

Lessons in Health IT Implementation

A PDA-based Counseling Tool for Improving Medical Student Smoking Cessation Counseling

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Background and Objectives: *There is little research on training medical students in smoking cessation counseling (SCC). This study aimed to determine if a personal digital assistant (PDA)-based SCC tool can improve medical student SCC. **Methods:** We conducted a randomized, controlled trial with third-year medical students. SCC behaviors, comfort, and knowledge were assessed using a validated survey before students attended a workshop on SCC. Student groups were then randomized to receive a paper-based reminder tool or the reminder plus a PDA-based SCC tool. The validated survey was repeated upon clerkship completion, and a videotaped standardized patient interview was assessed by trained reviewers using a 24-item SCC checklist. Focus groups assessed satisfaction with the PDA tool, usability, and barriers to use. **Results:** SCC behaviors, knowledge, and comfort increased among all participants, with no statistical differences between groups. The PDA tool group performed 62% of key SCC activities during the videotaped interview, while the control group performed 69%. Students reported discomfort using the PDA with patients, lack of time, and lack of training as barriers to use of the tool. **Conclusions:** We demonstrated improvement of SCC skills by third-year medical students using a workshop combined with a supplemental reference tool. However, a PDA-based tool did not increase key SCC behaviors compared with a paper-based reminder. For a PDA intervention to be effective in this setting, the tool must be simplified and additional training provided.*

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Smoking is the leading cause of preventable disease and death in the United States. Each year more than 5 million years of potential life are lost to smoking.¹ Medical student education is a logical locus for comprehensive smoking cessation counseling (SCC) training, yet the majority of practicing physicians report being inadequately trained during their formal medical education to help their patients stop smoking.²⁻⁵

There is good evidence for smoking cessation counseling interventions based on the behavioral change theories of the 5 A's, Stages of Change, and Motivational Interviewing. The 5 A's (ask, advise, assess, assist, and arrange) are seen as a unifying construct in providing behavioral counseling interventions and are used in

the recent evidence-based national smoking cessation guidelines.⁶ The Stages of Change behavioral change theory is a useful heuristic that conceptualizes behavior change as a process that involves passage through a series of distinct stages (precontemplation, contemplation, preparation, action, and maintenance).⁷ Finally, Motivational Interviewing is a brief psychotherapeutic intervention intended to increase the "probability that patients will enter into, continue, and adhere to a specific change strategy" aimed at reducing harmful behaviors such as tobacco use.⁸

Personal digital assistants (PDAs) and other point-of-care devices may be useful for improving smoking cessation counseling by physicians and trainees.⁹⁻¹² Point-of-care tools (desktop computers in patient rooms, Smartphones, PDAs) can be used to prompt and assist physicians during a patient visit. Studies advocate the use of patient-specific reminders at the point of contact with patients.^{13,14} Automated point-of-care tools have the ability to tailor interventions to the patient,¹⁵⁻²³ provide a brief intervention, and provide easy access to smoking cessation guidelines.²⁴

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Despite this promising evidence, there has been limited study of the use of technology for education at the point of care. Leung found significant improvement in the use of evidence-based medicine by medical students using a handheld computer program with clinical decision support software.²⁵ Two other studies found improvements in antibiotic prescribing for otitis media and in asthma treatment using point-of-care evidence technology.^{26, 27}

The use of point-of-care technologies is a promising educational modality because it is congruent with principles of adult learning theory. These theories emphasize that adults learn best when the information meets their immediate needs, utilizes previous learning experiences, has a real-world application, and when learners are able to directly apply what they are learning.^{28, 29} Point-of-care-based educational modalities can enable learners to access information at the time it is needed most, during a patient encounter or immediately before or after it.

Our objective was to develop and evaluate a PDA-based educational intervention (Educational Smoking Intervention Tool, or E-SMOK-I.T.) to augment teaching SCC to medical students. We tested the following hypotheses: (1) compared with the paper-based-only group (control), the PDA-based reminder group (intervention) would have increased knowledge of SCC, SCC behaviors, and comfort with SCC, (2) the intervention group would have better SCC skills, and (3) the intervention group would have better retention (up to 1 year) of these skills.

