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Medical school curriculum characteristics associated with intentions and frequency of tobacco dependence treatment among 3rd year U.S. medical students

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Abstract

Objective—Physicians play a critical role in addressing tobacco dependence, yet report limited training. Tobacco dependence treatment curricula for medical students could improve performance in this area. This study identified student and medical school tobacco treatment curricula characteristics associated with intentions and use of the 5As for tobacco treatment among 3rd year U.S. medical students.

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Methods—Third year medical students (N=1065, 49.3% male) from 10 U.S. medical schools completed a survey in 2009-2010 assessing student characteristics, including demographics, tobacco treatment knowledge, and self-efficacy. Tobacco curricula characteristics assessed included amount and type of classroom instruction, frequency of tobacco treatment observation, instruction, and perception of preceptors as role models.

Results—Greater tobacco treatment knowledge, self-efficacy, and curriculum-specific variables were associated with 5A intentions, while younger age, tobacco treatment self-efficacy, intentions, and each curriculum-specific variable was associated with greater 5A behaviors. When controlling for important student variables, greater frequency of receiving 5A instruction (OR = 1.07; 95%CI 1.01-1.12) and perception of preceptors as excellent role models in tobacco treatment (OR = 1.35; 95%CI 1.04-1.75) were significant curriculum predictors of 5A intentions. Greater 5A instruction ($B = .06$ (.03); $p < .05$) and observation of tobacco treatment ($B = .35$ (.02); $p < .001$) were significant curriculum predictors of greater 5A behaviors.

Conclusions—Greater exposure to tobacco treatment teaching during medical school is associated with both greater intentions to use and practice tobacco 5As. Clerkship preceptors, or those physicians who provide training to medical students, may be particularly influential when they personally model and instruct students in tobacco dependence treatment.

Keywords

tobacco dependence treatment; medical school curriculum and education; medical students

Introduction

Physician-delivered tobacco dependence treatment (Ask, Advise, Assess, Assist, and Arrange or the 5As) is associated with patient smoking cessation (1-3) and is recommended by the U.S. Public Health Service Clinical Guideline: Treating Tobacco Use and Dependence (3). Yet, despite its effectiveness, physicians, particularly in the U.S., rarely provide consistent or adequate tobacco dependence treatment (4-10). Reasons for this vary and include limited time and resources, (11-13) but many primarily report limited training as a significant barrier to effectively providing this intervention (14-17).

Because physicians who receive tobacco dependence treatment training are more likely to use and adhere to treatment guidelines and recommendations compared to untrained physicians (18), medical schools can be an optimal time to provide this training. The medical school setting includes opportunity for multiple classroom or online didactics, interaction with standardized patients, small-group discussions with faculty, and opportunities to observe and be instructed by clerkship preceptors. However, reviews of tobacco dependence treatment education in U.S. medical schools found limited educational efforts and missed opportunities to provide tobacco dependence treatment training to medical students (19-27). For example, Spangler and colleagues (2002) found instructional gaps (e.g. few practice opportunities) resulting in only short-term retention of tobacco treatment intervention skills by students (26).

In response to this gap, the Interagency Committee on Smoking and Health published a National Action Plan in 2002-2003 that included the recommendation that the knowledge and skill for providing tobacco dependence treatment be a core graduation requirement for all new physicians and other health care professionals (28). Yet, this and other medical school educational initiatives to enhance medical student knowledge (e.g. preventive medicine), resulted in a typically packed curriculum, that does not necessarily enhance tobacco treatment educational efforts (29-31). Medical schools are now streamlining teaching efforts because adding hours to the curriculum is unrealistic (32, 33). It would be beneficial if medical schools had more effective models to teach tobacco dependence treatment, but such models are presently unknown. Examining which types of learning experiences are best associated with tobacco dependence treatment intentions and increased behaviors by medical students during medical school may help guide curricula reform in tobacco dependence treatment education.

Prior research thus far only has identified student characteristics associated with intentions and tobacco treatment behaviors. These include positive beliefs in preventive medicine, intentions to practice in primary care, greater tobacco knowledge, older age, being a non-smoker, and being female (34, 35). In the current study, our goal was to evaluate if any curriculum characteristics were significantly associated with 5A intentions and behaviors beyond important student-level characteristics. Students reported on a list of curriculum characteristics they experienced during medical school and that included: amount of tobacco classroom instruction, frequency of the use of various instructional methods (i.e. case-based discussions, use of simulated patient encounters, participation in a clinical skills course, and participation in a web-based educational exercise or course), frequency of 5A instruction and observation, frequency of seeing clinic reminders, and perception of their clerkship preceptor/mentor as role models for providing tobacco dependence treatment.

