

Effects of the Tobacco Use Cessation Automated Clinical Practice Guideline

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Objective: To evaluate the effects of the Tobacco Use Cessation (TUC) Automated Clinical Practice Guideline (ACPG) (a variation of the US Department of Health and Human Services Clinical Practice Guideline on Treating Tobacco Use and Dependence) on guideline adherence in a multisite health system.

Study Design: The study used a pre-post cross-sectional design. Paired patients were enrolled from 6 clinics, including 2 control clinics (*arm 1*), 2 control clinics that received a check-in screen only (the check-in screen provided a simplified method for entering patient vital signs into the electronic medical record) (*arm 2*), and 2 clinics that received the TUC intervention (*arm 3*).

Methods: Baseline data on physician compliance with the 5 *As* (*ask, assess, advise, assist, and arrange*) at the last office visit were collected via telephone surveys from patients in the 3 study arms. The TUC-ACPG was then introduced in the TUC intervention clinics as part of the existing electronic medical record. Approximately 2 weeks after the TUC intervention, postimplementation data were collected via telephone survey.

Results: In the TUC intervention arm, postimplementation adherence rates increased relative to baseline for all 5 points of the guideline, with the largest increases seen in the *assess* and *arrange* guideline points. Controlling for factors such as age, race, and relevant comorbidities, logistic regression analysis indicated that the time (preimplementation vs postimplementation) × TUC intervention arm interaction demonstrated a statistically significant increase in the *assess* guideline point.

Conclusion: Although baseline adherence rates were already high, the introduction of the TUC-ACPG led to further increases in guideline adherence.

(*Am J Manag Care.* 2006;12:665-673)

Smoking is the most preventable cause of death in our society. In 2000, about 4.9 million smoking-related premature deaths occurred throughout the world.¹ Half of all Americans who continue to smoke will die from their smoking addiction.² In the United States from 1995 to 1999, tobacco use caused almost 1 in 5 deaths per year.^{3,4}

Smoking cessation decreases the risk of lung cancer, other cancers, heart attack, stroke, and chronic lung disease.⁵ Almost 70% of American smokers make at least 1 annual outpatient visit, but clinicians give smoking cessation advice to only 40% to 52% of the smokers.⁶ One study⁶ reported that only 15% of smokers who saw a physician in the last year were offered assistance with quitting.

Education and support from clinicians are key steps in improving quit rates. Clinician advice has proven to

be the most successful approach in a smoker's attempt to quit.⁷ Even brief advice provided during regular appointments is helpful.^{8,9} Treatments involving person-to-person contact are effective.¹⁰

The US Department of Health and Human Services Clinical Practice Guideline on Treating Tobacco Use and Dependence states that every patient who uses tobacco should be offered treatment and that healthcare delivery systems should institutionalize the consistent identification, documentation, and treatment of every tobacco user seen in a healthcare setting.¹⁰ One approach to this goal is to automate the tobacco use cessation (TUC) clinical practice guideline (CPG) so that the clinician is automatically prompted to counsel the patient during a visit. Numerous studies¹¹⁻¹⁸ have advocated the use of patient-specific reminders at the point of contact with the patient. Guidelines that are embedded in the electronic medical record (EMR) have been shown to be more effective than manual systems in improving documentation, appropriateness of testing, and treatment decisions, while reducing the cost of care.¹⁹ Tierney et al²⁰ found that physician compliance with suggested preventive care protocols can be increased by delayed feedback and by immediate reminders, with reminders having a larger effect. In a meta-analysis, Shea et al²¹ found that computer reminders improved preventive practices compared with the control condition for all conditions studied except cervical cancer screening.

Beginning in 1999, the Henry Ford Health System (HFHS) and the Tripler Army Medical Center (Honolulu, Hawaii) embarked on a joint project to automate CPGs and to evaluate their effects. As part of this project, the partners automated the TUC CPG. This article reports on the automation of the TUC CPG at HFHS and evaluates its effects on guideline adherence. Data from the Tripler

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This study was supported by grant B70035 from the US Department of Defense.

This scientific poster was presented at the Annual Research Meeting of Academy-Health; June 6, 2004; San Diego, Calif.

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Army Medical Center are not included in this article. The study was approved by the institutional review board at HFHS under expedited review, as well as by the US Army Medical Research and Materiel Command.