Methods

All University of Virginia third-year medical students during the academic year 2006–2007 were eligible to participate in this randomized, controlled trial approved by the University of Virginia Medical School Institutional Review Board. The intervention occurred during a required 4-week family medicine clerkship with approximately 10–12 students in each block. We randomized students by paired clerkship blocks to receive a supplemental paper-based reminder tool (control) or the paper-based reminder plus one provided on a handheld device (E-SMOK-I.T., intervention). *A priori* power calculations assuming two groups of 70, α of 0.05, and power of 0.80 showed the ability to detect an absolute difference of approximately 23%.

Educational Interventions

We adapted a workshop training students in skills for SCC from a Motivational Interviewing (MI)⁸ workshop conducted as a part of the family medicine clerkship.³⁰ The workshop consisted of lecture-discussion reviewing SCC techniques, including the 5 A's,^{6, 31} principles of MI, Stages of Change⁷ assessment, and Stages of Change-guided interventions as well as role-play practice with peers.

Students in both groups received a paper-based summary of MI techniques related to SCC following the workshop (see www.fmdrl.org/2631). Students in the intervention group also had the E-SMOKE-I.T. software loaded onto their required PDA. Following the MI workshop, they received 15 minutes of instruction from the study coordinator (SLP) on the contents, organization, and use of the E-SMOKE-I.T. software.

The E-SMOK-I.T. tool was designed to operationalize the 5 A's, Stages of Change, and MI and was adapted from earlier versions designed for practicing physicians.^{32, 33} The software helps users determine a patient's stage of change, provides scripted motivational interviews targeted to their stage, and makes relevant health behavior and stage-based interventions immediately accessible (see www.fmdrl.org/2632). The software includes an embedded "log file" so that all instances of use and content accessed were time and date stamped (downloaded at the end of each clerkship).

Assessment Instruments and Methodology

Pre-clerkship/Post-clerkship Knowledge, Behavior, Attitudes Survey. We administered a 29-item pre-clerkship-post clerkship survey assessing knowledge, behavior, and comfort regarding SCC during the clerkship orientation and again at the end of the clerkship. This survey has been previously validated with residents and faculty³² and was pilot tested for face and content validity with 23 third-year medical students prior to the study year.

Standardized Patient Interviews. At the completion of their clerkship, all students participated in a standardized patient interview designed to test their SCC skills in a patient scenario. Third-year students were also invited to an additional standardized patient interview at the completion of the academic year to assess their retention of SCC skills.

Experts in medical student education, standardized patients, and behavioral change were involved in the case development. Standardized patients were trained to portray a smoker in the precontemplative stage and practiced with the first author, who role-played different levels of student expertise. The 1.5-hour training session resulted in three standardized patients who could reliably reproduce the patient and distinguish and code each item in the assessment instrument described below. We then pilot tested the standardized patient case with six medical students, and the standardized patients completed the SCC assessment instrument described below after each encounter to test face validity.

Assessment of SCC Skills in Standardized Patient Interviews

We developed and validated an SCC assessment tool to assess students' expertise in applying the 5 A's,

Stages of Change and MI in the standardized patient interviews. We adapted this instrument from a previously developed instrument,³⁴ as well as from existing MI-based assessment instruments, since no instrument existed for assessing SCC based on the three behavioral theories in medical student education.³⁵⁻³⁹ Content validity was assessed by three experts in smoking cessation and MI. Face validity was assessed by the standardized patient raters in a pilot study and subsequently by the raters of videotaped medical student encounters during training and assessment of their inter-rater reliability. The full scale demonstrated moderate overall internal consistency (KR20=0.70).

To be classified as having met the criteria for “correct” SCC assistance (“strict” MI criteria), students had to (1) assess the patient’s readiness to quit smoking, (2) advise patients to quit smoking, including personalizing risks, and (3) assist patients with smoking cessation through stage-appropriate counseling (eight items on SCC assessment tool). This represents three of the 5 A’s. The other two, “ask” and “arrange,” were excluded since the SP interview began with a known smoker, and students could not arrange follow-up in this setting. In addition, students could not provide assistance clearly inappropriate for the precontemplation stage (eg, medications, setting quit date). We also analyzed the interviews using “less strict” MI criteria (eliminating “inappropriate assistance”).