Methods

Study Design

Study data was collected as part of a 10 medical school group randomized controlled trial (“Medical Students helping patients Quit Tobacco”; R01CA136888, Ockene, PI) designed to evaluate whether a multi-modal tobacco dependence treatment curriculum would enhance student tobacco treatment performance on an Objective Structured Clinical Examination (OSCE) compared to traditional tobacco dependence treatment education. Each component of the curriculum focused on enhancing tobacco knowledge and 5A skills, as well as patient-centered counseling skills. See Hayes et al, 2014 for more information about the larger study.(36)

Data for the current study is pre-intervention self-reported cross-sectional survey data from 3rd year medical students (MS3s) who were in the Class of 2011, at the time of survey administration from our participating medical schools. Surveys were administered between November 2009 and February 2010. It had 100+ items and was completed within 15 to 20 minutes. Surveys were anonymous and participation was voluntary. All survey items were developed based on our prior research. (22, 37) The study received approval from the Institutional Review Board at each participating medical school.

Measures

Student Characteristics

Demographics: Survey items included gender, age, history of smoking 100 cigarettes (yes or no), current use of any tobacco product, including cigars, pipes, or smokeless tobacco (yes or no), career choice (primary care defined as Family or Internal Medicine, Pediatrics, OB/GYN vs. other), and medical school.

Tobacco knowledge: Students answered 32 tobacco-related questions focused on various topics from smoking prevalence rates to treatment clinical guideline recommendations. Total scores are the percentage of correct responses out of 32 items.

Tobacco counseling self-efficacy: Students answered the question, “How skilled are you in each 5A (Ask, Advise, Assess, Assist, and Arrange)?” where 1 = not at all skilled, 2 = somewhat skilled, 3 = moderately skilled, and 4 = very skilled. Total scores ranged from 5 to 20.

Medical School Curriculum Characteristics

Tobacco instruction time: Students reported on “The amount of time they received any instruction about tobacco and its treatment during their 1st and 2nd years in medical school.” Response choices were: 30 minutes, 31-60 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, and 5 hours.

Instructional methods: For each instructional method, students reported the frequency at which they learned about tobacco dependence counseling: a) case-based discussion, b) simulated patient encounter, c) clinical skills course, and d) web-based education. Response choices were never, once, and more than once.

Frequency of tobacco dependence counseling instruction: Students reported the number of times they have been instructed in each 5A specifically. (“How many times have you been instructed in each 5A?”) with responses 1 = none, 2 = 1 to 3 times, 3 = 4 to 9 times; 4 = 10 to 25 times; 5 = >25 time; summed responses range from 5 to 25.

Frequency of tobacco dependence counseling observation: Students reported the frequency they observed each 5A skill from their preceptor during medical school, “Please estimate the number of times you have observed each tobacco dependence counseling skill from your preceptors.” 1 = none, 2 = 1 to 3 times; 3 = 4 to 9 times; 4 = 10 to 25 times; 5 = >25 times; summed responses range from 5 to 25.

Clinic Reminders: Students reported how often they saw chart stickers and/or checklists that prompted them or preceptors to encourage tobacco dependence treatment. Responses were: never, yes, on occasion, and yes, frequently.

Preceptor/Mentor perception: Students rated their agreement with the statement, “My preceptors/mentors are excellent role models who help their patients quit smoking.” Responses were: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.

Family medicine or Internal medicine clerkship completion: Because students rotate through clerkships in their 3rd year, students reported whether they had completed neither, one, or both of these clerkships at the time of the survey.

Outcome Measures

Intentions to use 5As for tobacco dependence treatment: Students reported their level of agreement with the following statement, “I intend to routinely use the 5A brief intervention with patients who smoke”. Response choices were the following: strongly disagree, disagree, agree, or strongly agree. We dichotomized responses into 1 = strongly agree/agree or 0 = strongly disagree/disagree for ease of comprehension.

