from the Pulmonary Division. We try to talk with everyone who has smoked in the past year because we are concerned about the effects of carbon monoxide from smoke exposure on your recovery from your (admitting diagnosis). CO reduces oxygen in your blood and can affect your recovery. We also want you to be as comfortable as possible while you are at OHSU. Are you having any cravings or withdrawal symptoms now?

This was followed with education regarding CO risks. The following is a lay language example of CO risk education:

> If you are exposed to tobacco smoke after you leave the hospital, the carbon monoxide in smoke will reduce the amount of oxygen in your blood, because it will attach to your red blood cells before oxygen. This can cause serious problems for your (surgery, wound, infection, etc.) recovery, since reduced oxygen impacts healing. You need good oxygen levels to heal and recover. Carbon monoxide also causes your heart to have to work harder and to pump blood faster to try to bring more oxygen to the rest of your body. We don't want you to put extra stress on your heart. We advise all our patients to stay off cigarettes and to stay away from other people's smoke when they go home. We don't want anything to happen to you after you leave the hospital.

CO risk education was provided prior to assessing patient willingness to remain abstinent postdischarge. Additional education was provided on risks of CO, based on patient interest. Patients in both groups received education on the general health benefits of abstinence.

Research Questions

Primary Question. Will a tailored message (TM) that links risks of continued smoking, including carbon monoxide (CO) exposure, to postdischarge recovery increase patient agreement to follow-up compared to patients who receive only our standard message (SM) that educates on more general health benefits of smoking abstinence?

Secondary Questions. (1) Are there differences in self-reported continuous abstinence rates at postdischarge for TM patients completing follow-up compared to those who receive the SM? (2) What variables predict any differences in outcomes between groups? (3) Assuming differences in outcomes between TM and SM message groups, can methods by which these differences occur be demonstrated?

Study Design

To test the effect of the revised approach with the TM compared to the original approach with our SM, we designed an evaluation using two sequential groups during the routine delivery of tobacco cessation consultations for which we had orders/referrals in 2013. Sample size was calculated to guide timing for each group's data collection. Data for the SM group were collected first and analyzed for patients discharged between January 25 and April 25. When the sample size for SM was reached, the TTSs were trained to deliver the TM. Data from the TM group were collected second and analyzed for patients discharged between April 29 and November 30. Data for each consultation were entered into our Administrative Database and identified by message group.

Database

All data were anonymized. Data from the Consult Service database were combined with Institutional Review Board–approved data from our Research Data Warehouse (RDW). Patient variables from the RDW were age, sex, type of admission (emergent, trauma, urgent medical, elective medical, urgent surgical, elective surgical), insurance coverage (or no coverage), history of mental disorders (including addictions), length of stay, cessation medication orders while hospitalized, and discharge diagnoses (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] codes).

Patient variables from the Consult Service database included: smoking during hospitalization, cravings during hospitalization, having a first cigarette less than 30 minutes after waking, recently having cut down on smoking, living with other smokers, smoking inside the home, average number of cigarettes smoked per day in the past 30 days, average number of cigarettes smoked per day in the past year, self-reported stress level, and having other hospital staff ask about tobacco use.

These variables were selected because most are associated with cessation outcomes reported in the literature (such as age, being male, income[32]; nicotine dependence variables such as cigarettes per day,[2,33] time to first cigarette, stress level, having others support cessation, and confidence in quitting[2]; history of mental health disorder [including substance abuse][2,32,33]; history of prior quit attempts and willingness to try to quit smoking[32]; and no other smokers in the household[2,32,33]) or are specific to hospital populations (such as no withdrawal symptoms after admission, no smoking while in the hospital, length of hospital stay[23]; use of cessation medications in the hospital[34]; type of admission[26]; and specifically an admission for cardiac disease[16]). Data on three additional variables collected during patient consultations were also selected as measures of interest and willingness in intervention participation: the amount of time spent with the patient during consult (consult time),[23] patient-reported willingness to remain abstinent (willingness score),[2] and confidence in remaining abstinent after discharge (confidence score). Data on two variables collected during postdischarge follow-up calls were also selected: self-reported smoking status and the use of stop-smoking medications.