Two independent raters were trained to utilize the checklist and view the videotaped standardized patient sessions. They achieved inter-rater reliability scores >.6 prior to beginning the rating process using video encounters obtained during pilot studies. Raters were blinded to the nature of the intervention.

Analysis

We compared control and intervention groups to look for differences in age (independent sample *t* test) and gender (chi-square analysis). The Mann Whitney U statistic was used for the following comparisons: computer literacy (self-identified as “novice,” “intermediate,” or “expert”), preintervention understanding of Stages of Change, use of stage-specific interventions, and use of MI. General Linear Models and Wilk’s Lambda were used to analyze the before and after test differences, differences between control and intervention groups, and interaction effects on medical student knowledge, behavior, and comfort.

To test for differences between control and intervention groups on SCC behaviors we used independent *t* tests and intention-to-treat analysis. We performed a linear regression analysis and used the partial correlation coefficient to examine the relationship between intervention and SCC score with the influence of the month during the academic year removed from both (as we expected student skills would improve over the year as they gained clinical experience). To assess

individual items in the SCC assessment instrument between control and intervention groups we used Pearson’s chi square. We applied a Bonferroni correction to account for the inflation in type 1 error rates due to multiple comparisons (adjusted alpha=.003). All statistical analysis used overall alpha level of .05 and SPSS version 15.0.

Qualitative Interviews With Intervention Group

One author (SLP) met with students in the intervention group in two groups of five–six students for 20 minutes following the standardized patient encounter. Semi-structured interviews collected feedback about the educational value of the software, their use of and satisfaction with the tool, and barriers to use. Emergent design principles^{40,41} and an inductive approach were used due to limited data and theories regarding use of PDAs for teaching medical students SCC. Interviews were audiotaped, transcribed, and analyzed for themes using NVivo 2 software (QSR International Pty Ltd, Melbourne, Australia). We (SMS, JBS) reviewed and validated an initial subset of interview transcripts and coded categories before coding continued with the remaining interviews.

Results

We obtained data for 122 students from a class of 133, for the pre-clerkship/post-clerkship test analysis (n=64, control; n=58, intervention). Of these, 116 completed video observations (n=63, control; n=53 intervention) for use in the final analyses on observed SCC behaviors (Figure 1). The mean age for participants was 26, and 52% were male. Sixty two percent reported their PDA literacy as intermediate on a 3-point scale. We found no significant differences between the control and intervention groups except that the control group reported increased preintervention use of Stages of Change (Mann-Whitney U=1,249, *P*=.020) (Table 1). Log files from the intervention group medical students revealed that 27 (42%) students used the program. These students viewed an average of 17 pages of content in the tool (range 2–212) and used it two times on average (range one–five).