Frequency of tobacco dependence treatment practices: Students reported the number of patients with whom they have used each 5A skill during medical school: a) Asking about smoking history, b) Advising to quit smoking, c) Assessing willingness to quit, d) Assisting with developing a quit plan, and e) Arranging follow-up contact related to smoking. Response choices were: 1 = no patients, 2 = 1 to 3 patients, 3 = 4 to 9 patients, 4 = 10 to 25 patients, and 5 = >25 patients. Responses were summed into a total frequency score and ranged from 5 to 25.

Statistical Analyses

All analyses used a total sample of 1065 students, 12.7% of our participating larger sample was omitted due to missing data on outcomes and/or predictor variables. Descriptive statistics and frequencies described student personal characteristics and tobacco curriculum experiences during medical school. Linear or logistic mixed-effect regression models were used to examine bivariate associations between predictor variables and our outcomes. Clustering of students within school was accounted for by including a random effect for school in each mixed-effect model (38, 39). In separate two-stage hierarchical mixed-effect regression models we entered significant ($p < .05$) student personal characteristics at the bivariate level onto Step 1 and entered all medical school curriculum-related variables onto Step 2 to determine the added contribution, if any, of these variables for each of the study outcomes. Step 1 also controlled for having completed the Family or Internal Medicine Clerkship (FM or IM) or both. We considered multicollinearity and no two variables within models were correlated at greater than $r = .5$. Analyses used SPSS Statistics, Version 22.0 and SAS 9.3 (SAS Institute, Cary, NC).

Results

Student Participation & Characteristics

A total of 1484 3rd year medical students across the 10 medical schools were eligible to complete the survey and 1221 completed the survey, for an overall response rate of 82.3%. Response rates differed by school (rates ranged from 49% to 100%) due to school differences in recruitment and accessibility to the 3rd year students (i.e. some students were off-campus completing clinical rotation requirements). As mentioned, surveys with no missing data (N=1065) were included for this study.

Characteristics of the MS3 students are summarized in Table 1. Age ranged from 22 to 58 years (average 25.9) and approximately one-third noted primary care as their career choice. Few students had ever smoked at least 100 cigarettes in their lifetime or currently used tobacco. On the tobacco knowledge questions, on average 23.6 out of 32 questions (Range = 8 to 30) were answered correctly. The highest majority of students correctly identified that the nicotine patch was a FDA recommended treatment for tobacco dependence (98.3% correct). The observed total score on tobacco treatment self-efficacy ranged from 5 to 20 (average 12.7). Greatest self-efficacy scores were for Ask ($M = 3.06$, $SD = .765$), while lowest scores were for Arrange ($M = 2.13$, $SD = .818$).

Medical School Tobacco Curriculum-Related Characteristics

Students most commonly reported either 2 or 3 hours of tobacco-related education during the MS1 and MS2 years (see Table 2). The majority of students had either participated once or more than once for each instructional teaching method on tobacco (Range 60.7% – 62.6%), with the exception of the web-based course, where more than two-thirds of students had not participated in a web-based course. Few students had frequently seen clinic reminders about tobacco treatment. The average total tobacco treatment observation score was 16.51, out of a possible range of 5 to 25. Although most students reported some experience with each 5A in observing a preceptor performing these skills, fewer students had observed Assist (26.7%) or Arrange (18.5%) greater than 10 times compared to Ask (80.7%), Advise (66.6%), or Assess (50.5%). The total instruction score was lower and rates for receiving instruction greater than 10 times was low for each 5A, (Ask-29.9%; Advise-16.3%; Assess-13.2%; Assist-8.8%; Arrange-7.0%). Nearly 70% agreed or strongly agreed that their preceptor was an excellent role model when it came to providing tobacco dependence treatment.

Intentions and Frequency of 5A Tobacco Dependence Treatment Behaviors

The average intentions score was 2.8 (Range 1 to 4) and 73.6% agreed or strongly agreed with the statement. The average total score for direct tobacco treatment experience was 16.1, out of a possible 5 to 25). A majority of students reported experience with 10 or more patients in each tobacco treatment behavior except in Assist and Arrange, (Ask- 93.2%; Advise- 66.3%; Assess-57.1%; Assist-13.5%; and Arrange-7.5%).