Table 1a. Demographic Variable Comparisons* for Patients with Completed Consults in Standard Message (SM) Group vs. Patients with Completed Consults in Tailored Message (TM) Group

	SM Group: $N = 232$ (Jan 25–Apr 25, 2013)	TM Group: $N = 298$ Apr 29–Nov 30, 2013)	p Value
Continuous Variables	**Mean (SD)**	**Mean (SD)**	***t*-test**
Average age (at admission)	50.6 (14.9)	51.9 (13.7)	0.3096
Average length of stay	7.5 (7.7)	6.8 (5.8)	0.2276
Categorical Variables	***n* (%)**	***n* (%)**	**chi-square†**
Gender			
Male	131 (56.5)	182 (61.1)	0.2845
Female	101 (43.5)	116 (38.9)	
Insurance class			
Commercial + Contracts	58 (25.0)	65 (21.8)	0.3884
Medicaid	68 (29.3)	77 (25.8)	0.3738
Medicare	56 (24.1)	95 (31.9)	0.0501
Nonsponsored	32 (13.8)	43 (14.4)	0.8348
Other/unknown sponsored	18 (7.8)	18 (6.0)	0.4354
Admission type			
Emergent	75 (32.3)	101 (33.9)	0.7043
Trauma	15 (6.5)	13 (4.4)	0.2829
Urgent medical	61 (26.3)	89 (29.9)	0.3650
Elective medical	14 (6.0)	19 (6.4)	0.8718
Urgent surgical	11 (4.7)	10 (3.4)	0.4172
Elective surgical	56 (24.1)	66 (22.1)	0.5892
History psych/drug/alcohol			
Yes	191 (82.3)	254 (85.2)	0.3655
Cessation Medication Orders			
At discharge Yes	80 (34.5)	113 (37.9)	0.4147
In-hospital Yes	150 (64.7)	223 (74.8)	0.0109
Primary discharge diagnosis			
Cancer	31 (13.4)	41 (13.8)	0.8949
Endocrine	5 (2.2)	6 (2.0)	0.9096
Cardiovascular	46 (19.8)	78 (26.2)	0.0868
Mental and behavioral	6 (2.6)	5 (1.7)	0.4668
Pulmonary	16 (6.9)	13 (4.4)	0.2031
Gastrointestinal	18 (7.8)	23 (7.7)	0.9862
Genitourinary	3 (1.3)	3 (1.0)	0.7572
Orthopedics	22 (9.5)	18 (6.0)	0.1366
Injury	40 (17.2)	55 (18.5)	0.7175
Other /Missing	45 (19.4)	56 (18.8)	0.8604

* Variables derived from electronic medical record data stored and requested from the Research Data Warehouse.
† p values reported for nonbinary categorical variables test specified level against all other levels combined.
SD, standard deviation; history psych/drug/alcohol, patient history of psychological diagnosis or drug or alcohol abuse.

Statistical Methods

Analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, North Carolina). Significance tests for comparisons of variables among SM vs. TM patients reported on Tables 1a and b were performed by Student's *t*-test for continuous variables and chi-square test for categorical variables.

Logistic Regression. Initially, associations between message group (TM vs. SM) and outcomes for agreement to follow-up and for abstinence at follow-up were determined using univariate logistic regression models. Following this step, bivariate models were built using message group and one of several potentially confounding covariates to predict each outcome. Results of these bivariate models were used in the development of two multivariate regression models.