Medical Student Knowledge, Behavior, and Comfort With SCC

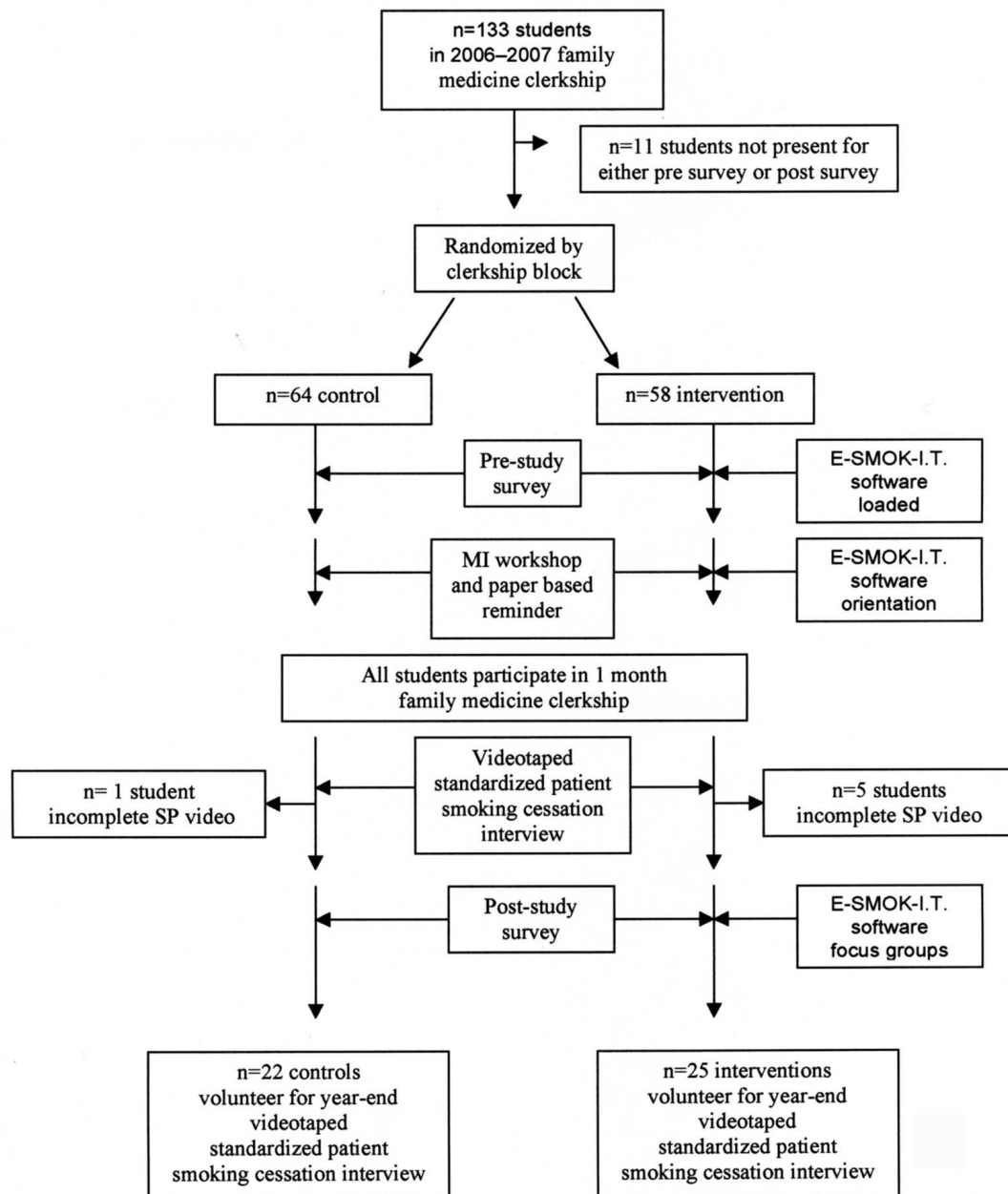
Overall SCC behaviors, knowledge, and comfort increased among all participants (*P*<.001) (Figure 2). There were no significant differences or interactions between control and intervention groups for pre-clerkship/post-clerkship knowledge (*F*=.24, *P*=.625), behavior (*F*=2.871, *P*=.093), or comfort (*F*=.202, *P*=.654).

Standardized Patient Interviews

Using intention to treat analysis, the control group performed slightly better, accomplishing 69% of key MI activities while the intervention group performed

Figure 1

Study Flow



62% ($t=2.32$, $P=.022$). When intervention participants who did not use the E-SMOK-I.T. tool were excluded, these differences did not persist (69% control versus 64% E-SMOK-I.T. users; $t=1.250$, $P=.215$ for strict MI criteria; 73% control versus 68% E-SMOK-I.T. users; $t=1.253$, $P=.214$ for less strict MI criteria). The relationship between intervention and SCC behaviors persisted when controlled for month to account for maturation of

students' clinical skills as the year progressed (partial correlation= $-.237$, $P=.011$).

We found no statistically significant differences between the groups for individual SCC behaviors (Table 2). Retention data from the standardized patient interviews at the end of the academic year were obtained for 47 student volunteers ($n=22$ control, $n=25$ intervention) and demonstrated no differences between the groups

(61% paper-based versus 59% E-SMOK-I.T. group; $t=.621$, $P=.538$ for strict MI criteria; 65% paper-based versus 61% E-SMOK-I.T. group; $t=.709$, $P=.482$ for less strict MI criteria). This lack of differences between the groups persisted when E-SMOK-I.T. non-users in the intervention group were excluded.

Focus Group Themes

Key themes related to difficulties in implementing the E-SMOK-I.T. tool are listed with representative quotes and frequencies of the instances in Table 3.