Predictors of Intention to routinely use 5A Tobacco Dependence Treatment Behaviors

Accounting for within-school clustering, student characteristics significantly associated with intentions to routinely use the 5As for tobacco treatment (Table 1) include the following: greater tobacco knowledge and greater tobacco treatment self-efficacy scores. Each of our medical school curriculum characteristics (Table 2) was also positively significantly associated with intentions to routinely use 5As. After controlling for FM or IM clerkships completed, and the significant student characteristics identified in Step 1 (student characteristics only), we found that greater frequency of receiving tobacco instruction ($OR = 1.07$; 95%CI 1.01-1.12), and greater agreement that preceptors were excellent role models in tobacco treatment ($OR = 1.35$; 95%CI 1.04-1.75) were the only statistically significant curriculum predictors in the multivariate model (Table 3). Participating in either FM or IM clerkships ($OR = 1.61$; 95%CI 1.03-2.50) or both ($OR = 1.76$; 95%CI 1.12-2.77), having

greater tobacco knowledge (OR = 1.03; 95%CI 1.01-1.04) and greater self-efficacy scores (OR = 1.08; 95%CI 1.02-1.15) also were associated with this outcome in this model.

Predictors of Frequency of Tobacco Dependence Treatment Behaviors

Accounting for within-school clustering, student characteristics significantly associated with greater frequency of use of tobacco treatment behaviors during medical school (Table 1) include younger age, greater tobacco self-efficacy scores, and greater intentions to routinely use the 5As. As above, greater exposure to each of our medical school curriculum-related factors (Table 2) was also associated with greater 5A use in tobacco dependence treatment during medical school. From the multivariate model (Table 4), completion of either FM or IM ($B = .80$ (.25); $p < .001$) or both clerkships ($B = 1.14$ (.25); $p < .001$), greater tobacco treatment self-efficacy scores ($B = .49$ (.03); $p < .001$), and intentions to use 5A behaviors ($B = .45$ (.20); $p < .05$) were significantly associated with frequency of 5A use. Greater instruction ($B = .06$ (.03); $p < .05$) and greater observation ($B = .35$ (.02); $p < .001$) were the only significant curriculum-related predictors.

Discussion

Each curriculum-related characteristic and teaching method was positively associated with both student 5A intentions and greater 5A use for tobacco treatment during medical school. Thus, greater exposure to any of the noted teaching/learning methods would be beneficial to enhance medical student education in tobacco dependence treatment. Little is known, however, about which educational methods are most effective for promoting student tobacco treatment skills. Our study is the first to address specifically this knowledge gap by examining which medical school curriculum characteristics are related to student tobacco treatment intentions and practices, while also controlling for the important student-level variables associated with these outcomes.

As expected, greater tobacco treatment knowledge and tobacco treatment skills self-efficacy were associated with intentions to use the 5As routinely for tobacco treatment. Yet, we also found that greater frequency in receiving 5A instructions also was significantly associated with intentions in the multivariate model. It is possible that the specificity and higher level of interaction that receiving 5A instruction requires contributed to its predominant association with greater 5A intentions. Passive learning from observation, classroom didactics, a case-based discussion, clinical skills course, or a simulated patient encounter, may not serve as the most optimal method to facilitate development of student tobacco treatment intentions. Perception of preceptors as excellent role models for tobacco treatment was associated with student intentions, suggesting the important effect that faculty and preceptors have on student attitudes and possible future behaviors (40-42).

Greater tobacco treatment skill self-efficacy and intentions were the two student-related variables most positively associated with 5A use in the multivariate model. This association is consistent with the literature (9, 35, 43, 44) and with several theoretical models of behavior change (45-50). The lack of the association between demographic variables and tobacco treatment behaviors, inconsistent with the literature, may be due to our particular sample, or represent that tobacco treatment practices are becoming more universal across demographic

groups. There were, however, predominant curriculum-related characteristics that were related to the student's clerkship experience. Greater frequency of being exposed to 5A instruction and observation of the 5As for tobacco treatment were both positively associated with frequency of using 5A behaviors during medical school. This suggests that students behave similar to their preceptors, particularly those who are specifically addressing how to implement each 5A and modeling it themselves. In order to assist the next generation of physicians to use tobacco treatment skills, directly affecting the clerkship experience through the skill and teaching performance of preceptors may be most beneficial.