METHODS

Study Intervention

The first step in building the Automated Clinical Practice Guideline (ACPG) was to assemble a subject matter expert group of physicians and other clinical staff who would help design the appearance of the screens and decide how the CPG would be implemented at HFHS. Based on the advice of the subject matter expert group, the CPG was modified slightly to fit more closely with clinic work flow and with daily routines. Therefore, the study intervention automated a variation of the rules (the 5 As) of the US Department of Health and Human Services Clinical Practice Guideline on Treating Tobacco Use and Dependence via the EMR as follows: (1) *ask* if the patient uses tobacco, (2) *assess* the patient's readiness to quit, (3) *advise* the patient to quit, (4) *assist* the patient with quitting, and (5) *arrange* for follow-up care. Although the US Department of Health and Human Services guideline suggests that the sequence be *ask, advise, assess, assist, and arrange*, the HFHS CPG reordered the sequence so that *assess* preceded *advise*. The reason for this reordering was to allow the *advise* step to be performed by a clinician. In a typical visit, the patient's first contact is with a nurse or a medical assistant. The first 2 questions of the reordered CPG (*ask* and *assess*) would be asked by a

nurse or a medical assistant. The *advise* step would then be carried out by the clinician. **Figure 1** shows an overview of the HFHS TUC-ACPG.

Using decision rules, screens were displayed to the provider during an office visit. These screens prompted the staff member to apply a rule, gave information to the provider, suggested dialogue to use with the patient, facilitated documentation, and encouraged the referral of selected patients (ie, those who expressed a willingness to quit and a desire to participate in a structured program) to the smoking intervention program (SIP).

As shown in Figure 1, the guideline protocol was for all patients to be *asked*, all current smokers to be *assessed*, and so forth; however, per the HFHS protocol, not every patient was asked at every visit. If a patient came in more frequently than the time frame specified in the HFHS TUC algorithm, the ACPG did not prompt an action. Based on the advice of the subject matter expert group, the algorithm was designed so that patients who had a return visit within a brief period would not be asked again at the return visit. **Figure 2** shows an overview of the timing algorithm.

The EMR was modified to include the automated TUC guideline. As part of a previous project, a check-in screen was added to the EMR. The check-in screen allowed support staff to document vital signs obtained from patients directly into the EMR. The TUC-ACPG was programmed to be a subsection of the check-in screen, and the TUC subsection was displayed only if required by the guideline (**Figure 3** shows a screen shot of the check-in screen and the TUC-ACPG questions). In the TUC intervention arm, nurses or medical assistants completed the

vital sign entry and the assessment of the patient's tobacco use status and willingness to quit. Clinicians (physicians, physician assistants, or nurse practitioners) completed the remaining sections. Therefore, the series of questions included in the TUC-ACPG was asked by various members of the patient care team. No individual healthcare worker was responsible for all of the 5 As.

HFHS is composed of the flagship hospital (Henry Ford Hospital), several other hospitals,

Figure 1. Overview of the Henry Ford Health System Tobacco Use Cessation Automated Clinical Practice Guideline Decision Rules

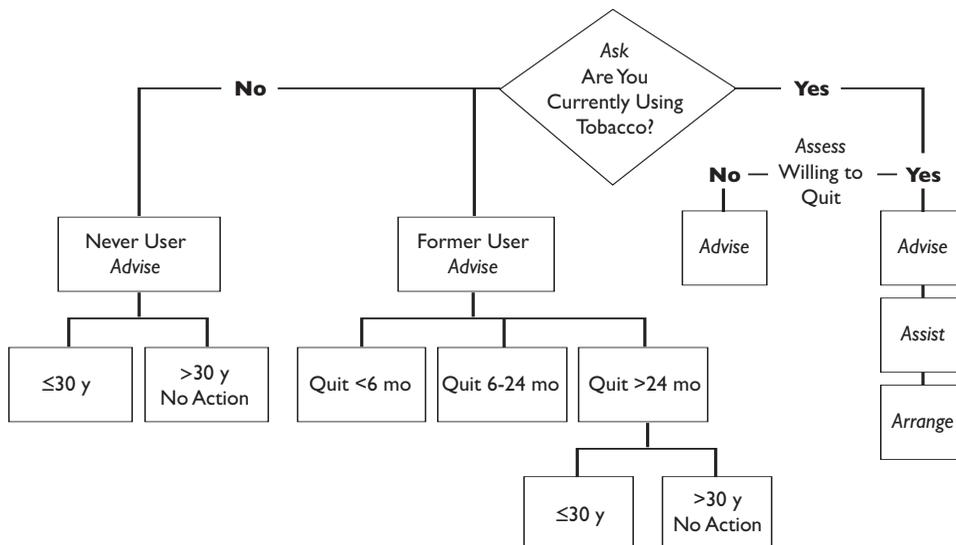
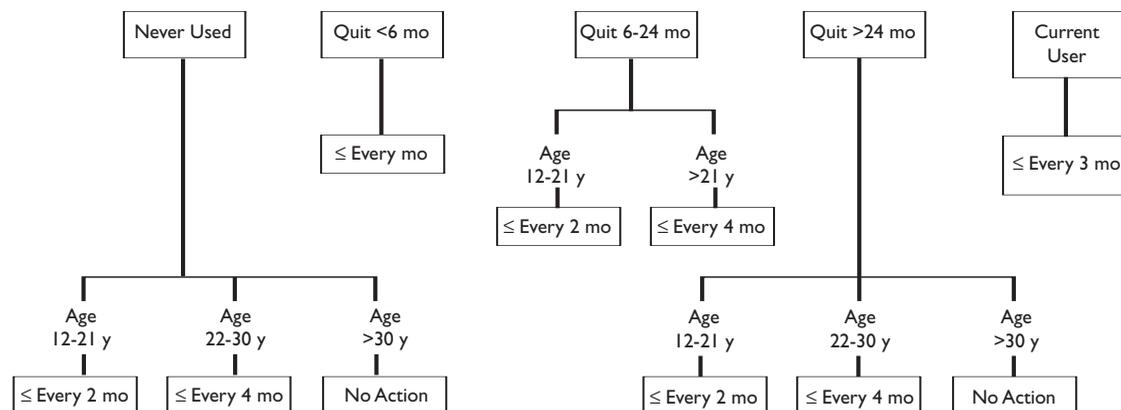