Discussion

This is the first randomized, controlled trial examining the use of a PDA-based reminder tool to enhance SCC by medical students. The absence of a positive intervention effect is an important cautionary finding, especially as more and more health promotion assessment, counseling, and reminders are becoming automated and

based in electronic systems such as electronic medical records and other devices. Several studies, including our own pilot work, have shown promising results when these types of interventions are applied with practicing clinicians, but the same may not hold true for medical students, especially during initial clinical years. As medical student training sites increasingly adopt health

Table 1

Demographics and Preintervention Characteristics of Control and Intervention Groups

Group Demographic or Characteristic	Control Group	Intervention Group	Statistic	P Value
Age	25.8	25.8	$t=.052$.959
Gender	52% male	51% male	Pearson chi-square=4.1	.251
Computer literacy (% novice, % intermediate, % advanced)	21, 67, 6	39, 57, 5	Mann-Whitney U=1709	.055
Use of MI (% "yes")	66	45	Mann-Whitney U=1356	.076
Use of Stages of Change (% "yes")	25	9	Mann-Whitney U=1249	.02
Understanding of Stages of Change (% "none," % "some," % "total")	36, 34, 25	59, 32, 9	Mann-Whitney U=1139	.109

MI—Motivational Interviewing

NOTE: Where percentages do not total 100, missing values were present

Figure 2

Pre-clerkship/Post-clerkship Differences in Smoking Cessation Counseling Knowledge, Behavior, and Comfort