In addition to these findings, it also is important to point out the curriculum training experiences of these medical students. Although improvements have been made to include more tobacco dependence treatment training in medical schools (6, 24), some students are likely to receive very little to no tobacco dependence treatment education. Nearly 40% of students endorsed having never participated in tobacco education in the form of a case-based discussion, simulated patient encounter, or clinical skills course, which is somewhat surprising given that these instructional methods are most common in medical education. Although students reported frequently observing the most performed 5A (i.e. Ask), consistent with what physicians most often do (5, 9, 51), far fewer reported having observed Assist or Arrange. On the other hand, receipt of specific 5A instruction was low for each 5A. If greater observation and specific instructional skills for the 5As is positively associated with student 5A use, then it would seem that there is room for improvement to ensure every student has opportunities to observe and learn from preceptors and mentors.

Strengths and Limitations

Our data also is unique in that we are fortunate to be able to pool data from over 1000 students across a mix of U.S. medical schools, making it more likely to examine variability in curricula methods and student experiences. The results regarding the strong influence of preceptors during the clerkship year favorably reinforce any potential future system-wide changes in medical education (e.g. less didactic classroom education and more routine interactive learning with feedback), particularly around behavioral health training.

There are some limitations to be noted. First, we were limited in the types of curriculum-related characteristics assessed and therefore reported by students. As medical school education advances and the use of more innovative technology (e.g. mobile health applications and web-based standardized patient encounters) become more common, it is likely that these instructional methods also will contribute to student attitudes and behaviors. These tools may be particularly advantageous because of their interactive instructional manner. Even with this limitation, we believe our data are very informative, as the instructional methods surveyed tend to be common and current. Another limitation is that our data was self-reported, suggesting the possibility for inaccurate reporting due to social desirability bias, particularly in regards to the student-level variables and student reported intentions and 5A behaviors. However, there is no evidence to suggest that this is a strong possibility, given that these students had not participated in our tobacco treatment intervention and are therefore not expected to receive more than their typical amount of tobacco treatment education, or to report very high levels of 5A intention or behavior.

Another limitation is that these data are from students who were MS3s during the 2009-2010 school year, and generally there is constant revision of curricula. Finally, because data are taken cross-sectionally, we cannot assume that greater exposure to particular medical school curricula will lead to intentions and greater tobacco dependence treatment behaviors in medical school.

Future research should continue to examine the association of other medical school curricula-related variables on student tobacco treatment behaviors both during medical school and longitudinally during the student's residency, particularly within primary care specialties and subspecialties. Intervention research focused on enhancing the clerkship or research related to formalizing the focused and interactive learning activities of medical students also will be useful, particularly if they affect long-term student and physician behaviors, which in turn, can influence patient tobacco use outcomes.

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Highlights

1. Medical school training for tobacco dependence treatment (e.g. 5As) is limited.
2. Tobacco curricula associated with student 5A intentions and behavior is unknown.
3. 3rd year students (N=1065) from U.S. medical schools completed surveys in 2009-10.
4. Instruction and preceptors as role models were associated with more 5A intentions.
5. More 5A instruction and observation were associated with student 5A behaviors.

Table 1

Student characteristics and unadjusted bivariate associations with a) intentions to routinely use the 5As (Agree/Strongly Agree) and b) frequency of 5A use in medical school, N=1065

	All Students	Intentions to routinely use 5As (Agree/Strongly Agree vs. Disagree/Strongly Disagree)		Frequency of 5A use	
Student Characteristics	Mean (SD) or % (N)	OR (95% CI)	p value	Beta (SE)	p-value
Age: Mean (SD)	25.94 (2.71)	1.00 (.99-1.01)	.627	-.09 (.04)	.042
Gender: % (N) Male Female	49.3 (525) 50.7 (540)	Reference .97 (.92-1.02)	.205	Reference .43 (.23)	.065
Smoked 100 cigarettes: % (N) No Yes	88.0 (937) 12.0 (128)	Reference .98 (.91-1.07)	.702	Reference .24 (.36)	.499
Any current tobacco use: % (N) No Yes	93.0 (990) 7.0 (75)	Reference 1.00 (.90-1.11)	.995	Reference -.25 (.45)	.584
Career Choice: % (N) Other Primary Care	34.4 (366) 65.6 (699)	Reference 1.02 (.96-1.07)	.549	Reference .47 (.25)	.054
Tobacco Knowledge, % correct: Mean (SD)	73.89 (9.65)	1.005 (1.003-1.008)	< .001	.021 (.012)	.089
Tobacco Self-Efficacy Score, 5-20 point scale: Mean (SD)	12.74 (2.83)	1.03 (1.02-1.04)	< .001	.72 (.03)	< .001
Tobacco Intentions: % (N) Strongly Disagree/ Disagree Strongly Agree/Agree	26.4 (281) 73.6 (784)	-----	-----	Reference 1.68 (.26)	< .001