Figure 2. Decision Rules Regarding Frequency of Applying the Tobacco Use Cessation Automated Clinical Practice Guideline

and 27 clinics. Of the 27 clinics, 6 primary care clinics were chosen to participate in the 3 arms of this study, including 2 control clinics that received no intervention (*arm 1* [control clinics]), 2 control clinics that received a check-in screen only (*arm 2* [check-in screen clinics]), and 2 TUC intervention clinics (*arm 3* [TUC clinics]). The TUC clinics were chosen based on population size, willingness to participate, and technical specifications necessary to implement the TUC-ACPG. Clinics were selected so that, in combination, they would meet the sample size criteria. The control and check-in screen clinics were selected to be similar to the TUC clinics in terms of patient demographic characteristics, size of the clinic, and number of physicians. The network and computer needs for these clinics were assessed, and additions or improvements were made to the clinics' patient examination rooms and triage areas as needed.

Staff members at the chosen clinics were informed about the study requirements, and their support was sought for the project. Providers at the check-in screen and TUC clinics were trained on how to use the new check-in screens within the EMR by the health system's EMR training specialists. The check-in screen was not made available to the staff at the control clinics. The providers in the TUC intervention arm were trained on how to respond to the prompts given for the TUC-ACPG. Support in the use of the standard EMR was given to providers in the other 2 study arms, although no process changes were made at those clinics. No instructions or advice regarding the TUC intervention was given at the control or check-in screen clinics. EMR training specialists were available as needed in the clinics to assist staff in using the new screens. Therefore, the training specialists were able to observe the staff using the new functionality. In addition, a review of electronically collected process

point data, although beyond the scope of this article, indicated that the screens were used by the clinicians.

Evaluation Design

A pre-post cross-sectional design was used to determine the effects of the TUC-ACPG on adherence to the guideline. The basic hypothesis was that the introduction of the TUC-ACPG would lead to increased compliance with the 5 As in the TUC intervention arms compared with the control and check-in screen arms. An associated aim was to assess staff satisfaction with the TUC-ACPG, the results of which will be reported in a separate publication.

Baseline data were collected from patients in the 3 arms of the study to measure preexisting differences between arms. In the baseline questionnaire, patients were asked about current tobacco use and types of tobacco used. Depending on their tobacco use status and age, follow-up questions were asked to determine if the patient would be asked the other relevant points of the guideline. For example, if a patient reported that she was a current tobacco user, she was then asked whether the physician or clinic staff had *asked* about her tobacco use, *assessed* her willingness to quit, *advised* her to quit, offered any *assistance* with quitting, and *arranged* for referral to the system's SIP. The questionnaire also asked about patient demographic characteristics.