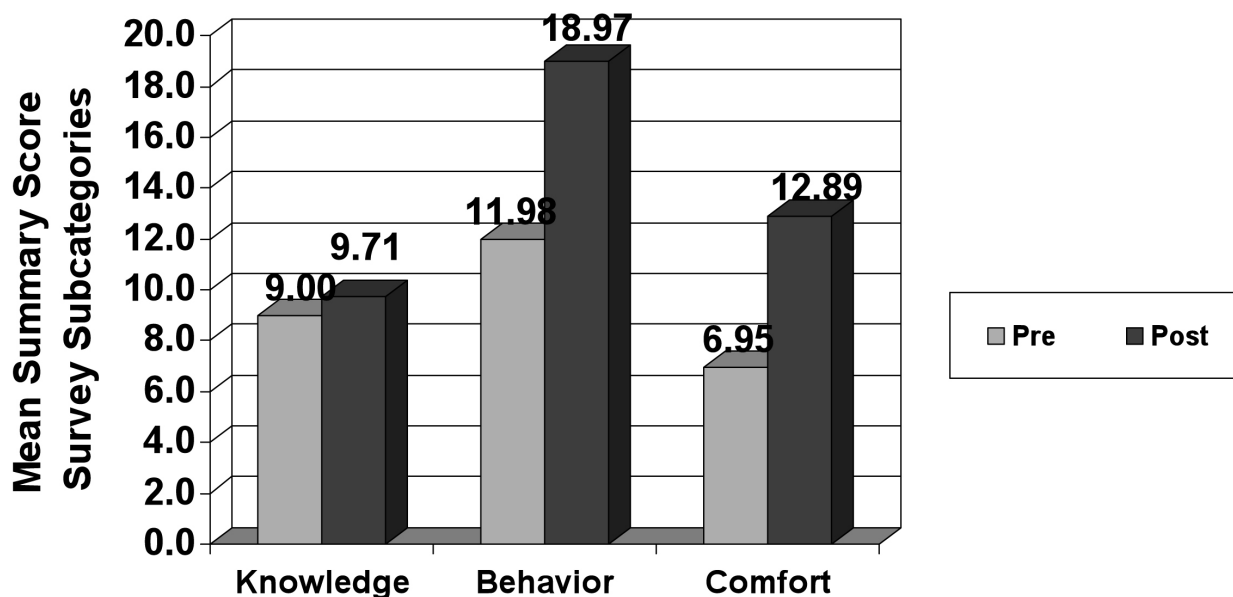


Table 2
Individual Smoking Cessation Counseling Behaviors

<i>Smoking Cessation Counseling Behavior</i>	<i>Control</i>	<i>Intervention</i>	<i>Pearson Chi-Square</i>	<i>P Value</i>
Advise patient to stop smoking	18%	15%	0.12	.73
Asked patient about importance of changing smoking behavior	64%	47%	3.11	.08
Asked patient about confidence in being able to change smoking behavior	49%	28%	5.26	.02
Student asked or patient mentioned what they like about smoking	84%	79%	0.46	.50
Student asked or patient mentioned what they dislike about smoking	60%	47%	2.01	.16
Personalized risks of smoking for the patient	95%	87%	2.61	.11
Arranged follow-up for patient	62%	68%	0.46	.50
Student expressed empathy during counseling	24%	19%	0.42	.52
Student avoided arguing and “rolled with resistance”	100%	100%	constant	
Student supported self-efficacy	19%	13%	0.72	.40
Student used at least two open-ended questions	98%	96%	0.55	.46
Student listened reflectively	76%	51%	8.03	.01
Student gave the patient support and affirmation	64%	55%	0.92	.34
Student used summary statements during the interview (at least one)	75%	55%	5.04	.03
Student used summary statements at conclusion of the interview (at least one)	3%	0%	1.71	.19
Student elicited “change talk”	79%	70%	1.40	.24
Student asked questions or performed counseling that was inappropriate for a pre-contemplative patient	11%	13%	0.12	.73

care IT, these findings deserve further investigation. Important gaps in teaching students how to use these technologies while interacting with patients exist and may have implications in training medical students for practice.

To further understand our finding of better performance of SCC among the control group students, we completed post-hoc analyses to see if the E-SMOK-I.T. tool itself caused a negative effect. When non-users of the tool are removed from the analysis, the differences between groups didn't persist. Users of the tool still did not perform better than the control group; however, we urge caution in interpreting these results due to possibility of Type 2 error as our study was not powered for this post-hoc analysis. Our tool also did not improve retention of SCC skills when a sub-sample of students was retested at the end of the academic year (even when non-users are excluded).

Using qualitative data to understand these findings is a particular strength of our investigation. Students found information in the E-SMOK-I.T. tool helpful, and nearly half in the intervention group referred to it at least twice. When asked about use at the point of care, many students indicated reluctance to use a PDA as part of a patient interview, and several students characterized this use as “unprofessional,” “awkward,” and potentially detracting from their credibility. It remains

to be seen if this dynamic might be changed with the tool's content deployed on a desktop computer or as part of an electronic medical record. After we reflected on the overall study data, an underlying theme of “less is more” became apparent in the students' comments. Many students noted the value of a few targeted questions, and some preferred the one-page reminder card in the intervention group. Another aspect of this theme was several recommendations to simplify the E-SMOK-I.T. tool. Finally, needing more training in use of the tool was consistently cited as a barrier, as well as lack of time for SCC and the lack of continuity with patients.

Important limitations to this study exist. PDAs are being used less as practices increasingly adopt electronic medical records. Although this intervention was tested on a PDA, we have successfully adapted the content and approach to be used with a Web-based version on desktop PCs, and it is also being developed for integration with electronic medical records. This work has been supported by consistently positive findings with practicing physicians despite the lack of effect in this trial. Generalizability of these findings may be limited due to a single medical school and only one intervention class. Student characteristics may differ between medical schools, and the availability of technology will also vary. However, these findings can be expected to be replicable at institutions with similar