Table 2

Curriculum characteristics and unadjusted bivariate associations with a) intentions to routinely use the 5As (Agree/Strongly Agree) and b) frequency of 5A use in medical school, N=1065

	All Students	Intentions to routinely use 5As (Agree/Strongly Agree vs. Disagree/Strongly Disagree)		Frequency of 5A use	
Curriculum Characteristics	Mean (SD) or % (N)	OR (95% CI)	p value	Beta (SE)	p-value
Total Classroom Instruction Time	2.5 (27)	Reference	.002	Reference	.085
<30 minutes	6.7 (71)	1.04 (.86-1.26)		1.42 (.79)	.342
31 to 60 minutes	10.0 (106)	1.03 (.86-1.23)		.74 (.75)	.027
1 hour	22.1 (235)	1.07 (.90-1.27)		1.65 (.75)	.021
2 hours	20.5 (218)	1.05 (.88-1.25)		1.73 (.77)	.002
3 hours	14.4 (153)	1.19 (.99-1.42)		2.39 (.84)	< .001
4 hours	6.2 (66)	1.18 (.97-1.43)		3.23 (.76)	< .001
5 hours	17.7 (189)	1.21 (1.01-1.44)		3.89 (.25)	< .001
Case-Based Discussion	39.2 (417)	Reference	< .001	Reference	.004
Never	35.8 (381)	1.08 (1.02-1.15)		.77 (.26)	.000
Once	25.1 (267)	1.15 (1.08-1.23)		2.14 (.30)	
More than Once					
Standardized Patient Encounter	39.2 (418)	Reference	< .001	Reference	.05
Never	42.6 (454)	1.10 (1.03-1.16)		.52 (.26)	< .001
Once	18.1 (193)	1.17 (1.09-1.27)		1.96 (.34)	
More than Once					
Clinical Skills Course	37.5 (399)	Reference	.001	Reference	.004
Never	39.0 (415)	1.05 (.99-1.12)		.77 (.26)	< .001
Once	23.6 (251)	1.14 (1.06-1.22)		1.93 (.31)	
More than Once					
Web-Based Course	68.6 (731)	Reference	< .001	Ref	.042
Never	21.3 (227)	1.08 (1.01-1.15)		.59 (.29)	< .001
Once	10.0 (107)	1.17 (1.07-1.27)		2.44 (.39)	
More than Once					
Total 5A Instruction Frequency	12.52 (3.91)	1.02 (1.01-1.03)	< .001	.38 (.03)	< .001
Total 5A Observation Frequency	16.51 (4.48)	1.01 (1.001-1.02)	< .001	.50 (.02)	< .001
Clinic Reminders	43.2 (460)	Reference	< .001	Reference	< .001
Never	42.4 (452)	1.10 (1.04-1.16)		1.23 (.24)	< .001
Occasionally	14.4 (153)	1.14 (1.05-1.23)		2.44 (.35)	
Frequently					
Preceptor as excellent role model in tobacco treatment (1 to 4 point scale)	2.76 (.643)	1.12 (1.07-1.16)	< .001	1.59 (.18)	< .001
Clerkship Completed at Survey	20.4 (217)	Reference	< .001	Reference	< .001
Neither Family or Internal Medicine	39.1 (416)	1.13 (1.05-1.22)		1.72 (.33)	< .001
Family or Internal Medicine Only	40.6 (432)	1.18 (1.09-1.27)		3.02 (.32)	
Completed Both					

Table 3

Multivariate binomial logistic mixed effects regression model predicting intentions to routinely use 5As among 3rd year U.S. Medical Students, N=1065