The augmented backward elimination (ABE) technique[35] was used to build the multivariate models to predict the effect of group on patient agreement to follow-up and self-reported abstinence at follow-up. The ABE technique was selected because it assesses the confounding effects of each covariate and excludes variables deemed insignificant in the final model. The resulting model is thereby simplified and observations can be included that may have had missing values for the omitted variables.[35] Criteria for inclusion/exclusion from the models were as follows:

1. Bivariate p value < 0.2500 for inclusion of covariate into initial multivariate model
2. P value > 0.1000 and change-in-estimate of $< 20\%$ to remove covariates (one by one) from multivariate model

Table 1b. Consult Assessment Variable* Comparisons for Patients with Completed Consults in Standard Message (SM) Group vs. Patients with Completed Consults in Tailored Message (TM) Group

	SM Group†: (Jan 25–Apr 25, 2013)	TM Group†: (Apr 29–Nov 30, 2013)	*p* Value
Continuous Variables	**Mean (SD)**	**Mean (SD)**	***t*-test**
Average # cigarettes in last 30 days	14.0 (9.8)	14.7 (9.6)	0.4204
Average # cigarettes in last year	17.1 (11.2)	17.5 (10.6)	0.6475
Categorical Variables	***n* (%)**	***n* (%)**	**chi-square‡**
Cravings during hospitalization			
Yes	101 (44.1)	174 (58.8)	0.0008
Smoking during hospitalization			
Yes	30 (13.1)	16 (5.4)	0.0018
First cigarette < 30 min after waking			
Yes	161 (70.3)	255 (85.9)	< 0.0001
Recently cut down on smoking			
Yes	68 (29.8)	66 (22.2)	0.0452
Live with other smokers			
Yes	124 (53.7)	135 (45.3)	0.0559
Smoke inside the home			
Yes	76 (33.5)	97 (32.6)	0.8223
Other hospital staff discussed tobacco use			
Yes	86 (40.0)	73 (24.8)	0.0002
Stress level			
Low	60 (28.4)	100 (34.0)	0.1839
Mod	70 (33.2)	101 (34.4)	0.7826
High	81 (38.4)	93 (31.6)	0.1151
Cessation medication use at follow-up			
Yes	48 (36.6)	55 (31.1)	0.3059
Consult Mediators	***n* (%)**	***n* (%)**	**chi-square**
Willingness score of 10			
Yes	102 (44.0)	142 (47.7)	0.3984
Confidence score of 10			
Yes	42 (18.1)	33 (11.1)	0.0213
10 or more minutes spent in consult			
Yes	83 (35.8)	206 (69.1)	< 0.0001

* Variables derived from Smoking Cessation Administrative Database.

† Sample sizes vary slightly due to missing values.

‡ *P* values reported for nonbinary categorical variables test specified level against all other levels combined.

SD, standard deviation; willingness score, willingness to remain abstinent from smoking postdischarge; confidence score, confidence in remaining abstinent from smoking postdischarge.

3. Assessment of final model with each covariate not included in the first multivariate model; exclusion of variable if p value > 0.1000 and change-in-estimate $< 20\%$

The three mediating measures of intervention interest and willingness were not included in the first multivariate model built to predict agreement to follow-up. A second multivariate model was developed in which these three potential mediators were added to the first ABE model to evaluate the methods by which the TM was effective in increasing agreement to follow-up. The multivariate model to predict abstinence at follow-up included the variables used for building the first "agree to follow-up" model with two additional variables: cessation medications ordered at discharge, and cessation medications reported being taken at follow-up. As in the analysis of agreement to follow-up, the three mediating covariates were added into a second multivariate model to evaluate the methods by which the TM was effective in increasing patient-reported abstinence at follow-up.

RESULTS

Patient Flow

Among patients discharged between January 25 and April 25, 2013, there were 323 unique orders/referrals for tobacco cessation consults. Of these, 232 patients were seen and received the SM. Of these, 40 did not have access to a phone for follow-up. Of the remaining 192 patients eligible for follow-up, 162 (84.4%) agreed to follow-up. Of these, 131 were reached, and 51 (38.9%) self-reported continuous abstinence since discharge (26.6% of those eligible for follow-up) (Figure 1).