Table 3
Themes and Student Quotations From Focus Groups

Theme	Quotes
Opportunity for Smoking Cessation Counseling (SCC) limited generally and for students in particular. <ul style="list-style-type: none"> • Patient non-receptivity (15 cites) • Non-prioritizing of SCC (7 cites) • Motivational Interviewing (MI)/SCC rare (11 cites) • Time for SCC generally and as a student (13 negative, 1 positive) • Student-patient issue (9 cites) • Student-doctor issue (10 cites) 	<ul style="list-style-type: none"> • “The patients didn’t really need help, they were either like I don’t want to quit or they knew what they needed—they could get it over the counter.” • “And with the time constraints, the only thing you really had time for was to say ‘Hey try this new drug for smoking cessation, it’s a lot cheaper than a pack a day. There is a good support group and there are a lot less side effects than Wellbutrin.’” • “I might have used it more if I were more comfortable with all the other aspects of being in that room. Like there is more than that one thing that I am worried about. Not that it takes a back seat, but there are about 7 or 8 things that I was worried about just being there ... that I am trying to do right ... if I were more comfortable with that then maybe I would have done it more.” • “Better for PCP than the students, they see the patient on an ongoing basis.” • “They [doctors] don’t do it [MI] in the practice I was in ... so attempting to do something that the doctors don’t do with the patients in their practice ... it just felt wrong.”
Use of technology at the point of care inhibited by discomfort and credibility. <ul style="list-style-type: none"> • Credibility with patients inhibits use of personal digital assistant (PDA) (13 cites) • Awkward with patients (48 cites) • Especially with personal conversation (18 cites) 	<ul style="list-style-type: none"> • “Not that it [E-SMOK-I.T.] is not useful, I just didn’t feel comfortable, its just that I think it detracts from my credibility. I think it is kind of rude looking at a palm pilot.” • “Looking at this while you are in an interview—if you have to do that—it would be very off putting.” • “So actually putting things into the program as you are talking to the patient I feel its not good for communication.” • “Well, its not that I don’t use a palm, I use it for looking up drugs and things, but I think in a conversation it is kind of awkward to kind of pull it out and break eye contact.”
E-SMOK-I.T. is a helpful reference, but not implementation at the point of care. <ul style="list-style-type: none"> • Information helpful (18; 4 not) • Questions valuable (15; 3 not) • Useful as a reference (17; 2 not) 	<ul style="list-style-type: none"> • “It is a good tool to train you so that you can converse in real time very quickly, very earnestly.” • “It did introduce the whole concept of pre-contemplation ... I didn’t even think of that. Before I would just go into a room and have a conversation and develop rapport but not really thought about what stage they are in and then the questions to ask.” • “... if that conversation doesn’t come naturally and you need help with those questions to help you understand them, then I think that can help, but not when you are in the room with the person.”
Examples of attempts to use E-SMOK-I.T. at the point of care (19 instances)	<ul style="list-style-type: none"> • “I guess it [the tool] gave me a little more [comfort with MI], I really like a little structure and it gave me more of that. It kept me from being too judgmental and putting too much pressure when they were not ready.” • “And using it in the room felt awkward so I ended up not going back to looking at it in the room when I was in the conversation with the patient.”
E-SMOK-I.T. organization and scripted conversation inhibited use at the point of care. <ul style="list-style-type: none"> • Navigation/organization (15 negative, 3 positive) • Scripted conversation (10 negative) 	<ul style="list-style-type: none"> • “Like there was this cost analysis thing someone told me about that I didn’t know was there.” • “It is just awkward with a patient when I open the program I kind of glanced at it but it wasn’t immediately obvious how to go about using it the best.” “I did have a hard time when I was messing around with it, navigating quickly between screens and the buttons were small enough that I would miss and hit the wrong thing.” • “It is like talking to a patient about anything like why are you here today—it is very conversational. If you are trying to use a formula it almost puts distance between you and a patient.” • “It is really awkward to be reading the questions off of there, it is such a sensitive personal communication.”
More training with E-SMOK-I.T. needed before using with a patient. (13 cites)	<ul style="list-style-type: none"> • “If the MI [workshop] hour was tailored to the tool ... interviewing each other did not work ... we just talked.” • “I guess I feel like I need more experience and practice with real people who want to quit smoking ... to get more comfortable with it [MI] and with the PDA and increase the comfort level.”
Recommendations to improve E-SMOK-I.T. (5 cites)	<ul style="list-style-type: none"> • “What is going to help me talk to a patient is to open up the tool and see a checklist of things that are screening questions and then after checking about 5 answers have the tool tell me this patient is in contemplation and then the questions that would be helpful to ask.” • “It would be easier if it was all on one page.”

student demographics and technology availability. The absence of sufficient power in the retention group may lead to a type II error and should be further tested in future studies adequately powered to detect a difference in retention.

Conclusions

We improved SCC by third-year medical students using a combination of a workshop and a supplemental reference tool. We demonstrated learning of SCC skills

by students with significant improvement over baseline in behaviors, comfort, knowledge, and performance. However, the mobile computer tool did not increase key SCC behaviors by medical students compared with a paper-based reminder. For a PDA-based SCC intervention to be effective in this setting, we would recommend full training with the tool, simplifying content and ensuring that students have training in using health care IT with patients.

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