Approximately 2 weeks after the TUC screens were introduced in the TUC intervention arm, postimplementation data were collected. The same telephone survey instrument used at baseline was used for the postimplementation data collection. The postimplementation telephone calls queried patients about visits made after a clinic visit that occurred during the postimplementation period. Data from the 2 clinics in each study arm were combined. The effect of the intervention was

Figure 3. Screen Shot of Check-in and Tobacco Use Cessation Automated Clinical Practice Guideline Intervention Screens

Entered: Signed:

Height: ft in kg Weight: BP (mm): / Pulse: beats Resp: breaths Temp: °C HC: in PF: L/min

Vitals	Hgt (cm)	Wt (kg)	BP	P	Resp	T (°C)	HC (cm)
04/15/2003			110/55	107	89		
04/03/2003			100/120	100	100		
04/02/2003	170.0						
04/02/2003	150.0						
04/01/2003					12		

Check-In Notes:
 DT:04/17/2003 10:35 USR:Tucfirst T, Tuclast PF:
 Patient c/o coughing, wants to quit smoking

TUC Status: Currently Using Physician:

Ask patient about tobacco use

Never Used
 Currently using
 Quit less than 6 months ago
 Quit between 6 and 24 months ago
 Quit more than 24 months ago

Patient currently uses tobacco. Is patient willing to make an attempt to quit at this time? Yes No

Clinician: Please check all actions taken

Advised to quit
 Discussed treatment plan
 Gave patient written material
 Recommended/Prescribed medication
 Referred to SIP (HFHS smoking intervention program)
 Referred to another smoking intervention program

Recommended/Prescribed medicine

Check all that apply:

Nicotine patch
 Nicotine gum
 Nicotine inhaler
 Nicotine spray
 Bupropion
 Other medication

Save & Lock Apply Changes Clear PW: << Previous Next >> More

determined by comparing the postimplementation data for each arm with the preimplementation data from the corresponding arm.

Research Subjects

To be enrolled as a research subject, an individual had to have been an adult patient who was paneled (ie, assigned) to a primary care physician in October 2002 and who visited an intervention or control clinic during the recruitment weeks. Based on the requirements of the institutional review board, the primary care physician must have actively or passively authorized the researchers to contact the patient. Furthermore, the patient must have actively or passively consented to the evaluation before receiving a telephone call for data collection. Potential participants were contacted via a series of mailings requesting them to participate in a telephone interview (active consent). The consent letter indicated that some HFHS clinics were testing a new patient care program involving a computerized physician reminder system that would assist providers in finding out whether patients used tobacco and in helping the patients who use tobacco to quit. Patients were invited to participate in the study by giving consent to a telephone interview.

For patients who did not respond to the mailings, passive consent to a telephone interview was assumed.

Patients were not enrolled as research subjects if they did not subsequently visit a clinic during the preimplementation or postimplementation recruitment weeks and participate in a telephone interview. A patient surveyed at baseline was considered ineligible for sampling at postimplementation; therefore, the patient populations at preimplementation and at postimplementation were independent samples. Patients who had an evaluation of tobacco use status already present in the EMR ($n = 173$) were excluded from the study population because in the TUC intervention arm the decision rules of the algorithm most likely would not require the patients to be *asked* if they use tobacco.

Sample Size

The sample size was based on the smallest number of patients required to determine an increase of 10% in the *assist* guideline point rate with an α level of .05 and 80% power. The following rates were assumed: a preimplementation *assist* rate of 25%, a tobacco use prevalence of 15%, and a telephone interview response rate of 50%. Based on these assumptions, a sample size of 3454 patients was required.

Data Collection Period

Preimplementation data collection occurred during 9 weeks of visits in 2003 (January 6 through March 8) to achieve the required sample size. Postimplementation data collection spanned April 21 through August 24. This 18-week postimplementation period represents 14 weeks of data collection for any study group, with staggered starting dates by study arm.

Data Analysis

All analyses were performed using SAS version 8.2 (SAS Institute, Cary, NC). The data were compared across the control arm, the check-in screen arm, and the TUC intervention arm. For categorical analyses, χ^2 test was used. For continuous variables (age, packs of cigarettes smoked, etc), t test or analysis of variance was

used. To assess whether the presence of various comorbidities influenced adherence with the guideline, these data were collected by downloading 2 years of inpatient and outpatient diagnoses data from the system's corporate billing data.