Among patients discharged between April 29 and November 30, 2013, there were 374 unique orders/referrals for tobacco cessation consults. Of these, 298 were seen and

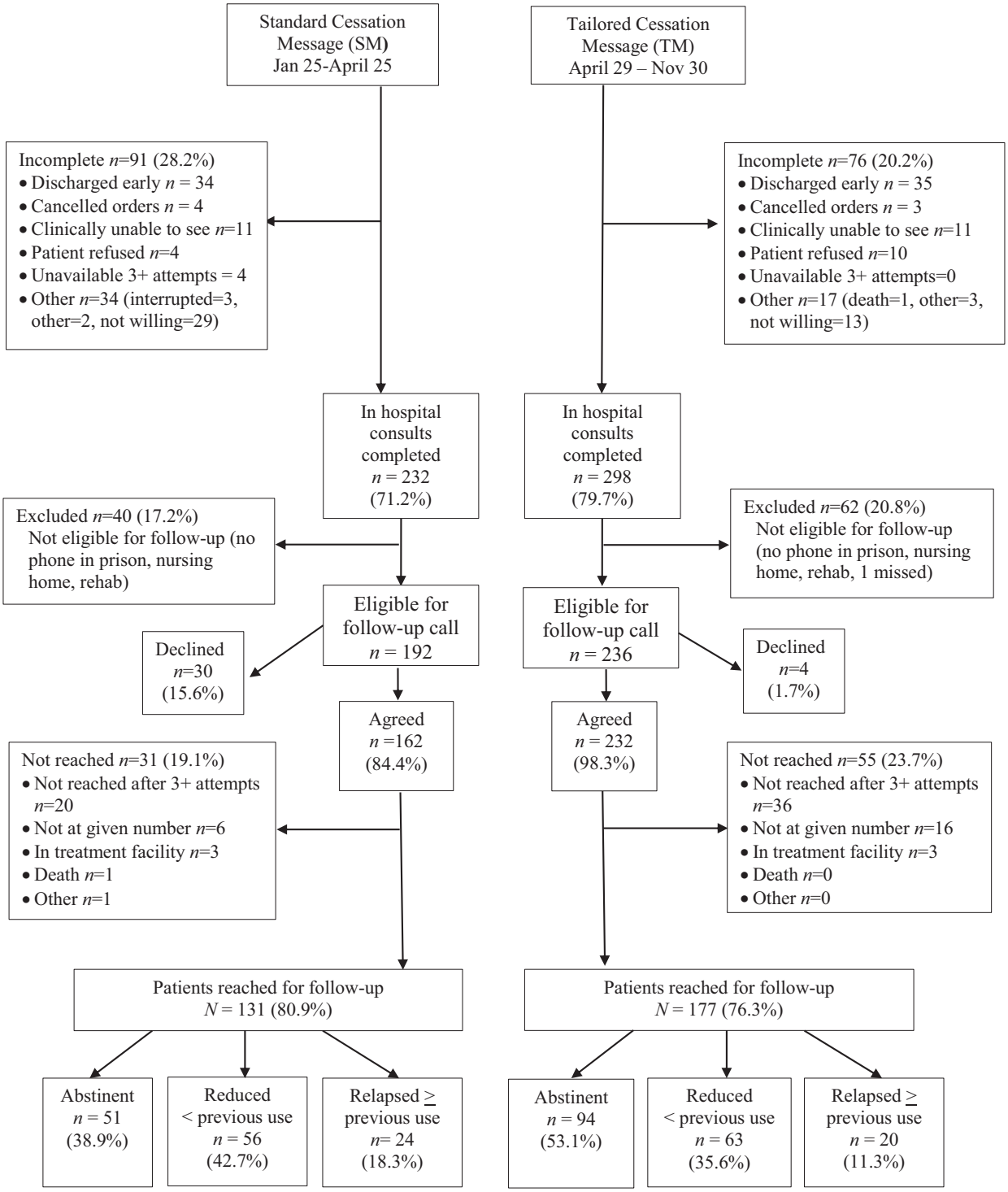

Figure 1: Shown here is the patient flow for the study. SM, standard message; TM, tailored message; consult, tobacco cessation consultation

received the TM. Of these, 61 did not have access to a phone for follow-up. and 1 patient was missed. Of the remaining 236 eligible for follow-up, 232 (98.3 %) agreed to follow-up. Of these, 177 were reached, and 94 (53.1%) reported continuous abstinence since discharge (39.8% of those eligible for follow-up) (Figure 1).