	Step 1: Student characteristics only		Step 2: Student and curriculum characteristics	
Predictors	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
<i>Student characteristics:</i>				
Number of clerkships: Neither FM or IM Both FM and IM	Reference 1.80 (1.17 – 2.77) 2.02 (1.30 – 3.13)	<0.005	Reference 1.61 (1.03 – 2.50) 1.76 (1.12 – 2.77)	0.03
Tobacco knowledge	1.03 (1.01 – 1.04)	0.002	1.03 (1.01 – 1.04)	.001
Tobacco self-efficacy	1.14 (1.08 – 1.21)	<0.0001	1.08 (1.02 – 1.15)	0.01
<i>Curriculum characteristics:</i>				
Case-based discussion: Never Once More than once	-----	-----	Reference 1.12 (.78 – 1.62) 1.02 (.62 – 1.67)	.82
Simulated patient encounter: Never Once More than once	-----	-----	Reference 1.24 (.85 – 1.79) 1.13 (.62 – 2.03)	.52
Clinical skills course: Never Once More than once	-----	-----	Reference .95 (.66 – 1.37) 1.07 (.64 – 1.79)	.90
Web-based education: Never Once More than once	-----	-----	Reference 1.22 (.81 – 1.85) 1.62 (.76 – 3.46)	.35
Total 5A instruction frequency (1-unit increase)	-----	-----	1.07 (1.01 – 1.12)	.02
Total 5A observation frequency (1-unit increase)	-----	-----	.99 (.95 – 1.03)	.57
Total classroom instruction time: <30 minutes 31 – 60 minutes 1 hour 2 hours 3 hours 4 hours 5 hours >5 hours	-----	-----	Reference .99 (.37 – 2.66) .77 (.30 – 1.98) .94 (.38 – 2.30) .72 (.29 – 1.80) 1.35 (.51 – 3.55) 1.01 (.34 – 3.02) 1.13 (.43 – 2.98)	.45
Clinic reminders: Never Occasionally Frequently	-----	-----	Reference 1.28 (.92 – 1.77) 1.27 (.76 – 2.12)	.31
Preceptor as role model	-----	-----	1.35 (1.04 – 1.75)	.02

Note.

^a Step 1 includes only student characteristics significant ($p < .05$) at the bivariate level and number of clerkships.

Table 4

Multivariate linear mixed model predicting frequency of 5A use in medical school among 3rd year U.S. Medical Students, N=1065

	Step 1: Student characteristics only		Step 2: Student and curriculum characteristics	
Predictors	<i>B</i> (SE)	p-value	<i>B</i> (SE)	p-value
<i>Student characteristics:</i>				
Number of clerkships: Neither FM or IM Both FM and IM	Reference 1.18 (.28) 1.85 (.28)	< .001 < .001	Reference .80 (.25) 1.14 (.25)	< .001 < .001
Age (1-year increase)	-.07 (.04)	.036	-.03 (.03)	.27
Tobacco self-efficacy	.65 (.03)	< .001	.49 (.03)	< .001
Tobacco intentions: (strongly agree or agree) Strongly disagree / disagree Strongly agree / agree	Reference .77 (.22)	< .001	Reference .45 (.20)	.03
<i>Curriculum characteristics:</i>				
Case-based discussion: Never Once More than once	-----	-----	Reference .16 (.21) -.17 (.27)	.45 .55
Simulated patient encounter: Never Once More than once	-----	-----	Reference -.14 (.21) -.31 (.30)	.50 .31
Clinical skills course: Never Once More than once	-----	-----	Reference -.05 (.21) -.23 (.27)	.79 .40
Web-based education: Never Once More than once	-----	-----	Reference -.05 (.22) .55 (.33)	.84 .10
Total 5A instruction frequency (1-unit increase)	-----	-----	.06 (.03)	.04
Total 5A observation frequency (1-unit increase)	-----	-----	.35 (.02)	< .001
Total classroom instruction time: <30 minutes 31 – 60 minutes 1 hour 2 hours 3 hours 4 hours 5 hours >5 hours	-----	-----	Reference .17 (.62) -.25 (.59) .19 (.56) -.05 (.57) .19 (.59) -.17 (.64) .58 (.59)	.79 .67 .73 .93 .74 .79 .42
Clinic reminders: Never Occasionally Frequently	-----	-----	Reference .12 (.19) .46 (.27)	.52 .08
Preceptor as role model	-----	-----	-.07 (.15)	.63

Note.

^a Step 1 predictors include only student characteristics significant ($p < .05$) at the bivariate level and number of clerkships.