Logistic regression analysis was used to model the probability of adherence with each of the points of the guideline, controlling for differences in demographic factors and in comorbidities. The basic process in building the models began with a simple approach in which we modeled the probability of a yes response to a guideline question given the independent variables of time (preimplementation vs postimplementation) and study arm (control, check-in screen, or TUC) and the interactions between time and study arm. A forward stepwise selection procedure was used. Various demographic factors and comorbidities were added to this basic model, 1 at a time, to evaluate whether they were significant predictors of the response. For example, race was added to the basic model. If race was a significant predictor, it was kept in the model and age was added, and so forth. The variables of time and study arm were forced to remain in all models. Time was coded as a 0,1 variable, with 0 indicating preimplementation and 1 indicating postimplementation; race was also coded as a 0,1 variable, with 0 indicating white and 1 indicating nonwhite. Site was coded as 2 dummy variables, with 0,0 indicating the control arm; 1,0, the check-in screen arm; and 0,1, the TUC intervention arm.

Clustering by provider within each arm could not be controlled for in these analyses because data on physicians seen during each visit were not collected. It was anticipated that clustering by physician within each clinic would be minimal for the following 2 reasons: (1) Each patient was seen by at least 2 members of the clinic staff during each individual appointment. To reiterate, the first 2 questions of the TUC-ACPG were asked by a nurse or a medical assistant, and the subsequent questions, if asked, were asked by a clinician (physician, physician assistant, or nurse practitioner). Therefore, there would be a large number of potential clinician, nurse, and medical assistant combinations for each patient visit. (2) In addition, although patients chosen for this study were paneled to specific physicians, patients who made same-day appointments did not necessarily see their paneled provider but saw any provider who had an opening in his or her schedule for that day.

RESULTS

Patients Available for Research

In the preimplementation period, 22 593 visits occurred, with 8867 patients eligible for an interview.

Interviews were completed with 1761 individuals in the control arm, 1763 in the check-in arm, and 1810 in the TUC arm (total = 5334). For postimplementation, 35 637 visits occurred with 7507 patients eligible for an interview. Interviews were completed with 1426 individuals in the control arm, 1256 in the check-in arm, and 1288 in the TUC arm (total = 3970).

Demographics

The study arms demonstrated small but statistically significant differences at baseline. The check-in screen arm had a slightly older and less educated population than the other arms, and the TUC intervention arm had a significantly larger Asian/Pacific Islander population. These differences remained at postimplementation. **Table 1** gives the preimplementation vs postimplementation differences in demographic characteristics; only the differences in mean age in the control and check-in screen arms and in education in the TUC intervention arm were statistically significant.

Comorbidities

Table 1 gives the preimplementation vs postimplementation prevalences of comorbidities. Significant pre-post differences were found in the prevalence of respiratory comorbidities among the control and check-in screen arms and in the prevalence of cardiovascular comorbidities among the TUC intervention arm.

Tobacco Use

Comparing the preimplementation and postimplementation periods, individuals in the check-in screen arm were most likely to currently use tobacco (Table 1). They were also the least likely to have never used tobacco. For tobacco users, cigarettes were the most frequent choice, used at preimplementation by 92% in the control arm, 95% in the check-in screen arm, and 89% in the TUC intervention arm and used at postimplementation by 90% in the control arm, 94% in the check-in screen arm, and 94% in the TUC intervention arm. The rates of use of other forms of tobacco were exceedingly low and did not vary among arms at either period. There were no statistically significant preimplementation vs postimplementation differences within each arm in the percentage of tobacco users who smoked cigarettes or in the mean number of packs smoked per week.

Guideline Adherence

Guideline adherence rates were calculated for each of the 5As for each study period. At preimplementation, staff members in the TUC intervention arm were more likely to *ask* (88%) compared with the control arm (81%) and the check-in screen arm (86%) ($P < .001$). There were no sta-

Table 1. Comparison of Preimplementation vs Postimplementation Demographic Characteristics, Comorbidities, and Tobacco Use Status by Study Arm*