Demographic and Smoking History Comparisons

Few statistically significant differences in demographics were exhibited between the treatment groups when all patients who completed consults were compared. The TM group had a significantly higher proportion of patients with in-hospital cessation medication orders (74.8% vs. 64.7%,

Table 2. Multivariate Regression Results* Predicting Patient Agreement to a Postdischarge Follow-Up Call: Comparisons for Tailored Message (TM) Group [*n* = 233]† vs. Standard Message (SM) Group [*n* = 176]†

Covariates		Multivariate Model 1‡		Multivariate Model 2§	
		Estimate of OR (95% Confidence Intervals)	*p* Value	Estimate of OR (95% Confidence Intervals)	*p* Value
Variables from RDW and consult questionnaire	**Group (TM vs. SM)**	**10.83 (3.66–32.04)**	**<0.0001**	**5.75 (1.83–18.03)**	**0.0027**
	Medicare (Y vs. N)	2.75 (0.90–8.36)	0.0750	2.60 (0.82–8.29)	0.1056
	Cravings in the hospital? (Y vs. N)	2.65 (1.18–5.98)	0.0118	2.52 (1.04–6.09)	0.0405
	Other hospital staff discuss? (Y vs. N)	2.43 (1.02–5.81)	0.0451	2.14 (0.85–5.36)	0.1065
Consult mediators	Willingness score=10 (Y vs. N)	N/A		5.37 (1.65–17.50)	0.0052
	Confidence score=10 (Y vs. N)	N/A		0.42 (0.11–1.64)	0.2117
	Consult time 10 min. or more (Y vs. N)	N/A		3.88 (1.44–10.50)	0.0075

* Using augmented backward elimination (ABE) technique as described in Statistical Methods.
† Sample size reflects 19 subjects excluded due to missing values for one or more covariates.
‡ Covariates evaluated included Research Data Warehouse (RDW)–sourced and consult assessment responses, no consult mediators.
§ Covariates included previous model with additional consult mediators.
OR, odds ratio; willingness score, willingness to remain abstinent from smoking postdischarge; confidence score, confidence in remaining abstinent from smoking postdischarge.

$p = 0.0109$), and marginally higher proportions on Medicare (31.9% vs. 24.1%, $p = 0.0501$) and having a cardiovascular diagnosis (26.2% vs. 19.8%, $p = 0.0868$), compared to SM group patients. (Table 1a)

Differences between the groups in smoking history variables were that higher proportions of TM patients reported cravings in the hospital (58.8% vs. 44.1%, $p = 0.0008$) and having their first cigarette less than 30 minutes after waking (85.9% vs. 70.3%, $p < 0.0001$) compared to SM patients. Higher proportions of SM patients smoked while hospitalized (13.1% vs. 5.4%, $p = 0.0018$), had cut down recently (29.8% vs. 22.2%, $p = 0.0452$), lived with other smokers (53.7% vs. 45.3%, $p = 0.0559$), and had other hospital staff discuss tobacco use during hospitalization (40.0% vs. 24.8%, $p = 0.0002$). Additional group differences were seen in proportions of patients who reported high levels of confidence in quitting (SM 18.1% vs. TM 11.1%, $p = 0.0213$) and those whose consults lasted greater than 10 minutes (TM 69.1% vs. SM 35.8%, $p < 0.0001$). (Table 1b)

Predictors of Agreement to Follow-Up

In the univariate analysis, TM patients were significantly more likely than SM patients to agree to follow-up (odds ratio [OR] = 10.17, 95% confidence interval [CI] = 3.71–31.07, $p < 0.0001$). Bivariate analyses yielded nine covariates with p values less than 0.2500 to include into initial multivariate ABE models (correlated insurance/Medicaid/Medicare variables were evaluated separately). Five of these covariates were eliminated according to ABE criteria, and the final multivariate model included the message group variable along with three remaining significant covariates: Medicare coverage, cravings in the hospital, and anyone else in the hospital discussed tobacco use (Table 2). After adjusting for these confounders, the TM group remained significantly more likely than the SM group to agree to follow-up (OR = 10.83, $p < 0.0001$). Patients covered by Medicare, those experiencing cravings in the hospital, and those who had other hospital staff discuss tobacco use with them were all more than twice as likely as their counterparts to agree to follow-up (p values 0.0750, 0.0118, and 0.0451, respectively).

Three potentially mediating consult variables (consult time, willingness score, and confidence score) were added to the model to evaluate the methods by which the TM was effective in increasing agreement to follow-up (Table 2). The OR for TM vs. SM groups in this model decreased substantially (OR = 5.75, $p = 0.0027$), with the variables for willingness score and consult time contributing significantly to the final model (p values 0.0052 and 0.0075, respectively). These findings suggest that the TM may have contributed to increasing agreement to follow-up in part by increasing subjects' willingness to try to remain abstinent during their recovery in order to reduce the risk of poorer recovery outcomes and to engage in longer consult times (10 minutes or more) than the SM. ORs and their CIs are presented in Table 2.

Predictors of Abstinence at Follow-Up

Univariate analysis showed TM patients were also significantly more likely than SM patients to self-report continuous abstinence since discharge at follow-up (OR = 1.78, 95% CI = 1.12–2.81, $p = 0.0141$). Bivariate analyses yielded 14 covariates with p values less than 0.2500 to include into initial multivariate ABE models (correlated insurance/Medicaid/Medicare variables were evaluated separately). Five of these covariates were eliminated according to ABE criteria, and the final multivariate model included the message group variable and covariates age, Medicare, cardiovascular (CV) diagnosis, length of hospi-

Table 3. Multivariate Regression Results* Predicting Patient-Reported Abstinence from Smoking at Postdischarge Follow-Up Call: Tailored Message (TM) [*n* = 175]† vs. Standard Message (SM) [*n* = 123]†

Covariates		Multivariate Model 1‡ Estimate of OR (95% Confidence Intervals)	Multivariate Model 1‡ *p* Value	Multivariate Model 2§ Estimate of OR (95% Confidence Intervals)	Multivariate Model 2§ *p* Value
Variables from RDW and consult questionnaire	**Group (TM vs. SM)**	**2.07 (1.17–3.66)**	**0.0130**	**2.02 (1.09–3.72)**	**0.0245**
	Average age (at admission)	1.05 (1.03–1.08)	<0.0001	1.05 (1.02–1.07)	0.0002
	Medicare (Y vs. N)	0.39 (0.19–0.78)	0.0080	0.42 (0.20–0.86)	0.0173
	Primary discharge diagnosis: CV (Y vs. N)	2.07 (1.11–3.85)	0.0223	1.92 (1.02–3.60)	0.0434
	Length of stay (per day increase)	1.10 (1.04–1.16)	0.0008	1.09 (1.03–1.16)	0.0019
	Cravings in the hospital? (Y vs. N)	0.38 (0.21–0.69)	0.0013	0.41 (0.23–0.75)	0.0038
	Still smoking in hospital (Y vs. N)	0.14 (0.02–0.87)	0.0349	0.12 (0.02–0.75)	0.0234
	Cut down recently? (Y vs. N)	1.85 (0.97–3.52)	0.0602	1.67 (0.86–3.25)	0.1297
	Smoking allowed inside? (Y vs. N)	0.49 (0.26–0.91)	0.0241	0.51 (0.27–0.95)	0.0351
	Meds at follow-up (Y vs. N)	4.46 (2.37–8.39)	<0.0001	4.76 (2.50–9.06)	<0.0001
Consult mediators	Willingness score=10 (Y vs. N)	N/A		1.52 (0.82–2.83)	0.1878
	Confidence score=10 (Y vs. N)	N/A		2.10 (0.88–5.01)	0.0948
	Consult time 10 min. or more (Y vs. N)	N/A		1.33 (0.71–2.48)	0.3709

* Using augmented backward elimination (ABE) technique as described in Statistical Methods.
† Sample size reflects 10 subjects excluded due to missing values for one or more covariates.
‡ Covariates evaluated included Research Data Warehouse (RDW)–sourced and consult assessment responses, no consult mediators.
§ Covariates included previous model with additional consult mediator.
OR, odds ratio; CV, cardiovascular; willingness score, willingness to remain abstinent from smoking postdischarge; confidence score, confidence in remaining abstinent from smoking postdischarge.