Characteristic	Control Arm			Check-in Screen Arm			TUC Intervention Arm		
	Pre	Post	P	Pre	Post	P	Pre	Post	P
Age, mean, y	53.2	54.3	.05	55.6	57.1	.02	52.2	51.7	.33
Male sex	41.7	42.0	.85	39.4	41.8	.18	41.9	42.4	.76
Race			.41						.54
Asian/Pacific Islander	2.3	1.9		1.3	1.2	.99	8.2	8.5	
Black	10.7	12.2		11.3	11.6		8.8	9.6	
White	81.0	79.4		79.8	79.6		78.4	76.3	
Other	6.0	6.5		7.6	7.6		4.6	5.5	
Education			.84			.62			.06
<High school graduate	7.7	7.6		15.8	15.5		6.7	5.3	
High school graduate	24.2	24.0		35.0	34.3		22.0	19.2	
Some college or technical school	34.4	33.4		33.8	32.7		30.5	33.6	
≥College graduate	33.8	35.0		15.4	17.5		40.9	41.9	
Comorbidity									
Respiratory	18.8	15.1	.01	31.7	24.8	<.001	16.6	16.6	.99
Cardiovascular	58.3	56.2	.25	61.5	62.5	.59	61.6	53.4	<.001
Neoplasm	2.8	2.0	.13	2.3	3.0	.25	1.9	2.6	.23
Tobacco use status			.01			.04			.98
Current	16.0	18.0		21.8	21.7		13.9	13.4	
Never	42.1	43.6		34.1	38.2		49.7	50.5	
Quit									
<6 mo	3.6	1.8		4.3	2.7		2.7	2.7	
6 mo to 2 y	3.1	2.5		2.7	2.4		2.0	2.1	
>2 y	35.2	34.3		37.1	35.0		31.8	31.3	

*Data are given as percentages unless otherwise indicated. TUC indicates tobacco use cessation; Pre, preimplementation; Post, postimplementation. Preimplementation vs postimplementation differences in mean age within each study arm were tested using *t* test. All other differences were tested using χ^2 test of independence.

tistically significant differences among the study arms for the baseline rates of *assess*, *advise*, *assist*, and *arrange*, although there was a trend toward the highest rate for each rule occurring in the TUC intervention arm.

At postimplementation, the TUC intervention arm demonstrated the highest rate of compliance for each of the 5 As of the guideline, followed by the check-in screen arm and, finally, the control arm. For the TUC intervention arm, 93% of individuals reported being *asked*, compared with 90% in the check-in screen arm, and 84% in the control arm ($P < .001$). For *assess*, 78% of individuals in the TUC intervention arm reported having their willingness to quit assessed, compared with 54% and 60% in the control and check-in screen arms, respectively ($P < .001$). The differences among arms at postimplementation were statistically significant for *ask*, *assess*, and *arrange* ($P = .001$) and were marginally significant for *assist* ($P = .07$). Only the differences in the rates of *advise* were not statistically significant.

Comparing the preimplementation vs postimplementation values for each study arm (Table 2), the control arm

showed no statistically significant differences in adherence for the questions pertaining to *ask*, *assess*, *advise*, or *arrange*. For *assist*, guideline adherence decreased from 57% in the preimplementation period to 48% in the postimplementation period ($P = .04$). In the check-in screen arm, the percentage of individuals who were *asked* increased significantly from 87% to 90%; however, there were no statistically significant differences in any of the other rules of the guideline. For the TUC intervention arm, adherence with each rule of the guideline increased during the postimplementation period compared with the preimplementation period. Only the increases for *ask* and *assess* were statistically significant.

Logistic Regression Findings

The 3 populations demonstrated differences in their baseline demographic characteristic measures and in the prevalence of relevant comorbidities. Therefore, logistic regression analysis was used to model the probability of adherence with the guideline, controlling for these factors.

Table 3 gives point estimates of the odds ratio (95% confidence interval) for each of the variables. For each of the 5 As, the variables listed are those that were included in the most parsimonious model. The variables of time (preimplementation vs postimplementation) and study arm were forced to remain in all models.

Ask. After controlling for other variables, being in the postimplementation population increased the odds of being *asked* by 39.2%. Patients in the check-in screen arm were 44.3% more likely to be *asked* than patients in the control arm. Being in the TUC intervention arm vs the control arm increased the odds of being *asked* 2-fold. Being nonwhite decreased the odds of being *asked* by about 40%. Further examination of the finding for race using χ^2 analysis indicated that Asian/Pacific Islander populations were less likely to be *asked* at every clinic. The presence of a respiratory or cardiovascular comorbidity increased the odds of being *asked*.

Assess. Being in the TUC intervention arm increased the odds of being *assessed* by 58.5%, and the time-x-TUC intervention arm increased the probability by 74.2%. The presence of a respiratory comorbidity increased the odds of being *assessed* 2-fold. Each 1-year increase in age increased the odds of being *assessed* by 1.0%.

Advise. Being in the TUC intervention arm vs the control arm increased the odds of being *advised* by 33.4%. The presence of a respiratory comorbidity increased the odds of being *advised* by 2.12 times. Each 1-year increase in age increased the odds of being *advised* by 0.9%.

Assist. Each 1-year increase in age increased the odds of being *assisted* by 0.2%. The presence of a respiratory comorbidity increased the odds by 72.4%.