tal stay, cravings in the hospital, still smoking in the hospital, recently cut down, smoking allowed inside the home, and cessation meds being taken at follow-up (Table 3). After adjusting for these confounders, the TM group continued to be significantly more likely than the SM group to remain abstinent (OR = 2.07, 95% CI = 1.17–3.66, $p = 0.0130$). Abstinence increased with increasing age and longer hospital stay (p values < 0.0001 and 0.0008, respectively). Patients who had reported cutting down tobacco use at admission were more likely than their counterparts to self-report continuous abstinence until follow-up (OR = 1.85, $p = 0.0602$), as were patients with a CV diagnosis (OR = 2.07, $p = 0.0223$). Those taking cessation medications at follow-up were significantly more likely to be abstinent (OR = 4.46, $p < 0.0001$). Medicare patients, those experiencing cravings in the hospital, and those who allowed smoking inside their homes were all less than half as likely to remain abstinent at follow-up (p values 0.0080, 0.0013, and 0.0241, respectively), and those who smoked during their hospital stay were significantly less likely to be abstinent at follow-up (OR = 0.14, $p = 0.0349$).

The addition of consult-specific mediators into the ABE–derived model yielded minimal change for TM vs. SM groups (OR = 2.02, 95% CI = 1.09–3.72, $p = 0.0245$) (Table 3). This suggests that although the TM group was significantly associated with increased abstinence at follow-up, the method by which this association arose was other than increased willingness or confidence in abstaining after discharge, or increased time spent in consult (Table 3).

DISCUSSION

This evaluation compares two messages designed to engage patients in a tobacco cessation intervention in a real-world hospital setting. After our Consult Service protocol was implemented in 2007, an ongoing QI process was undertaken to increase treatment effectiveness. As part of our review, we learned that medical staff seldom educated patients about how smoking could directly affect their recovery, a potentially important factor for increasing willingness to participate in cessation treatment and to remain abstinent during recovery. This finding led to a QI project to test whether including tailored information about smoking risks for patients' recovery vs. a more general health benefits message could help improve engagement in tobacco cessation while hospitalized and agreement for the critical postdischarge follow-up step. Our primary interest was increasing patient interest while hospitalized, but we also assessed self-reported continuous abstinence for those completing follow-up two to three weeks after discharge. When looking for a common denominator to use in our TM, we found that education about the immediate risks of carbon monoxide (CO) on healing and recovery[3,5–7,28–30] could be relevant to most hospital patients. We added the tailored CO risk message for the TM group, but kept the overall intervention the same for both groups. We found that the TM group was more likely to agree to follow-up ($p < 0.0001$) compared to the SM group. We found that patients receiving the TM were more likely to report maximum scores (= 10) on "willingness to remain abstinent" and to engage in longer

consult times (> 10 minutes), suggesting that linking the increased risks of continued smoking to hospital recovery improved patient interest in tobacco cessation and agreement for follow-up. When contacted at follow-up, the TM group self-reported a higher rate of continuous abstinence compared to the SM group ($p = 0.0130$). However, the variables that helped explain effectiveness of the TM for increasing "agree to follow-up" were not significant predictors of abstinence at follow-up.

Overall, these data suggest that when patients are presented with a smoking risk message specific to their immediate hospital recovery, they may become more interested and act on that information. These results support Gilbert and colleagues' findings that a tailored risk letter engaged more smokers to participate in smoking cessation than a general risk letter.[36] In addition, a recent systematic review found that new information about chemicals contained in tobacco smoke can lead to behavior change,[37] supporting our use of messaging regarding CO exposure risks.[38] These data also support anecdotal comments from TTS staff that some TM patients reported that their willingness to agree to follow-up and to remain abstinent was due, in part, to new information about their risk of poor recovery outcomes. These findings suggest that additional clinician education on how to deliver this type of risk message to patients who smoke would be helpful.

Our data on abstinence at follow-up are less clear. We hypothesized that increased interest in cessation and agreement for follow-up during hospitalization could lead to higher abstinence rates after discharge. Although our data showed this to be the case, the mechanisms by which increased participation in our cessation intervention resulted in increased abstinence after discharge are not evident. The reasons smokers give for why they are willing to attempt abstinence are often unique, so it may be helpful in the future when collecting follow-up data to inquire more specifically about their reasons for maintaining abstinence.

Tobacco dependence is a chronic disease characterized by periods of abstinence (remission) and relapse.[2] Long-term abstinence is a gold standard outcome, but many hospital patients will relapse and return to smoking within months.[19] Because tobacco smoke, and particularly CO, has such immediate and negative effects postdischarge on immune response,[3] wound healing,[29,30] bone unions,[4] and cardiac effort,[5–7,28] any period of even a few weeks of abstinence following hospital discharge can improve recovery outcomes.[39] A recent study reported that less than half of patients who smoke may be willing to engage in smoking cessation in the hospital and suggested that new ways to engage more patients in treatment are needed.[40] An engagement message linking tobacco abstinence to hospital recovery appears to be a message that resonates with patients, can interest more patients in hospital smoking cessation treatment, and could easily be reinforced in discharge and follow-up instructions.

Strengths and Limitations

This analysis involved nearly 700 hospital patients, and the design allowed delivery of either the SM or TM to a distinct group of patients based on month of admission. Messaging that educates patients about the risks of tobacco use and CO exposure on their immediate recovery is one that hospitals can readily incorporate into usual hospital workflow. Even patients in hospitals without specialized cessation services might benefit from having clinicians provide such a risk message coupled with referral to a quitline for follow-up.

Our hospital is a regional academic medical center and Level 1 trauma center with a patient population that may be different from other hospitals. This analysis did not address the effects of the two approaches by race or ethnicity. EHR data were incomplete regarding race/ethnicity and not included in the analysis. Although hospital medical staff did not generally provide patients with detailed information about the effects of smoking on their illness/condition and recovery, some specialists (for example, cardiology, pulmonary) may have provided more specific information than others. At the other extreme, anecdotal reports from the TTSs indicate that some patients were unaware that a consultation had been ordered. We assumed that these variabilities existed independently of the messages from our Consult Service, thereby affecting both groups equally.

Patients seen by our TTS staff received varying amounts of information, within our protocol limitations, based on their interest and ability to participate in the consult. Our staff were trained to follow the protocol, particularly for the engagement message, but they were also trained to respond to patients' interests, needs, and questions. Longer consult times had an effect on the outcome, as they were predictive of increased agreement for follow-up. Although some of the longer consult times likely contained more complete health risk explanations because some patients were more curious, our anecdotal information suggests that these longer consults also included conversations about other topics (such as the perceived quality of their hospital care).

Like some other clinically based programs, we did not biochemically verify patient self-reported abstinence rates,[20,23,25] which could have resulted in an overestimation of abstinence rates. Finally, the hospital did not assess expired breath CO at admission or during hospitalization. It may be that assessing CO levels and providing those data to patients would enhance the effects of CO risk messaging.

CONCLUSION

Continued smoking following discharge is a risk to patient safety. However, patients who smoke often have little interest in smoking cessation while hospitalized. Our QI project was aimed at increasing patient interest and participation in smoking cessation treatment and follow-up. We

found that providing a smoking cessation engagement message linking risks of continued smoking, including carbon monoxide exposure, to hospital patients' immediate post-discharge recovery resulted in higher rates of agreement to follow-up and willingness to remain abstinent, and longer consult times, compared to our standard health benefit message without links to immediate recovery. While the primary message effect was increased patient interest in our cessation treatment protocol and follow-up, patients receiving the tailored-risk message were also more likely to self-report continuous abstinence at follow-up. The TM was subsequently integrated into our tobacco dependence intervention as standard of care. This was a low staff burden modification to our existing protocol. Other hospitals and health care settings may benefit from providing similar risk messaging in their tobacco dependence interventions.

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