Arrange. Being in the TUC intervention arm vs the control arm increased the odds of being *arranged* for follow-up by 66.0%. Being female decreased the odds of being *arranged* by 28.0%, the presence of a respiratory comorbidity increased the odds by 62.7%, and the presence of a cardiovascular comorbidity increased the odds by 55.6%.

Table 2. Comparison of Preimplementation vs Postimplementation Guideline Adherence Rates by Study Arm*

Guideline Point	Preimplementation	Postimplementation	χ^2 Value	P
Control Arm				
<i>Ask</i>	81.8	84.0	2.44	.12
<i>Assess</i>	57.2	54.0	0.54	.46
<i>Advise</i>	64.8	64.8	0.0002	.99
<i>Assist</i>	57.1	48.4	4.06	.04
<i>Arrange</i>	19.6	14.8	2.07	.15
Check-in Screen Arm				
<i>Ask</i>	86.5	89.8	6.90	.009
<i>Assess</i>	60.3	60.1	0.002	.96
<i>Advise</i>	70.1	69.6	0.03	.88
<i>Assist</i>	52.2	52.1	0.001	.97
<i>Arrange</i>	19.1	17.8	0.17	.68
TUC Intervention Arm				
<i>Ask</i>	88.4	92.8	14.30	<.001
<i>Assess</i>	66.4	77.8	6.30	.01
<i>Advise</i>	70.9	72.0	0.06	.80
<i>Assist</i>	56.3	59.8	0.50	.48
<i>Arrange</i>	25.4	28.7	0.55	.46

*Data are given as percentages of guideline adherence unless otherwise indicated. The Ask guideline point comprised all patients; Assess, Assist, and Arrange, current users; and Advise, current users and recent quitters. TUC indicates tobacco use cessation.

DISCUSSION

This project focused on improving clinic adherence to the TUC guideline. Because tobacco use is a complex behavior with numerous motivators and reinforcements, no single approach or program can be expected to affect tobacco use rates profoundly. In this project, the goal was to influence staff behavior, which in turn should affect outcomes in susceptible patients over the long term.

Baseline Adherence Rates

At baseline, each of the arms had high rates of guideline adherence, with the rates of *asking* patients about their tobacco use ranging from 82% to 89% among the groups. These baseline rates were close to or above the *Healthy People 2010* target of 85% compliance with the *ask* algorithm.²² Any increase in compliance rates that was seen at postimplementation should be viewed as substantial given these high baseline adherence rates.

Patient Recall

This study assessed patient recall of provider behavior as a proxy measure of guideline adherence. There will inevitably be some discrepancies between what the

Table 3. Logistic Regression Analysis of the Probability of Completing Each Guideline Point

Guideline Point	Point Estimate of Odds Ratio (95% Confidence Interval)
Ask	
Time, pre vs post	1.392 (1.218-1.591)
Check-in screen arm	1.443 (1.240-1.679)
TUC intervention arm	2.008 (1.710-2.359)
Race	0.610 (0.528-0.706)
Respiratory comorbidity	1.685 (1.406-2.018)
Cardiovascular comorbidity	1.190 (1.046-1.354)
Assess	
Time, pre vs post	0.991 (0.779-1.262)
Check-in screen arm	1.130 (0.888-1.436)
TUC intervention arm	1.585 (1.124-2.235)
Time-x-TUC intervention arm interaction	1.742 (1.038-2.924)
Respiratory comorbidity	2.087 (1.625-2.682)
Age	1.013 (1.005-1.020)
Advise	
Time, pre vs post	1.034 (0.844-1.267)
Check-in screen arm	1.163 (0.922-1.468)
TUC intervention arm	1.334 (1.028-1.731)
Respiratory comorbidity	2.121 (1.656-2.715)
Age	1.009 (1.002-1.017)
Assist	
Time, pre vs post	0.939 (0.767-1.149)
Check-in screen arm	0.908 (0.719-1.147)
TUC intervention arm	1.188 (0.915-1.543)
Respiratory comorbidity	1.724 (1.371-2.169)
Age	1.010 (1.002-1.017)
Arrange	
Time, pre vs post	0.938 (0.729-1.206)
Check-in screen arm	1.019 (0.752-1.381)
TUC intervention arm	1.660 (1.210-2.278)
Sex	0.720 (0.561-0.923)
Respiratory comorbidity	1.627 (1.249-2.119)
Cardiovascular comorbidity	1.556 (1.212-1.998)

TUC indicates tobacco use cessation; pre, preimplementation; post, postimplementation.

patient reports to have occurred and what the electronically collected process point data (ie, what boxes the clinician accessed or checked) report to have occurred. Pollak et al²³ found that patients who recall advice to quit tobacco use tended to be older, in poorer health, heavier smokers, male, white, and more motivated to quit. In our study, staff members may have overreported their adherence with the 5 As. An area of further research will be to look at these discrepancies to understand the dynamics of the interaction between patient and provider.

The data also show that nonwhites were less likely to be *asked* than whites. Closer examination of the nonwhite category indicated that individuals of Asian/Pacific Islander heritage comprised a large portion of the nonwhites who were not *asked*. A cursory review of the automated entries and process point data in the postimplementation period for this group presenting to an intervention arm clinic shows a differing view. For the TUC intervention arm, 76% of the visits by individuals of Asian/Pacific Islander heritage were captured in the TUC-ACPG process point data. Of this data subset, 92% of individuals had entries in the data tables indicating that they were *asked* about their tobacco status. Although little information is available on racial disparities in the recall of patient services, studies^{24,25} indicate that minorities, particularly Asian/Pacific Islanders, report lower satisfaction with medical care. In a large health maintenance organization population, Murray-Garcia et al²⁶ found significant differences by race and ethnicity in patient satisfaction with primary care. Pollak et al²³ identified race as the only factor associated with lack of agreement between patient and provider recall of smoking cessation advice.

Logistic Regression Findings

Although results from the χ^2 analyses indicated statistically significant increases in compliance with *ask* and *assess* in the TUC intervention arm, the logistic regression analysis showed that only the time-x-TUC intervention arm interaction for the *assess* guideline point was statistically significant. Therefore, the data indicate that the support staff in the TUC intervention arm were complying with the algorithm as designed. In the future, clinician education should stress that all current smokers should be *advised* to quit even though they may not be ready to quit at that particular time. Data also indicate that clinicians were aware of the need to *ask* about tobacco use in patients with respiratory comorbidities and, to a lesser extent, in patients with cardiovascular comorbidities.

Limitations of the Study

Several limitations of the study should be noted. First, the clinics chosen to participate in the study were a convenience sample of clinics, based on size, demographic makeup, location, number of physicians, and willingness to participate in a research study. A clinic's

willingness to participate could indicate that the clinic was less “set in its ways” and more amenable to adopting a new technique. Ideally, a random sample of clinics would have been drawn, but a convenience sample was used instead because of logistic considerations. Second, we were unable to control for clustering by physician within clinics or study arms, because data on the clinician, nurse, or medical assistant seen at the last visit were not collected. It would be infeasible to go back and collect that data, as many patients may have left the system, moved to another clinic, or changed providers. As discussed previously, the dispersion of responsibility for completing the 5 As over clinician, nurse, or medical assistant combinations should have reduced this clustering to some degree. Third, patients did not necessarily see their paneled physician at any particular visit, as same-day appointment patients see whatever clinician is available. In a further study of this type, physician data should be collected so that clustering by physician can be controlled for in the analysis.

The HFHS TUC-ACPG was a variation of the US Department of Health and Human Services Clinical Practice Guideline on Treating Tobacco Use and Dependence. As discussed in the “Methods” section, a subject matter expert group was convened to give guidance and advice on designing and implementing the ACPG at the HFHS. This consultation was sought to increase the likelihood that the new functionality would meet the needs of the providers, fit into the clinic work flow, and be used. The subject matter expert group recommended changes in the order of the questions and in the timing algorithm. As already discussed, the changes in the order of the algorithm may have led to a decrease in the latter points of the guideline if the patient had already expressed an unwillingness to quit smoking at the time.

Within the ACPG, clinicians were able to automatically refer a patient to the HFHS SIP. Although we did not collect data regarding referrals to the SIP, it is clear from EMR data that many individuals in the TUC intervention arm were indeed referred to the SIP.

CONCLUSIONS

In summary, the addition of the TUC-ACPG to the EMR led to statistically significant increases in the number of patients for whom willingness to quit was assessed. The CPG provided a simple electronic means by which individuals could be referred to the SIP for follow-up care. At all sites, the rate of asking patients about their tobacco use status was high, indicating that staff members were compliant in carrying out the first part of the guideline. By nesting the TUC-ACPG within

the EMR, physicians were provided with a seamless, automatic, rules-driven prompt for asking patients about tobacco use and then completing the rest of the algorithm as required. If the TUC-ACPG is rolled out to other clinics within the system, it is anticipated that improvements in compliance with the TUC-ACPG will be seen in all the clinics.

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